

# Excel Encyclopaedia Edition 3

Excel is a world-class premium performing end-to-end infrastructure solution  
- designed, manufactured, supported and delivered - without compromise.

**excel**  
without compromise.

[www.excel-networking.com](http://www.excel-networking.com)

January 2015





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### Foreword

Welcome to the third edition of the Excel Encyclopaedia, the first version was published back in September 2010 and received much acclaim for its educational and factual content.

The Encyclopaedia has been designed to provide consultants, M&E contractors, end users and installation partners with a thorough understanding of structured cabling and more importantly a complete insight into the Excel Structured Cabling Solution.

Written by key members of our team including two RCDD qualified technicians, in this third edition we have added even more detail and updated much of the core content to ensure that you've got one trusted source of information.

The Excel Encyclopaedia is available in electronic format from the Excel website [www.excel-networking.com](http://www.excel-networking.com) to allow you to copy and paste the relevant information for your requirements, particularly in the Pre-Sales Support section which provides ready-made specification document templates to assist with complex bids. There is also an iPad friendly version.

We hope that you find this book a useful reference tool and we would welcome your feedback should you have any suggestions for content for future issues, simply email us at [encyclopaedia@excel-networking.com](mailto:encyclopaedia@excel-networking.com)



**Andrew Percival**

Managing Director

## Technical Contributor

Paul Cave is Technical Manager at Excel Networking and has over 30 years experience in the IT industry, more than 25 of which has been in the Structured Cabling and Networking Markets.

During this period Paul has had numerous articles published as well as presentations at major conferences.

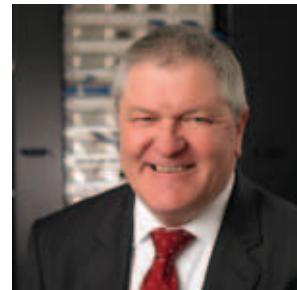
He holds a number of professional qualifications including:

- Certified Data Centre Design Professional (CDCDP)
- BICSI Technician, RCDD
- Registered Telecomms Project Manager

Paul is a member of:

- The Expert Panel for British Standards Committee TCT/7/2 and TCT/7/3
- BSI Committee, IST/046 Sustainability for and by IT

He is also heavily involved in acting as Excel's Technical Representative onsite for quality audits and inspections, throughout EMEA and even further afield at times.



**Paul Cave**

Technical Manager



# Introduction

The demands of today's business environment mean we increasingly rely upon the instant supply and availability of information from both colleagues and the outside world.

This information can present itself in a variety of ways: as standard data in word processing documents, as voice messages, video clips, Internet downloads, even x-ray images, and quite often as a combination of these. As a result we constantly expect more from our computer networks and IT systems, not only in terms of performance but also, and just as importantly, in terms of availability – 'up time' – and reliability. Investment in powerful computers, the Cloud, e-commerce and faster communications networks has never been higher, and is no longer limited to the blue chip corporate or city financial institutions. From sectors such as retail, education and health, to transport and leisure, it's hard to name a business type that is not reliant, to some extent, on an efficient and effective IT strategy.

A challenge facing the modern IT manager is that these typical demands have to be met against a backdrop of ever-changing standards, new applications and budget restraints. User needs change as new applications become available, mainstream or cost effective. Increasing use of voice over IP telephony (VoIP), CCTV, wireless and general mobile computing, the Cloud, Internet, Intranets, Email and video conferencing all add to the growing demands placed on a company's local area network. Add to this the fact that 10 Gigabit Ethernet over copper and fibre is now a reality, and the benefits of a business getting its network specification decisions right are endless.

**Consider this and then consider the fact that one of the most important components of these modern, business critical networks is often treated as an afterthought – cabling.**

## Cabling

A network is only as good as its weakest link. In the highly complicated world of network and IT infrastructure, this may be an over simplification of matters, but it is nevertheless true.

If your cabling infrastructure is not designed, installed and, in the first instance, built from components that can cope with the demands of now and the foreseeable future, your investment in hardware – from servers, through routers and switches, to client devices – is wasted and your business suffers. Many surveys over recent years have confirmed that more than 50% of network failures are due to problems with the installed cabling.

The life expectancy of your cabling infrastructure is far greater than that of any of the hardware that will connect to it. You must therefore plan well, think ahead and consider your choices carefully when deciding upon, not just the type and standard of structured cabling for your business, but also the brand you choose.

**A well designed, correctly installed, standards-compliant structured cabling system, backed by a comprehensive warranty programme, is the best way of protecting your investment and allowing for future needs.**

## Introducing Excel

Excel is a world-class premium performing end-to-end infrastructure solution – designed, manufactured, supported and delivered – without compromise.

Excel structured cabling products constitute an end-to-end solution where performance and ease of installation are prerequisites. With an emphasis on compatibility and standards compliance 'from cable to rack', reliability and product availability, Excel is the complete trusted solution.

Since its launch in 1997, Excel has enjoyed formidable growth and is now sold in over 70 countries, highlighted in green below, predominately across EMEA with customers supported by Excel offices in the UK and Dubai.

The meteoric rise of the brand reflects a growing demand throughout EMEA for a reliable, standards compliant, readily available, structured cabling and rack system.



 Countries supplied by Excel

Excel is able to deliver this mix as a result of strict European quality assurance and a growing base of distributors and integrators across EMEA, which combine to make the brand an increasingly viable option. With a focus on independent testing and a full 25 year product and application warranty, when installed by an Excel Partner, it's easy to see why this is the system of choice in many government, education and commercial installations.

## Excel Brand Values



- **Proven:** standards-compliant products, with third party independent verification from test houses such as Delta and 3P.
- **Accepted:** Numerous reference sites across EMEA, including some major Bluechip organisations.
- **Compatible:** an end-to-end system supported by one company with one warranty providing support and peace of mind from racks to copper, fibre & voice cabling systems.
- **Flexible:** from Category 3 through to Category 7<sub>A</sub> copper cabling and optical systems from conventional multimode OM1 to OM4 and Singlemode OS2, to pre-terminated high density MTP and highly flexible blown fibre systems, Racks and Intelligent Power Distribution Units.
- **Reliable:** EMEA wide partner programme, 25 year warranty programme, pre and post sales technical support, 19-year plus product development programme, third party verification as standard on all key solutions.
- **Available:** EMEA wide stock availability via Excel Distribution Partners for immediate delivery.

## CIBSE

CIBSE is The Chartered Institution of Building Services Engineers and sets standards and provides authority on building services engineering. It publishes Guidance and Codes which are internationally recognised as authoritative, and sets the criteria for best practice in the profession. CIBSE promotes the career of building services engineers by accrediting courses of study in further and higher education, by approving work based training programmes. Once qualified, CIBSE offers engineers a range of services, all focused on maintaining and enhancing professional excellence throughout their career.

Excel is accredited to provide a series of courses covering different aspects of structured cabling for use by CIBSE members within the Continuing Professional Development (CPD) programme.

The free of charge Excel courses are designed to enhance the skill levels of Building Service Engineers and Consultants who either have a basic grounding in the installation of structured cabling solutions or are just starting to build their expertise. Their modular format allows the structure of the training to be specific to the delegates' requirements and covers five key aspects: Cable Capacity in Trunking, Data Networks, Data Trunking, Data Networking Standards, PoE and IT Infrastructure for Building Management Systems. The courses are delivered throughout the UK.

CIBSE members can find out more about the range of courses available from Excel by visiting the CPD Directory at [www.cibse.org](http://www.cibse.org) or can email [cibse@excel-networking.com](mailto:cibse@excel-networking.com) for further information.

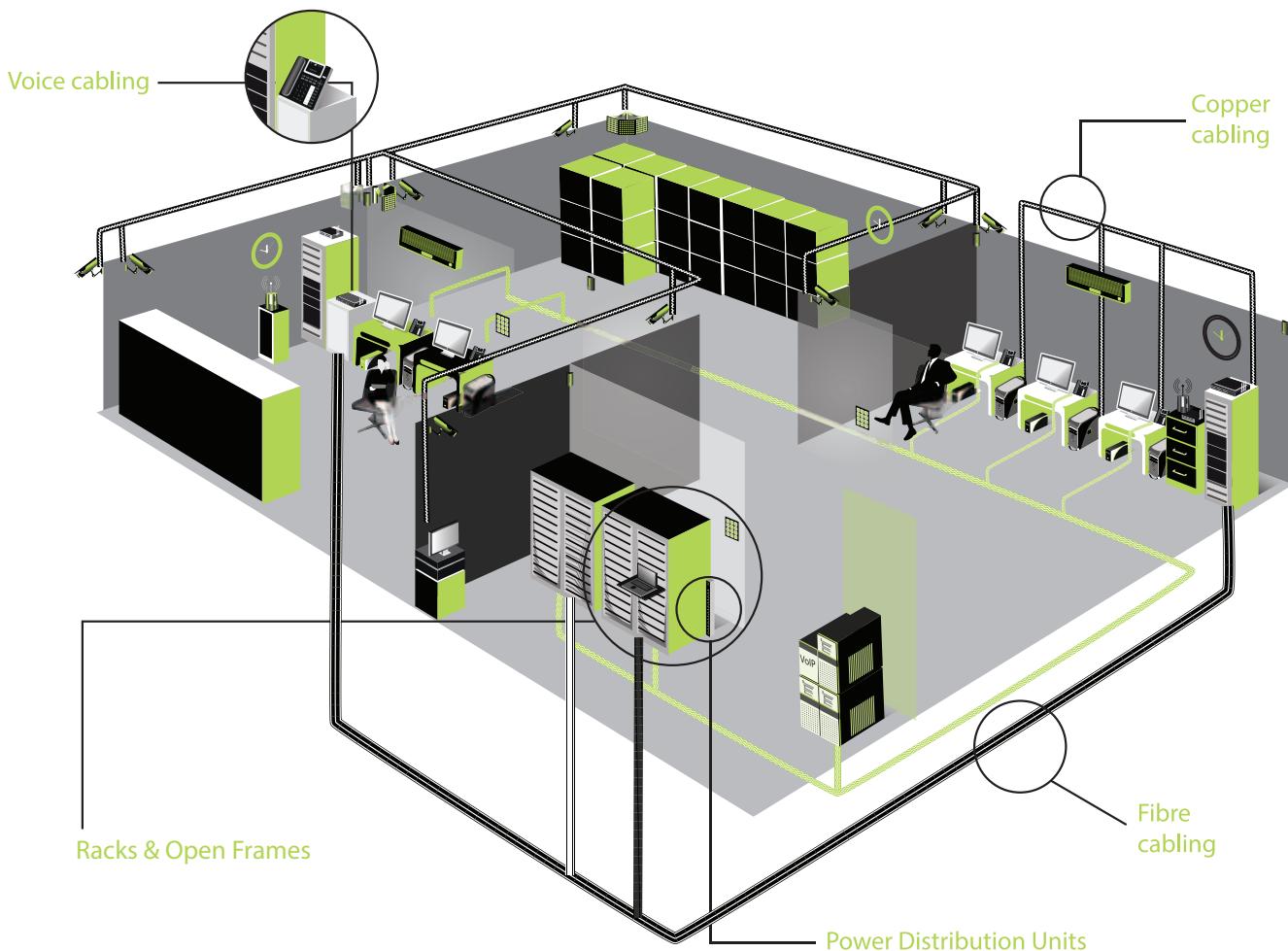
## Excel Award Winning System

Excel is an award winning solution with the following accolades to date:

		
<a href="#">Network Computing 2014</a>	<a href="#">Network Computing 2013</a>	<a href="#">Network Computing 2012</a>
		
<a href="#">Comms Expo 2012</a>	<a href="#">Networking Computing 2011</a>	

## Excel System Offering

Excel offers one of the market's most comprehensive cabling solutions, including:



### Copper

- Category 3 UTP
- Category 5e U/UTP and F/UTP
- Category 6 U/UTP and F/UTP
- Category 6<sub>A</sub> U/UTP, U/FTP and F/FTP
- Category 7<sub>A</sub> S/FTP
- Pre-Terminated Solutions

### Fibre

- Internal/External Grade Cable
- Patch Cords and Pigtailed – ST, SC, LC
- Connectors and Adaptors
- Patch Panels
- Excelerator MTP
- Blown Fibre
- Excelerator Pre-Terminated Solutions

### Voice

- Internal Grade Cabling
- External Grade Cabling

### Racks & Open Frames

- Environ® CR (Comms) Racks
- Environ® ER (Equipment) and SR (Server) Racks
- Environ® 2 Post Racks
- Environ® Wall Mount Racks
- Accessories
- PDUs – Standard, Modular and Intelligent

Throughout the Encyclopaedia we will provide you with indepth information across the complete Excel solution.  
To find out more details and part number information simply visit [www.excel-networking.com](http://www.excel-networking.com)

## Excel Manufacturing Facilities

Excel products are manufactured in ISO 9000 factories to meet European quality standards. The products are manufactured and tested to strict guidelines ensuring a consistent level of performance, designed to exceed the relevant standards.

The following photographs have been taken at two of our approved Excel manufacturing facilities:



Copper production  
Physical foam PE Machine

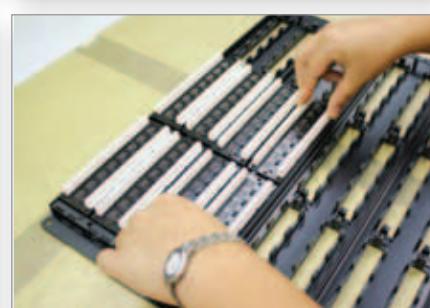


Copper production  
HDMI high density quality (foam)  
machine



High frequency network analyser

Patch Panel Assembly Line  
100% Testing



Please visit [www.excel-networking.com/videos/](http://www.excel-networking.com/videos/) to view a video on our cable manufacturing factory.



S1

### Environ House

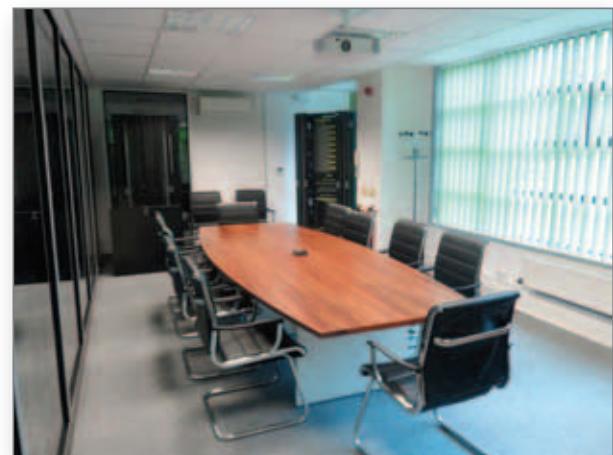


Environ House, Birmingham UK

Environ House was opened in January 2014 and provides a 16,000 sq ft warehouse and office facility. This is located on the same industrial park as Excel House in Birmingham, UK.

The warehouse is totally dedicated to the assembly of Environ racks and a number of shifts are in place to ensure that we meet the growing demand for the racks.

The meeting rooms include full AV equipment and have Excel racks and products on display. These facilities are available for Excel partners to utilise for customer presentations and demonstrations. We can also arrange for a tour of the Environ assembly area if required.



## Excel's Pedigree

The Excel brand is owned by Mayflex

### Why Mayflex?

All together. Products, Partners, People, Service – Mayflex brings it all together.

Mayflex lead the way in the distribution of Converged IP Solutions. We use our specialist knowledge and experience to bring together best in class infrastructure, networking and electronic security solutions to create a compatible, feature rich, value for money offering to meet the demanding needs of business types and sizes across all sectors.

Working together with VARs, Installers, integrators, and specifiers we provide support through pre-sales, product selection, commercial flexibility and technical know-how to enable the delivery of truly converged solutions which provide businesses with advanced, scalable, cost effective and reliable IP based communications networks and building management systems.

With revenues in excess of £100 Million, our resources ensure the constant development of the Excel product portfolio and the ability to hold the majority of Excel products in stock for immediate despatch.



Excel House, Birmingham UK



# Environmental Policy

Businesses operating in today's challenging environments have a number of important issues to consider, including the economic, environmental and social impact they are having on the world around them.

## Excel

At Excel, we strive towards having the best practices in place to help with our environmental and corporate responsibilities. These include:

1. Complies fully with all relevant environmental legislation, regulations and other relevant requirements.
2. Has identified the significant environmental impacts of its business.
3. Is working with its supply chain to ensure minimum waste where possible.
4. Provide the framework for setting and reviewing environmental objectives and targets, including the reuse, recycle and reduction of all waste.
5. Document, communicate and improve awareness of environmental matters to its employees and supply partners.

## Excel Initiatives

Excel has introduced a number of measures to help reduce the amount of paper that is used as a business including the following:

- Invoices and statements are emailed out to customers where possible
- Order confirmations are sent via email instead of fax
- All our offices have separate receptacles for the disposal and recycling of paper, tins/cans and plastic bottles
- Employing a company to collect and recycle all company confidential documentation – this resulted in over 335 trees being saved between 2010 and 2013.
- New energy efficient LED lighting is being installed into our UK warehouse facility which should help to reduce our carbon footprint.

## A Solid and Dependable Environmental Responsibility Programme

Excel continually reviews and reduces any negative environmental impact that its business activities create, including waste production and waste disposal.

With the introduction of literature produced on recycled or FSC paper, we are moving towards all of our literature being produced on paper made from recycled fibres.

All of our stationery is printed on FSC certified paper. FSC paper is produced from sustainable sources and is certified by the Forest Stewardship Council.

## Implementation of the WEEE Compliance Statement

As a supplier of electrical and electronic equipment, Excel has a clear and compliant approach to its responsibility with regard to the European Union's Waste Electrical and Electronic (WEEE) Directive. All products that are subject to the WEEE Directive, supplied by Excel from 13th August 2005, are compliant with the WEEE marking requirements. Such products are marked with the 'crossed out wheelie bin' WEEE symbol in accordance with European Standard EN 50419.

## Commitment to reducing our packaging and waste by 40% or more

Through our waste management programme, we aim to reduce our packaging usage and waste disposal by more than 40%. Our aim is to use only recyclable packaging cartons and materials for the transportation of our products to customers.

From 1st September 2008, all Excel cartons that leave our distribution warehouse have two symbols displayed on them: the green triangle, confirming that the carton is made from recycled materials and proving that we are compliant with EU directives, and the green dot, indicating that Excel is contributing to a 'packaging waste compliance scheme'.

We are also aware of our landfill responsibilities and we have an efficient recycling system in place at our head office location in order to recycle all our waste cardboard, paper, plastic and wood.

## EU Directive 2012/19/EU on the Restriction of the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS)

Excel is fully compliant with the updated directive on Restriction of Hazardous Substances (RoHS) which came into force on 13th August 2012 and became effective on 14th February 2014. We have put in place the appropriate measures to ensure compliance for ourselves and our customers.

The Excel brand is owned by Mayflex and therefore falls under the Mayflex Quality management system ISO 9001: 2008



By Royal Charter

# Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2008

This is to certify that:

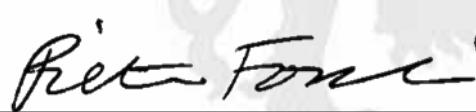
Mayflex UK Ltd  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham  
B6 7JJ  
United Kingdom

Holds Certificate Number: FS 547274

and operates a Quality Management System which complies with the requirements of ISO 9001:2008 for the following scope:

**Stockholding and supply of cabling infrastructure, networking products and internet protocol security products from quality assured sources without lot traceability. The assembly of data cabinets.**

For and on behalf of BSI:

  
Pietro Foschi - Strategic Delivery Director

Originally registered: 06/03/2009

Latest Issue: 11/12/2014

Expiry Date: 27/01/2018



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...making excellence a habit.<sup>TM</sup>

This certificate was issued electronically and remains the property of BSI and is bound by the conditions of contract.  
An electronic certificate can be authenticated [online](#).  
Printed copies can be validated at [www.bsigroup.com/ClientDirectory](http://www.bsigroup.com/ClientDirectory)

Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 845 080 9000  
BSI Assurance UK Limited, registered in England under number 7805321 at 389 Chiswick High Road, London W4 4AL, UK.  
A Member of the BSI Group of Companies.

S1

The Excel brand is owned by Mayflex and therefore falls under the Mayflex Environmental management system ISO 14001: 2004



# Certificate of Registration

ENVIRONMENTAL MANAGEMENT SYSTEM - ISO 14001:2004

*This is to certify that:*

**Mayflex UK Ltd**

Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham  
B6 7JJ  
United Kingdom

Holds Certificate No: **EMS 542863**

and operates an Environmental Management System which complies with the requirements of ISO 14001:2004 for the following scope:

Stockholding and supply of cabling infrastructure, networking products and internet protocol security products. The assembly of data cabinets.

For and on behalf of BSI:

Gary Fenton, Global Assurance Director

Originally registered: **19/11/2009**

Latest Issue: **23/04/2012**

Expiry Date: **23/04/2015**



Page: 1 of 1

This certificate was issued electronically and remains the property of BSI and is bound by the conditions of contract.  
An electronic certificate can be authenticated [online](#).  
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Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 845 080 9000  
BSI Assurance UK Limited, registered in England under number 7805321 at 389 Chiswick High Road, London W4 4AL, UK.  
A Member of the BSI Group of Companies.



# This is to certify that

Mayflex UK Ltd

COMPANY REGISTRATION NO.

06745491

VALPAK MEMBERSHIP NO.

RM06302

has fulfilled their recycling and recovery obligations  
for the 2013 compliance year through Valpak Limited

*as required by*

The Producer Responsibility Obligations  
(Packaging Waste) Regulations 2007 as amended

Valpak Chairman:



Valpak Chief Executive Officer:



Recycling & Climate Change

In the vast majority of cases recycling waste is more efficient than producing new products from virgin material. This results in lower emissions of those greenhouse gases that cause climate change. Through the activity undertaken by Valpak you have directly supported

the recycling of 92 tonnes of material,  
which saves approximately 81 tonnes of carbon dioxide equivalents\*

Your contribution has helped the UK to achieve the recovery of 7,549,031 tonnes of packaging during 2013.

\*Carbon metric factors from Zero Waste Scotland





CERTIFICATE OF  
**ENVIRONMENTAL**  
ACCOMPLISHMENT

This is to certify that

Mayflex UK Limited

participated in Shred-it's shredding  
and recycling program and saved 71 trees  
from destruction in 2013

Shred-it congratulates staff members on the positive impact  
this initiative has made towards saving our environment.

THANK YOU FOR  
YOUR BUSINESS.

SH13UK5



## Excel Check List

Excel provides numerous technical and commercial benefits - why not compare Excel to other cabling systems and suppliers and see how they compare?

Items shown with an \* are not currently available outside of the UK

Products	Excel	Alternative
Complete end-to-end <a href="#">Copper</a> , <a href="#">Fibre</a> and <a href="#">Rack</a> Solution	✓	
Copper Structured Cabling System in a choice of <a href="#">Category 7<sub>A</sub></a> , <a href="#">Category 6<sub>A</sub></a> , <a href="#">Category 6</a> and <a href="#">Category 5e</a> (screened & unscreened)	✓	
Fibre Optic System in a choice of <a href="#">Multimode</a> and <a href="#">Singlemode</a>	✓	
<a href="#">Excelerator MTP Fibre Optic</a> Solution in a choice of Multimode and Singlemode	✓	
The <a href="#">Excelerator MTP</a> offering is based around the US Conec Elite® connector	✓	
Pre-terminated Copper Solutions	✓	
<a href="#">Excelerator Fibre Optic Pre-terminated</a> Solutions	✓	
<a href="#">Blown Fibre</a> Solutions in Multimode and Singlemode	✓	
Angled Toolless Jacks - ideal for high density applications	✓	
High density Solutions including the <a href="#">0.5U</a> and <a href="#">V Panel</a>	✓	
Smallest <a href="#">Category 6<sub>A</sub> screened module</a> on the market - Just 28mm in depth	✓	
The <a href="#">Category 6<sub>A</sub> U/FTP cable</a> is just 6.7mm in diameter and allows the installation of 12% more cables in containment than a typical 7.1mm diameter product	✓	
<a href="#">Voice Cabling</a>	✓	
<a href="#">Environ® Rack and Open Frames</a> - wall, floor and server racks (up to 47U & 1200mm deep)	✓	
<a href="#">Power Distribution Units (PDUs)</a> – Standard, Modular and Intelligent	✓	

Quality Management	Excel	Alternative
<a href="#">25 Year Product and Application Warranty</a> across all Copper, Fibre, Voice Systems and Racks	✓	
<a href="#">Third Party Verification</a> from leading test houses Delta and ETL	✓	
Category 6 and 6 <sub>A</sub> carry both component and channel performance Third Party Verification	✓	
ISO9001: 2000 Accreditation	✓	
ISO14001: 2008 Accreditation	✓	
<a href="#">Environmental Policy</a>	✓	



## Introduction

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Services	Excel	Alternative
<a href="#">Online warranty application process</a>	✓	
Warranty applications processed within 5 working days	✓	
<a href="#">Free labelling software</a>	✓	
Faceplate printing service	✓	
Rack Configuration Service - in house built to specification service	✓	
Cut to length cable service	✓	
Pre-Sales Support from product selection to design support	✓	
Order between 8.00 a.m. and 8.00 p.m. for next day delivery in the UK *	✓	
Extensive Stock Availability	✓	
Trade Counter at Birmingham UK Headquarters open 7am to 7pm *	✓	
Choice of timed & same day deliveries *	✓	
Finance options *	✓	
Placement Plus Delivery Service - racks placed in final location & packaging removed *	✓	
Free Next day delivery to the UK mainland *	✓	
<a href="#">Partner Programme</a>	✓	
Available throughout EMEA	✓	
Toolbox Training *	✓	
Audit Overview *	✓	

Marketing\Collateral Information	Excel	Alternative
Winner of the Network Computing 'Cabling Supplier of the Year' Award for the last 4 years	✓	
Numerous reference sites - visit <a href="http://www.excel-networking.com">www.excel-networking.com</a> for a full list	✓	
<a href="#">Case studies</a> across multiple verticals	✓	
Comprehensive multilingual website <a href="http://www.excel-networking.com">www.excel-networking.com</a>	✓	
Powerpoint and iPad partner slide presentations	✓	
Online Specification Sheet Generator	✓	
Branded Literature – Excel Partners can brand literature with logo and address details	✓	
<a href="#">Partner Area</a> – includes warranty application and technical documentation	✓	
Literature – includes brochures, catalogues, specification sheets	✓	
<a href="#">White Papers</a>	✓	
<a href="#">'How To' Videos</a>	✓	
<a href="#">Blog</a>	✓	
<a href="#">Installation Guidelines</a>	✓	
Encyclopaedia Reference Manual	✓	
<a href="#">Delta Verification Certificates</a>	✓	

Items shown with an \* are not currently available outside the UK

# Excel Copper Structured Cabling Systems

## Section 2

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## Copper Cabling Systems

Copper infrastructure cabling offers different Categories and Classes of performance. There are many different bodies who publish standards. The three commonly referenced standards series are published by International Organisation for Standardisation (ISO), European Committee for Electrotechnical Standardisation (CENELEC - EN standards) and Telecommunications Industry Association (TIA). These are supplemented by national standards. Although they are similar, the performance requirements are not identical. The various performance standards support different applications. By specifying and installing a specific standard you are assured that all current and future applications designed for that standard of infrastructure cabling will work.

Category	5e	6	6 <sub>A</sub>	7	7 <sub>A</sub>
Class	D	E	E <sub>A</sub>	F	F <sub>A</sub>
Supported Frequency	100 MHz	250 MHz	500 MHz	600 MHz	1000 MHz
Application					
10Base-T	Ethernet	✓	✓	✓	✓
100BASE-TX	Fast Ethernet	✓	✓	✓	✓
1000BASE-T	Gigabit Ethernet	✓	✓	✓	✓
10GBASE-T	10 Gigabit Ethernet			✓	✓

Refer to 'Excel Copper Terminology Explained' for details of the anomalies between the standards.

The above is a summary list of the current Ethernet standards that are supported. All channels of Class D and above support Power over Ethernet and Power over Ethernet Plus (PoE - IEEE 802.3at Type 1 and PoE-plus - IEEE 802.3at Type 2). Many more applications are supported by the various Classes of Channels. Class D, E and E<sub>A</sub> all utilise the RJ-45 (8 Position 8 Connector) Plug and Jack. They also offer backwards compatibility i.e. a Category 6 Patch Lead will work in a Class D Link and maintain the Class D Link performance. The anomaly is Category 7/Class F. This standard was devised around the time of Category 6 /Class E. Class F originally was designed with the purpose of being able to use the pairs contained within the 4 pair system for different applications concurrently. For example, Fast Ethernet requires 2 pairs and voice systems require either 1 or 2 pairs. With a Class F Channel these applications can be supported at the same time by separating the pairs with special connecting leads. 1, 2 and 4 Pair connecting leads are available. As a result, the very end connector at the Telecommunications Outlet is not an RJ-45. Category 7 and Category 7<sub>A</sub> are not recognised by the TIA.

### Category 8

At the time of writing this version of the Excel Encyclopaedia, October 2014, developments have started into a new Category/Class of copper cabling. These are very much in a "work in progress" status, and therefore, any products on the market **may** only meet the draft versions of the time of development. At such an early stage of development the standards are likely to go through changes in requirements. Caution needs to be taken in selecting products on the market that are "compliant" with the draft standards as there is no guarantee of compliance in later or final versions.

The Institute of Electrical and Electronics Engineers (IEEE – pronounced "Eye-triple-E") formed a study group to investigate Next Generation BASE-T. Next Generation BASE-T means the next version of Ethernet delivered over copper twisted pair cabling. The outcome of the study group was the formation of IEEE P802.3bq 40GBASE-T Task Force. As the title indicates, the development is for 40 Gigabit Ethernet over twisted pair copper. The task force are currently defining the application and the needs of the cabling system to support this. The current requirement is for the cabling system to support a channel of up to 30 m made from of up to 2 connectors.

TIA – the TIA has sensibly announced that they will be calling the cabling system to support this new application, Category 8 (despite the next Category in their sequence being Category 7 – the Category 7 on the market relates to an ISO or

**Connector** - is a mated plug and socket. The plugs at each end of the channel, which are inserted into the equipment, do not form part of the channel as this socket is not defined in the cabling standards. The requirement of the socket in the equipment only has to support the applications of the equipment and not all applications listed in the cabling standard.

CENELEC standard, the equivalent is not recognised by the TIA). The TIA will develop the standards for Category 8 Cable and Connecting hardware. These will be used to form Category 8 Channels, and later Links. Summary of the likely attributes:

- 2000 MHz bandwidth
- $\leq 2$  connectors
- $\leq 30$  m Channel

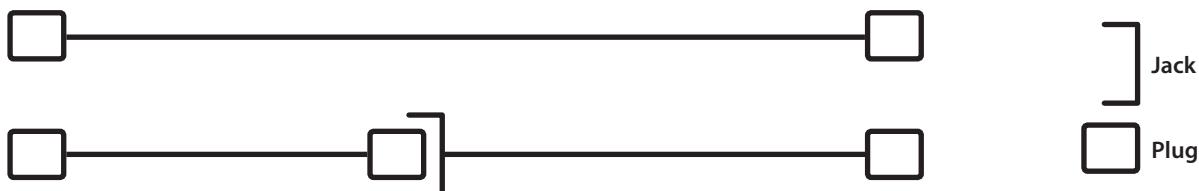
ISO – has existing components that are Category 7<sub>A</sub> that forms channels of Class F<sub>A</sub> that have a bandwidth of 1000 MHz. ISO are looking to develop two versions to support 40 Gigabit Ethernet. One based on developments of the Class F<sub>A</sub> increased to 1600 MHz and the other a 2000 MHz bandwidth. ISO will have two versions of Category 8.

### 1600 MHz

The first version will comprise of Category 8.1 cables and connecting hardware that can be used to form Class I channels (Roman Numerals "1"). These channels are likely to have the following attributes:

- 1600 MHz
- $\leq 1$  connector
- $\leq 10$  m Channel

$\leq 1$  connector means either a channel consisting of a Switch/Harness Link and a Cord or a customer made Cord with connectors on the end of the cable for connecting directly in the equipment at each end:



### 2000 MHz

The second version will comprise of Category 8.2 cables and connecting hardware that can be used to form Class II channels. These channels are likely to have the following attributes:

- 2000 MHz
- $\leq 2$  connector
- $\leq 30$  m Channel

2 connector channels usually take the form of permanent links with patch panels at each end. The equipment is then connected to these Links with Equipment Cords:



CENELEC – at the time of writing this version of the Excel Encyclopaedia, CENELEC have not started work on Category 8 / Class I, II.

### Usage

Category 8, as previously mentioned, is being developed to support 40 Gigabit Ethernet on twisted pair copper. This application is intended for use in Data Centres, and the topography envisaged is "End of Row" or "Top of Rack". This topography model means that optical fibre will be used to the End of Row or Top of Rack. Then the Category 8 can be used within the Row/Rack (or adjacent racks).

### Connector Type

The IEEE require that the connector is standardised on one type. This highly **unlikely** to be the RJ45. However the preference is for an RJ45 type. Therefore a different, 4 pair connector (Jack & Plug) will be specified. One of the connectors being considered is the ARJ45 as this is similar in operation as the RJ45 with increased performance. (The ARJ45 and RJ45 are not interoperable) There are other connectors being proposed by various manufacturers. However, their licensing requirements will more than likely exclude them as they are too restrictive.



# Which Category/Class to Specify

Selecting the Category/Class of cabling to specify, needs careful consideration. What is the requirement of the network today? This will answer the absolute minimum requirement of the cabling system. However, cabling systems are often required to have a long life; this is because they are often procured as Capital Expenditure. As it forms the fabric of the building, it is also disruptive to replace data cabling systems, therefore it's desirable to have longevity. Excel offers a [25 Year Warranty](#) for installations installed by Excel Partners. The infrastructure data cabling will often have a number of network churns within the service life. Some network equipment is updated and replaced every three years (sometimes more often in some sectors), therefore a level of 'Future proofing' is desirable in network designs. Design for Tomorrow not Today!

## Screened and Unscreened

Categories [5e](#), [6](#) and [6<sub>A</sub>](#) components are available in screened and unscreened versions. Category 7 is a screened system with cable of S/FTP PIMF (Pairs In Metal Foil) construction. Selecting whether to install an unscreened or a screened system depends upon the environment for installation.

Generally the performance of Category [5e](#) and [6](#) unscreened systems is suitable for most installations in the working environment. In these cases screened is often used where the external electromagnetic noise is high or perceived to be high. The decision whether to install screened or unscreened Class E<sub>A</sub>/[Category 6<sub>A</sub>](#) also brings in the need to consider Alien Cross Talk. Alien Cross Talk is when cross talk occurs between pairs within one cable and adjacent cables. As the cross talk influence is from outside of the sheath it is referred to as alien. Please see section [Category 6<sub>A</sub>](#) Screened or Unscreened Systems for further details.

## Which Standard Body?

As previously mentioned, ISO, BS EN and TIA standards are specified designs in the United Kingdom and other countries in Europe. Often the various standards are included in the same specification. Firstly, it is important to note that it is not possible to comply with standards from these three bodies at the same time. Some specifications mitigate this with a caveat that states in instances where there are conflicts the most onerous requirement shall be adhered to. However, who decides which is the most onerous requirement?

Let us also consider the geographical 'home' of these standards.



For the European market the EN standards published by CENELEC are likely to best suit the needs. CENELEC standards are automatically adopted by member states. So in the case of the UK they become BS EN XXXXX. The EN standards, along with a couple of British Standards, offer a robust suite. For the rest of the world, with the exception of America, the ISO standards are likely to be the best "fit".

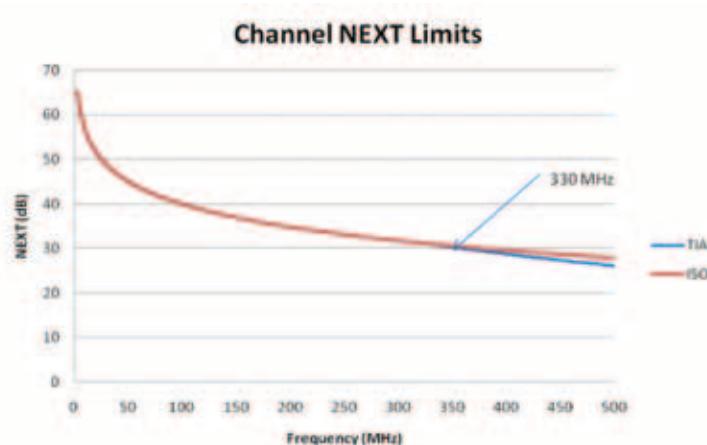
Phase of Project	Appropriate Standard
Design	EN 50173 series
Administration, Spaces, Pathways	EN 50174 series
Installation	EN 50174 series
Functional Bonding	EN 50174 series & EN 50310
Testing	EN 50173 series

The standards from the other bodies are good, and with care a 'mix and match' suite can be compiled.

Infrastructure cabling products that are compliant with the ISO and EN standards are also compliant with the TIA standards. This is not necessarily true with a TIA compliant product. This is why Excel has gone to great troubles to ensure that the Category 6<sub>A</sub> product offering is ISO compliant. It ensures that it will meet the needs of all environments. The advice is to select a suite of standards that suits the location of the installation.

## Category 6<sub>A</sub> standards - Key Differences Explained

The key difference between the standards for Category 6<sub>A</sub> is the requirements for Near End Cross Talk (NEXT) performance. The 'A' in Category 6<sub>A</sub> means augmented, which means that the requirements for Category 6 are Augmented up to 500 MHz. With the ISO and EN standards the NEXT limit equation is simply extended above 250 MHz to 500 MHz using the same equation. The TIA standard relaxes the limit at 330 MHz. The following graph shows the relaxation of the NEXT performance requirements to the TIA compared to ISO. The EN limits are the same as ISO.



## Categories & Classes

The terms Category and Class are used within the standards documentation to indicate the performance. Within the ISO & EN standards documentation a Category refers to the performance of a component – cable, connector etc. And from these Categories of components a Class of Channel or Link is constructed. If the number of connectors and the maximum length of the channel is observed then the lowest performing Category of component will dictate the Class of the Channel.

The TIA has Categories of components and Categories of Channels & Links.





## Current Standards

The following is a summary of the current standards discussed within this section. The majority of which are also relevant for Optical Fibre.

### International Organisation for Standardisation - ISO

ISO/IEC 11801:2002/Amd 2:2010 Information technology – Generic cabling for customer premises. Amendment 2.

### CENELEC EN

EN 50173 Information technology – Generic cabling systems

EN 50173-1:2011 Part 1: General requirements

EN 50173-2:2007 + A1:2010 Part 2: Office premises

EN 50173-3:2007 + A1:2010 Part 3: Industrial premises

EN 50173-4:2007 + A2:2012 Part 4: Homes

EN 50173-5:2007 + A2:2012 Part 5: Data centres

EN 50173-6:2013 Part 6: Distributed Building Services

EN 50174 Information technology – Cabling installation

EN 50174-1:2009 + A1:2011 Part 1: Installation specification and quality assurance

EN 50174-2:2009 + A1:2011 Part 2: Installation planning and practices inside buildings

EN 50174-3:2013 Part 3: Installation planning and practices outside buildings

EN 50310:2010 Application of equipotential bonding and earthing in buildings with information technology equipment.

### The British Standards Institute - BS

BS 6701:2010 Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance.

BS 7671:2008 + A1:2011 Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition.

### Telecommunications Industry Association - TIA

ANSI/TIA-568-C Generic Telecommunications Cabling for Customer Premises

ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard

ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard

ANSI/TIA-568-C.3 Optical Fibre Cabling Components Standard

ANSI/TIA-568-C.4 Coaxial and Broadband Components

# CENELEC Members

The table below lists the members of CENELEC. The CEN-CENELEC Internal Regulations, Part 2, states that the **EN (European Standard) “carries with it the obligation to be implemented at national level by being given the status of a national standard and by withdrawal of any conflicting national standard”.**

For example EN 50173-1:2011 is published in the United Kingdom as BS EN 50173-1:2011 and as DIN EN 50173-1:2011 in Germany.

Country	National Standards Organisation	Website	Standards Prefix
Austria	Austrian Standards Institute/ Österreichisches Normungsinstitut	<a href="http://www.as-institute.at">www.as-institute.at</a>	ÖVE/ÖNORM
Belgium	The Belgian Standards Body Bureau de Normalisation (NBN)	<a href="http://www.nbn.be">www.nbn.be</a>	NBN
Bulgaria	Bulgarian Institute for Standardisation	<a href="http://www.bds-bg.org">www.bds-bg.org</a>	БДС
Croatia	Croatian Standards Institute / Hrvatski zavod za norme	<a href="http://www.hzn.hr">www.hzn.hr</a>	HRH
Czech Republic	The Czech Office for Standards, Metrology and Testing / Úřad pro technickou normalizaci, metrologii a státní zkušebnictví (ÚNMZ)	<a href="http://www.unmz.cz">www.unmz.cz</a>	ČSN
Cyprus	The Cyprus Organisation for Standardisation (CYS)	<a href="http://www.cys.org.cy">www.cys.org.cy</a>	CYS
Denmark	Danish Standards Foundation / Fonden Dansk Standard	<a href="http://www.ds.dk">www.ds.dk</a>	DS
Estonia	Estonian Centre for Standardisation / Eesti Standardikeskuse	<a href="http://www.evs.ee">www.evs.ee</a>	EVS
Finland	The Finnish Standards Association SFS / Suomen Standardisoimisliitosta	<a href="http://www.sfs.fi">www.sfs.fi</a>	SFS
France	French Association for Standardisation Association française de normalisation (AFNOR)	<a href="http://www.afnor.org">www.afnor.org</a>	NF
Germany	German Institute for Standardisation / Deutsches Institut für Normung e.V.	<a href="http://www.din.de">www.din.de</a>	DIN
Greece	Hellenic Organisation for Standardisation / Ελληνικός Οργανισμός Τυποποίησης	<a href="http://www.elot.gr">www.elot.gr</a>	ΕΛΟΤ
Hungary	Hungarian Standards Institution / Magyar Szabványügyi Testület	<a href="http://www.mszt.hu">www.mszt.hu</a>	MSZ
Iceland	Icelandic Standards / Staðlaráð Íslands	<a href="http://www.ist.is">www.ist.is</a>	ÍST
Ireland	National Standards Authority of Ireland	<a href="http://www.nsai.ie">www.nsai.ie</a>	I.S.
Italy	Italian Organisation for Standardisation / Ente Nazionale Italiano di Unificazione	<a href="http://www.uni.com">www.uni.com</a>	UNI
Latvia	Latvian Standard / Latvijas standartus	<a href="http://www.lvs.lv">www.lvs.lv</a>	LVS
Lithuania	Lithuanian Standards Board / Lietuvos standartacijos departamento	<a href="http://www.lsd.lt">www.lsd.lt</a>	LST
Luxembourg	The Luxembourg Institute for Standardisation, accreditation, safety and quality of products and services / Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services	<a href="http://www.ilnas.public.lu">www.ilnas.public.lu</a>	ILNAS
Malta	Malta Competition and Consumer Affairs Authority	<a href="http://www.mccaa.org.mt">www.mccaa.org.mt</a>	MSA
The Netherlands	Netherlands Standardisation Institute / Nederlands Normalisatie-instituut	<a href="http://www.nen.nl">www.nen.nl</a>	NEN
Norway	Standards Norway / Standard Norge	<a href="http://www.standard.no">www.standard.no</a>	NS
Poland	Polish Committee for Standardisation / Polski Komitet Normalizacyjny	<a href="http://www.pkn.pl">www.pkn.pl</a>	PN
Portugal	Portuguese Institute of Quality / Instituto Português da Qualidade	<a href="http://www.ipq.pt">www.ipq.pt</a>	NP



Country	National Standards Organisation	Website	Standards Prefix
Romania	Romanian Standards Association / Asociatia de Standardizare din Romania	<a href="http://www.asro.ro">www.asro.ro</a>	SR
Slovakia	Slovak Standards Institute / Slovenského ústavu technickej normalizácie	<a href="http://www.sutn.sk">www.sutn.sk</a>	STN
Slovenia	Slovenian Institute for Standardisation / Slovenski inštitut za standardizacijo	<a href="http://www.sist.si">www.sist.si</a>	SIST
Spain	Spanish Association for Standardisation and Certification / Asociación Española de Normalización y Certificación	<a href="http://www.aenor.es">www.aenor.es</a>	UNE
Sweden	Swedish Standards Institute / Svenska Standards Institute	<a href="http://www.sis.se">www.sis.se</a>	SS
Switzerland	Swiss Association for Standardisation / Schweizerische Normen-Vereinigung	<a href="http://www.snv.ch">www.snv.ch</a>	SN
Turkey	Turkish Standards Institution / Türk Standardları Enstitüsü	<a href="http://www.tse.org.tr">www.tse.org.tr</a>	TS
United Kingdom	British Standards Institution	<a href="http://www.bsigroup.com">www.bsigroup.com</a>	BS

## Channel Configurations

For the purposes of the Excel Encyclopaedia the configurations and rules are based on the EN 50173 series of standards. The particular section is Clause 6.2.2.2 Dimensions of EN 50173-2:2007+A1:2010

The copper channel comprises of the Equipment Cord through to the Work Area Cord up to, but **excluding**, the end connection (Plug from the Work Area Cord & Jack in the Terminating Equipment.

The maximum channel length supported by the standard is 100 m. There are four recognised channel models ranging from a two connector to four connector configurations. A "connector" in terms of the channel is a plug/jack mated pair. As the channel does not include the connector in the equipment at each end, this is not included in the number of connectors.

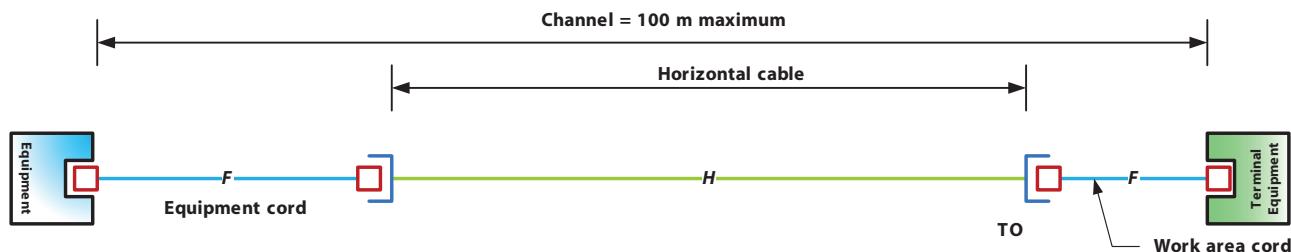
The maximum length of the Horizontal Cable is calculated based on the Class of the system and the lengths of the attached cords and links. The following general restrictions apply:

- The physical length of the channel shall not exceed 100 m
- The physical length of the horizontal cable shall not exceed 90 m. This may need reducing depending on the length of the attached cords
- Where a MUTO (Multi User Telecommunications Outlet) is used the length of the work area cord shall not exceed 20 m
- Where a CP (consolidation point) is used the horizontal cable length shall be at least 15 m in length. This is to reduce the effect of multiple connections in close proximity. This minimum length is often misquoted. The minimum length only applies where a CP is used. See sections c) & d) below.
- The length of individual patch cords or jumpers shall not exceed 5 m

Below are the mentioned configuration models followed by the length calculations.

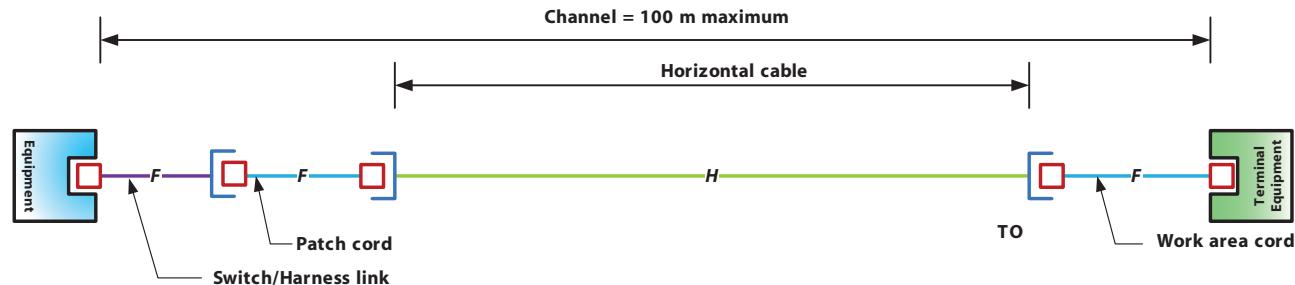
Value	Note	
H	maximum length of the fixed horizontal cable (m)	
F	combined length of patch cords, jumpers, equipment and work area cords (m)	
C	length of the CP cable (m)	
X	ratio of flexible cable insertion loss (dB/m) to fixed horizontal cable insertion loss (dB/m)	1.5 for stranded cable 1 for solid core cable
Y	ratio of CP cable insertion loss (dB/m) to fixed horizontal cable insertion loss (dB/m)	1.5 for stranded cable 1 for solid core cable

### Interconnect to Telecommunications Outlet (TO)



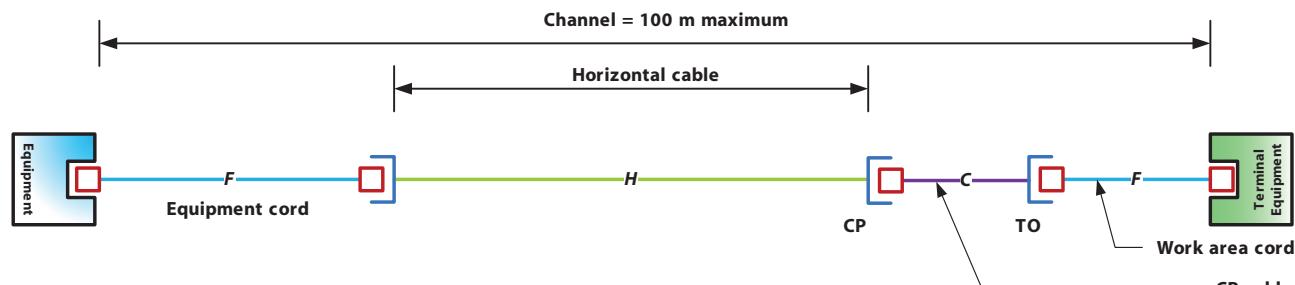
Class	Equation
Class D (Category 5e)	$H = 109 - (F \times X)$
Class E (Category 6)	$H = 107 - 3 - (F \times X)$
Class E <sub>A</sub> (Category 6 <sub>A</sub> )	$H = 107 - 3 - (F \times X)$
Class F (Category 7)	$H = 107 - 2 - (F \times X)$
Class F <sub>A</sub> (Category 7 <sub>A</sub> )	$H = 107 - 2 - (F \times X)$

### Cross-connect to Telecommunications Outlet (TO)



Class	Equation
Class D (Category 5e)	$H = 107 - (F \times X)$
Class E (Category 6)	$H = 106 - 3 - (F \times X)$
Class E <sub>A</sub> (Category 6 <sub>A</sub> )	$H = 106 - 3 - (F \times X)$
Class F (Category 7)	$H = 106 - 3 - (F \times X)$
Class F <sub>A</sub> (Category 7 <sub>A</sub> )	$H = 106 - 3 - (F \times X)$

### Interconnect to Consolidation Point (CP) to Telecommunications Outlet (TO)

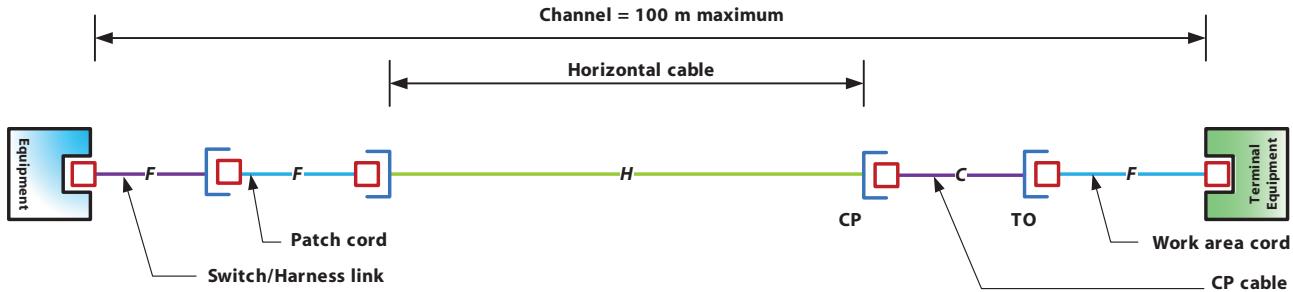


Class	Equation
Class D (Category 5e)	$H = 107 - (F \times X) - (C \times Y)$
Class E (Category 6)	$H = 106 - 3 - (F \times X) - (C \times Y)$
Class E <sub>A</sub> (Category 6 <sub>A</sub> )	$H = 106 - 3 - (F \times X) - (C \times Y)$
Class F (Category 7)	$H = 106 - 3 - (F \times X) - (C \times Y)$
Class F <sub>A</sub> (Category 7 <sub>A</sub> )	$H = 106 - 3 - (F \times X) - (C \times Y)$



## Cross-connect to Consolidation Point (CP) to Telecommunications Outlet (TO)

S2



Class	Equation
Class D (Category 5e)	$H = 105 - (F \times X) - (C \times Y)$
Class E (Category 6)	$H = 105 - 3 - (F \times X) - (C \times Y)$
Class E <sub>A</sub> (Category 6 <sub>A</sub> )	$H = 105 - 3 - (F \times X) - (C \times Y)$
Class F (Category 7)	$H = 105 - 3 - (F \times X) - (C \times Y)$
Class F <sub>A</sub> (Category 7 <sub>A</sub> )	$H = 105 - 3 - (F \times X) - (C \times Y)$

## Temperature

The Channel Length calculations are based on a temperature of 20°C. As the temperature increases above 20°C the length H is reduced.

Cable type	% reduction of H per °C increase
Unscreened cable	0.2 % (20°C to 60°C)
Screened cable	0.4 % (20°C to 40°C)
	0.6 % (>40°C to 60°C)

The maximum operating temperature for compliant Channel is 60°C.

For ease the above calculations are available in a spreadsheet "Channel Length Calculations". The spreadsheet may be downloaded from the Technical Note section of the Partner Area – Excel website <http://www.excel-networking.com>

## Testing

Testing of the channel models is covered in the Installation Guidelines section.

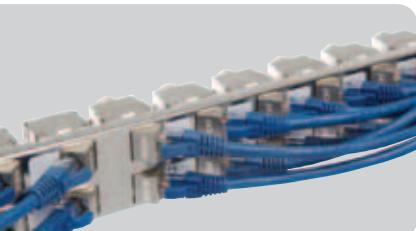


# Excel Copper Cabling Systems

When installed by an accredited Excel Partner the Excel copper range can be covered by a [25 year product and application warranty](#).

S2

The Excel copper cabling solution includes:



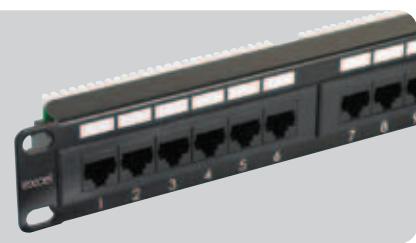
## Excel [Category 6 A](#) Range

- Choice of screened straight or angled [jacks](#) and compatible panel frames
- Choice of [F/FTP, U/FTP or U/UTP cable](#)
- Choice of 'shotgun' twin cable in [F/FTP](#) and [U/FTP](#) designs
- Screened and unscreened [patch leads](#) in a variety of lengths and colours
- Full range of [mounting hardware](#) available
- [Third Party Verified](#) Standards Compliance Performance
- [LSOH cable](#) as standard



## Excel [Category 6](#) Range

- Choice of screened and unscreened straight or angled [jacks](#) and compatible panel frames
- Choice of [U/UTP or F/UTP cable](#)
- Choice of 'shotgun' twin cable in [U/UTP](#) design
- Screened and unscreened [patch panels](#)
- [Excel Plus Patch Panel](#) range offers enhanced labelling system
- [LSOH U/UTP](#) cable as standard
- Screened and unscreened [patch leads](#) in a variety of lengths and colours
- [Third Party Verified](#) Standards Compliance Performance



## Excel [Category 5e](#) Range

- Choice of screened and unscreened straight [jacks](#) and compatible panel frames
- Choice of [U/UTP or F/UTP cable](#)
- Screened and unscreened [patch panels](#)
- [Excel Plus Patch Panel](#) range offers enhanced labelling system



## Excel Copper [Accessories](#)

- Full range of plastic [mounting hardware](#) available
- Grid Outlet Position ([GOP](#)) Box range
- [Containment](#) and cable matting



# Category 6<sub>A</sub> Screened or Unscreened Systems?

The advances in infrastructure copper cabling have led to an improvement in performance. Applications are increasing at a rate of 10 fold magnitude at each change, and this is with the medium still using a balanced cabling system.

S2

Through the history of balanced cabling systems there have been unscreened and screened versions. Different geographical markets had their preference; for example the United Kingdom has always predominately chosen unscreened while Germany favours screened cabling system installations. Environmental factors can also affect the decision. Installations where high noise is measured or anticipated are often cited as a reason to go screened. But whatever the choice, both systems use balanced cabling which gives a high level of protection and low emission.

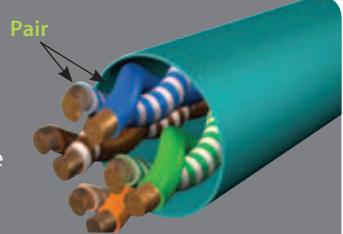
The effect of crosstalk within the cable has been known about, and therefore measured, since the early Categories and Classes of cabling systems. This was always in the form of Near End Crosstalk (NEXT) as measured from each end. NEXT is the influence from the signal of one pair to another within the same cable sheath. But as cabling systems and the associated applications have advanced, the signals from other cables have the potential to cause crosstalk issues as well. This is known as Alien Crosstalk (ANEXT); 'Alien' referring to the fact that it's from outside of the cable sheath.

Many factors affect the Alien Crosstalk performance of the system design. For the cable this includes such things as the twist rate of the pairs and the geometry of the pairs. Four pair cable is constructed so that each pair has a different twist rate thereby eliminating potential issues, but this means that adjacent cables will have pairs that are of identical twist rates. For example the Blue pair in a bundle of cables will all be twisted at the same rate and this has the potential to cause an issue with unshielded cable if the cable is installed in strict 'tramline' fashion.

Whether the installed cabling system is to be screened or unshielded it is important to follow manufacturer Installation Guidelines as well as design guidelines and testing recommendations.

## Balanced Cable System

A balanced system comprises of a cable constructed with a number of conductors twisted together in pairs. Copper infrastructure cable consists of 4 pairs of conductors. The signal transmitted down the two conductors of the pair are equal but opposite. The receiver detects the difference. This is known as differential mode transmission. Any external noise induced onto the pair will be common to both conductors. This is known as common-mode and is cancelled out at the receiver.



## Testing of Category 6<sub>A</sub> Installations

Both unshielded and shielded cabling systems shall have a Permanent Link test carried out to measure performance against the relevant required standard.

By design, a screened Class E<sub>A</sub>/Category 6<sub>A</sub> does not require additional Alien Crosstalk testing. However, for unshielded cabling installations a level of Alien Crosstalk testing has to be carried out and this is tested in the channel configuration. The channel under test is referred to as the 'Disturbed' and all channels that have an effect on this are referred to as the 'Disturbers'. The installation method will determine whether the cable is a Disturber of the cable in question (the Disturbed). All cables within a bundle become Disturbers as they are adjacent for the majority of the installation. The test is set up using specific test articles attached to the tester. The Disturbed channel is connected along with one of the Disturber channels, and this is done so at the Near and Far end. The test is carried out and then repeated for each Disturber within the bundle or channels considered to be Disturbers. The results are then collated and analysed using software to determine a Pass or Fail. The more Disturbers that are involved the longer the testing regime.

For example, carrying out a 10% Alien Crosstalk test on an installation of 42 Patch Panels (1008 Ports) with a bundle size of 24 would equate to:

101 Disturbed Channels each with 23 Disturber Channels = 2323 individual tests. This is in addition to the certification testing.

100% Certification Testing= 1008

10% ANEXT Testing = 232

Total = 3331 tests.

If the testing regime was specified as 100% Alien Crosstalk testing based on the above parameters this would result in 23,184 tests being carried out for ANEXT alone. Meaning, with the certification testing, it would take 24 times as long as certification testing alone.

The number of Disturbers has to be agreed. In addition to bundles, consideration has to be given to adjacent ports within the patch panel. This will also be vertically between patch panels in addition to horizontally within the same panel.

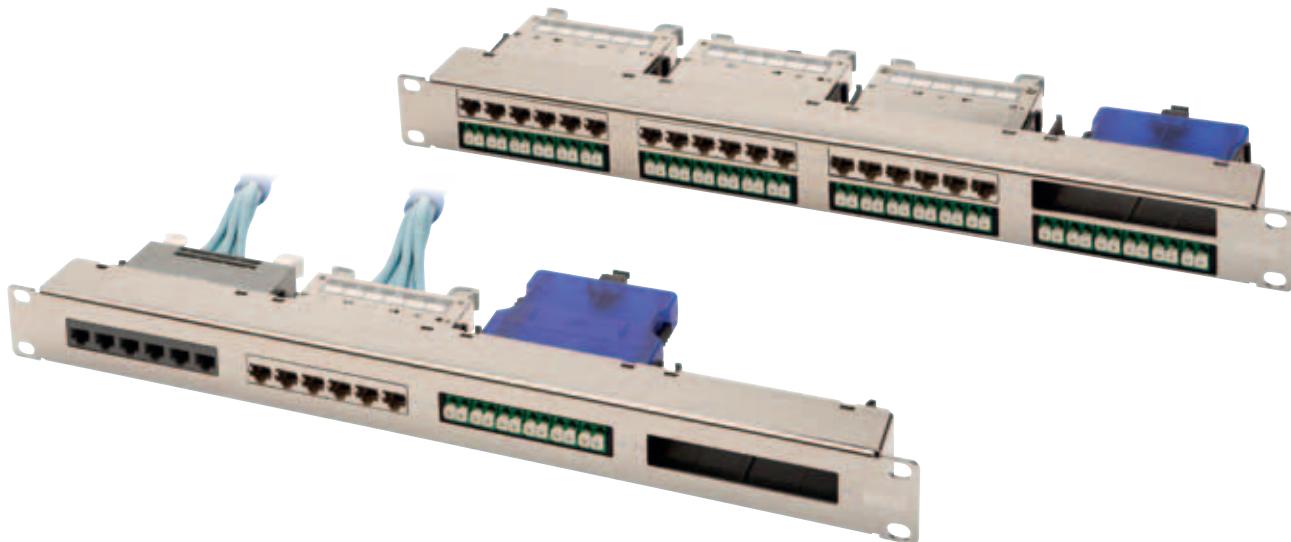
Reducing the bundle size results in fewer Disturber channels present and so it is therefore good practice to limit Class E<sub>A</sub> / Category 6<sub>A</sub> to bundle sizes to about 12, or even 6.

In conclusion, Unscreened Class E<sub>A</sub> / Category 6<sub>A</sub> Alien Crosstalk is more influenced by the installation than screened systems, hence resulting in a far higher field testing requirement and associated time.

S2

## Excel Mixed Use Patch Panel Frames

The Excel Mixed Use Panel provides the ability to have fibre and copper presented in one panel offering complete flexibility in the installation. The Excel Mixed Use Panel accepts 6 port copper or fibre modules – the modules are available in a choice of Category 6<sub>A</sub> Screened, Category 6 Screened and Unscreened, LC fibre and MTP.



The Excel Mixed Panel is suitable for installations from data centres where the mixed use panel may aid separation of the routes of cabling, to a remote wall box that has a small number of fibre and copper links, its design provides a versatile and flexible solution that will suit many applications.

The construction of the panel has a chrome colour finish and comes in a choice of a 4 or 8 module panel using only 1U of rack space.

### Features

- 4 & 8 Module Patch Panels
- Accepts Copper & Fibre 6 Port Cassettes
- 25 Year system warranty available

Part Number	Description
100-230	Excel 1U Mixed Use Patch Panel Frames - 4 Module - Unloaded
100-231	Excel 1U Mixed Use Patch Panel Frames - 8 Module - Unloaded
100-235	Excel 6 Port Category 6 Unscreened Module
100-236	Excel 6 Port Category 6 Screened Module
100-237	Excel 6 Port Category 6 <sub>A</sub> Screened Module
201-600	Excel 6 Port Duplex (12 Fibre) OM3 LC Module
201-601	Excel 6 Port Duplex (12 Fibre) OM4 LC Module
201-602	Excel 6 Port Duplex (12 Fibre) OS2 LC Module
201-610	Excel 6 Port Duplex (12 Fibre) OM3 LC to MTP Module
201-611	Excel 6 Port Duplex (12 Fibre) OM4 LC to MTP Module
201-612	Excel 6 Port Duplex (12 Fibre) OS2 LC to MTP Module



Diagram shows fibre (left) and copper (right) modules loaded into the Mixed Use Panel



## Excel Copper Terminology Explained

We follow the guidelines below in relation to the Excel copper product range.

S2

### 1. General Terminology

The term used in the ISO standards is Screen. The term shield is not used in context of a cable or connecting hardware.

Therefore the two types of installations are:

- Unscreened Cabling System
- Screened Cabling System

### 2. Connecting Hardware Terminology

Connecting hardware covers Jacks (also referred to as outlets, modules and sockets) and Patch Panels.

They are either unshielded or shielded.

Excel Terminology	
Category 6 Unshielded Jack	
Replace with appropriate Category ( <a href="#">5e, 6 or 6<sub>A</sub></a> )	↑
or Screened	↑
or Patch Panel	↑

### 3. Copper Cable Terminology

There are two families of copper cable

- Unshielded Cable
- Shielded Cable

Excel Terminology	
Category 6 Unshielded Twisted Pair (U/UTP) Cable	
Replace with appropriate Category ( <a href="#">5e, 6, 6<sub>A</sub> and 7</a> )	↑
Change to Screened for any cable other than U/UTP	↑
Use acronym that fits in accordance with chart on page 33	↑

### 4. Patch Cord Terminology

There are two families of patch cords

- Unshielded
- Shielded

Excel Terminology	
Category 6 Unshielded Twisted Pair (U/UTP) Patch Lead	
Replace with appropriate Category ( <a href="#">5e, 6 or 6<sub>A</sub></a> )	↑
Change to Screened for any cable other than U/UTP	↑
Use acronym that fits in accordance with chart on page 33	↑

### Anomalies

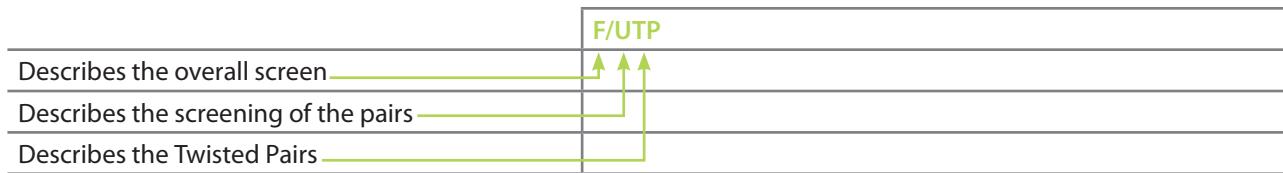
- The term Category 5e only applies to the TIA standards. The requirements are to ensure Gigabit Ethernet can be transmitted. This was encompassed in the ISO & EN standards as the requirements for Category 5. However, Category 5e is an accepted (although not mentioned in ISO & EN) term across all three standards bodies.
- The term Category 6<sub>A</sub> only applies to ISO & EN cables. The TIA refer to Category 6A. As Excel cable is ISO compliant it shall standardise on Category 6<sub>A</sub>. Cable compliant with ISO is also compliant with the TIA requirements. This is not necessarily true the other way round.

## 5. Cable Types

The first letter of the acronym describes the overall screening. The second letter describes the screening of individual pairs and the TP refers to the Twisted Pairs.

The reason for the additional letter at the beginning of the acronym is to avoid confusion of the different types of screened cables which have been developed in the last few years.

Example



The following are the types of cable recognised in the ISO/IEC 11801 standard.

<b>U/UTP</b> Unscreened outer with unscreened twisted pairs		<b>SF/UTP</b> Screened braid and foil outer with unscreened twisted pairs	
<b>F/UTP</b> Screened foil outer with unscreened twisted pairs		<b>S/FTP</b> Screened braid outer with individual screened foil twisted pairs	
<b>U/FTP</b> Unscreened outer with individual screened foil twisted pairs		<b>F/FTP</b> Screened foil outer with individual screened foil twisted pairs	
<b>U/FTP</b> Unscreened outer with two sets of two pairs foil screened in "S" configuration		<b>F/FTP</b> Screened foil outer with two sets of two pairs foil screened in "S" configuration	

### "S" Foil Cable

"S" Foil cable has been added to the [Excel Category 6<sub>A</sub> product portfolio](#). The "S" foil has the performance and functionality of individually screened pairs whilst using less material. The reduction in material has resulted in a smaller diameter. The smaller diameter has resulted in a reduction of 19.7% in cross-sectional area for the **F/FTP** and 14.5% for the **U/FTP** versions of this Category 6<sub>A</sub> Cables.

Reducing the cross-sectional area means that the cable takes up less space in the containment.

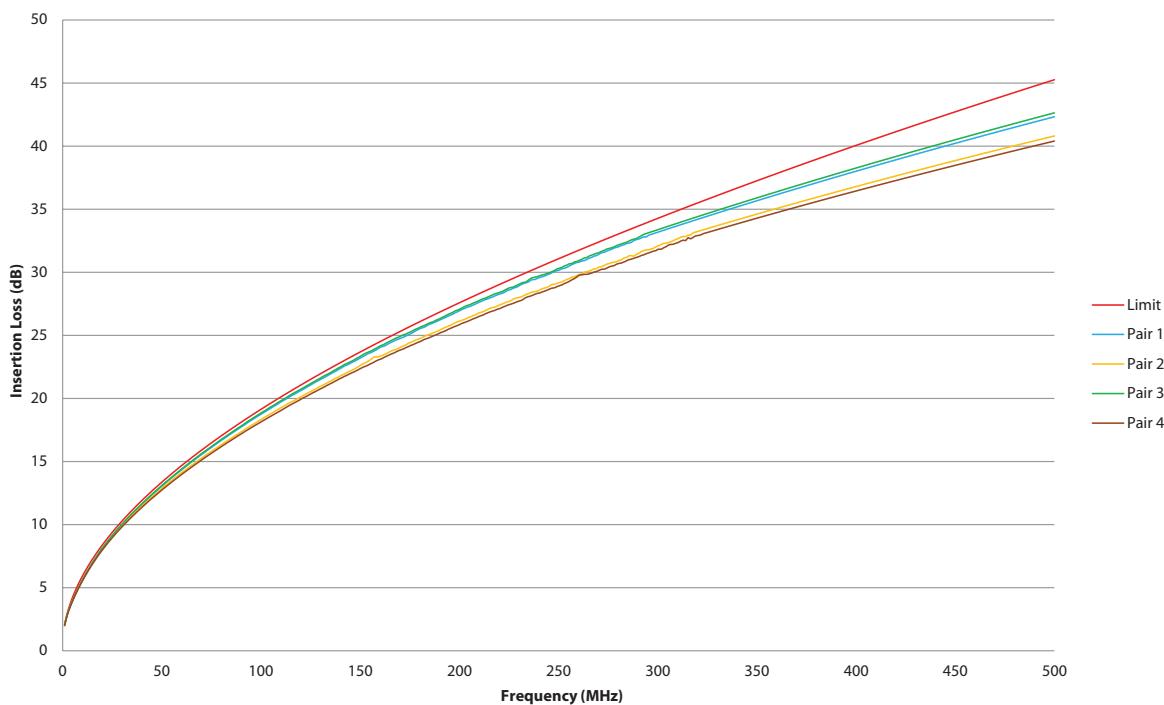
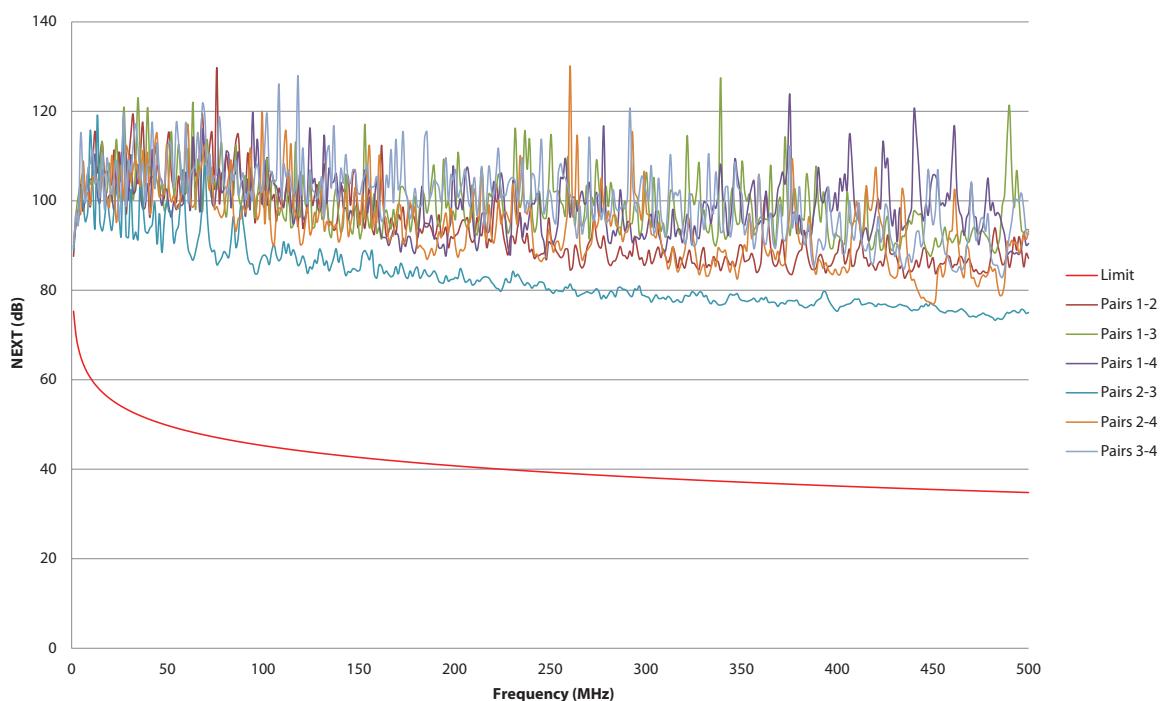


# Excel Category 6<sub>A</sub> Typical Performance Charts

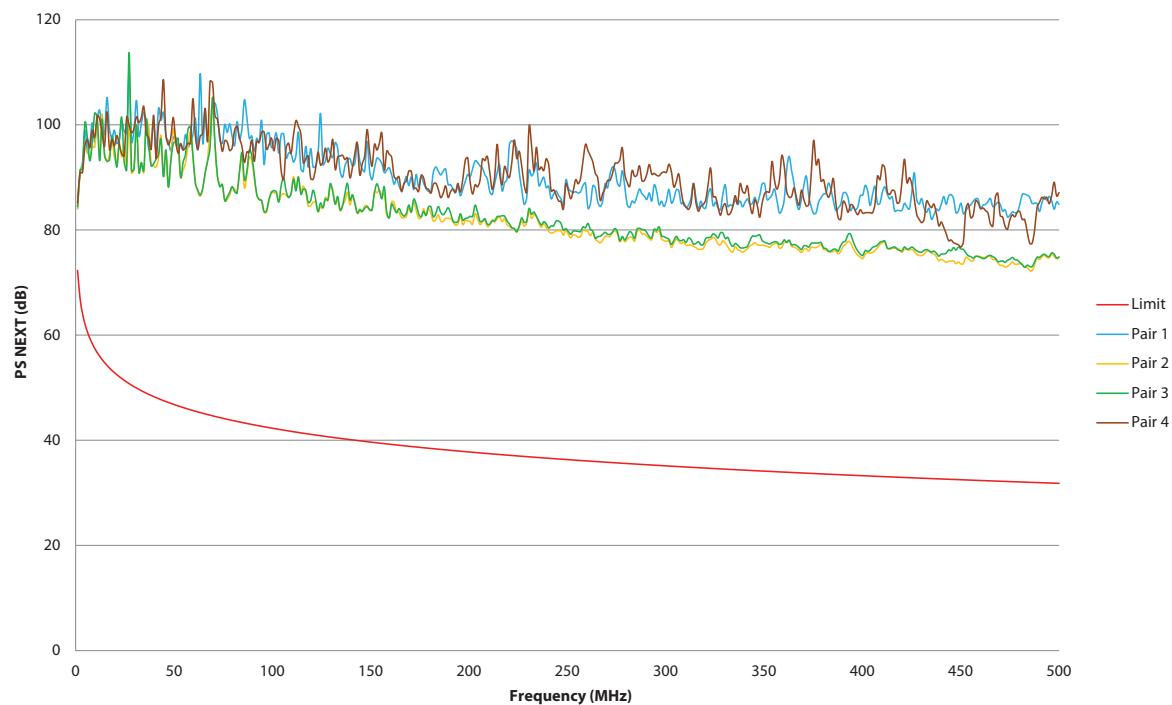
## 100-196 Excel Category 6<sub>A</sub> Screened (F/FTP) S-Foil Cable - LSOH

S2

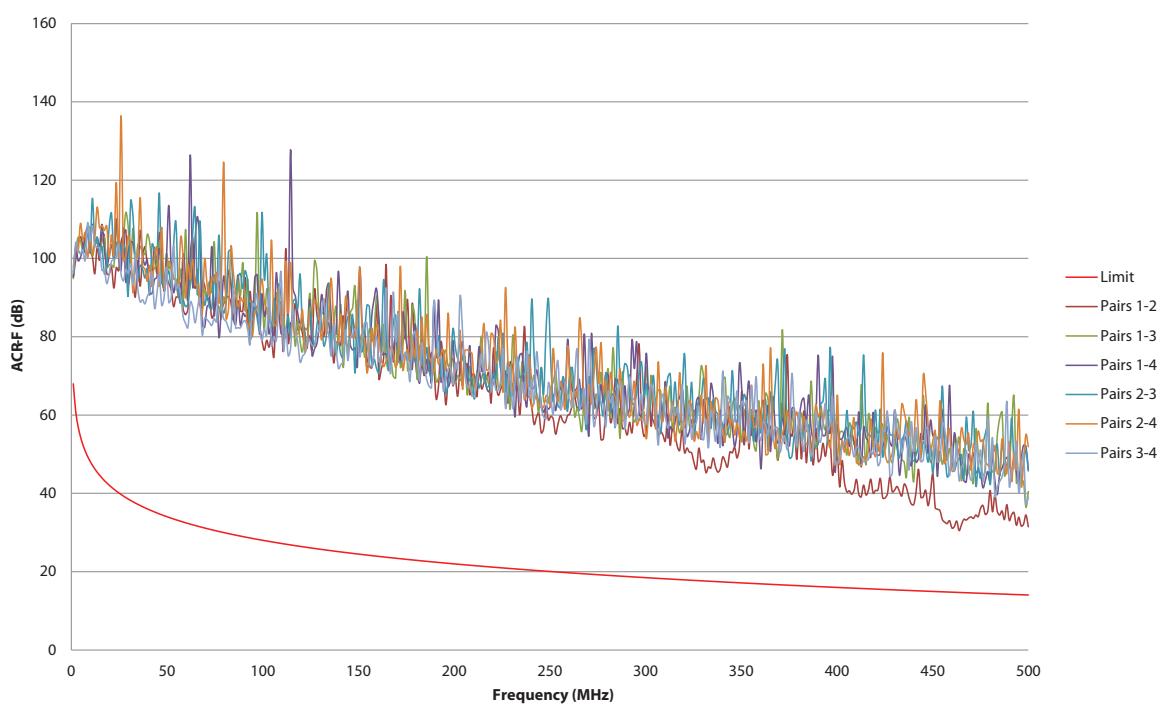
The following graphs show full frequency sweep cable tests carried out on a Network Analyser with cable adapters. The limits required for cable defined in IEC 61156 are indicated by red lines (—). IEC 61156 is the cable standard referenced in ISO/IEC 11801:2002. The test is of a 100m length of cable without connecting hardware (jacks, modules or patch panels) and the broader the gap between the red "limit line" and the standard "under test line" the better the performance of the product under test. This 'gap' is often referred to as headroom and indicates performance above that required by the standard.

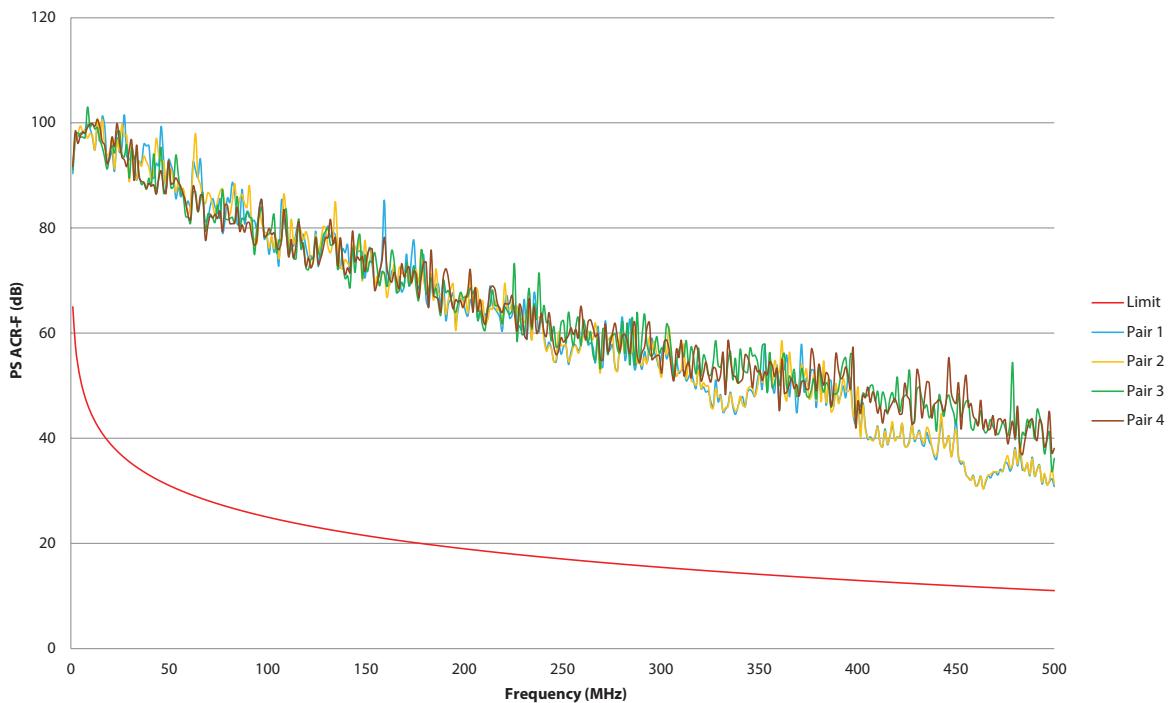
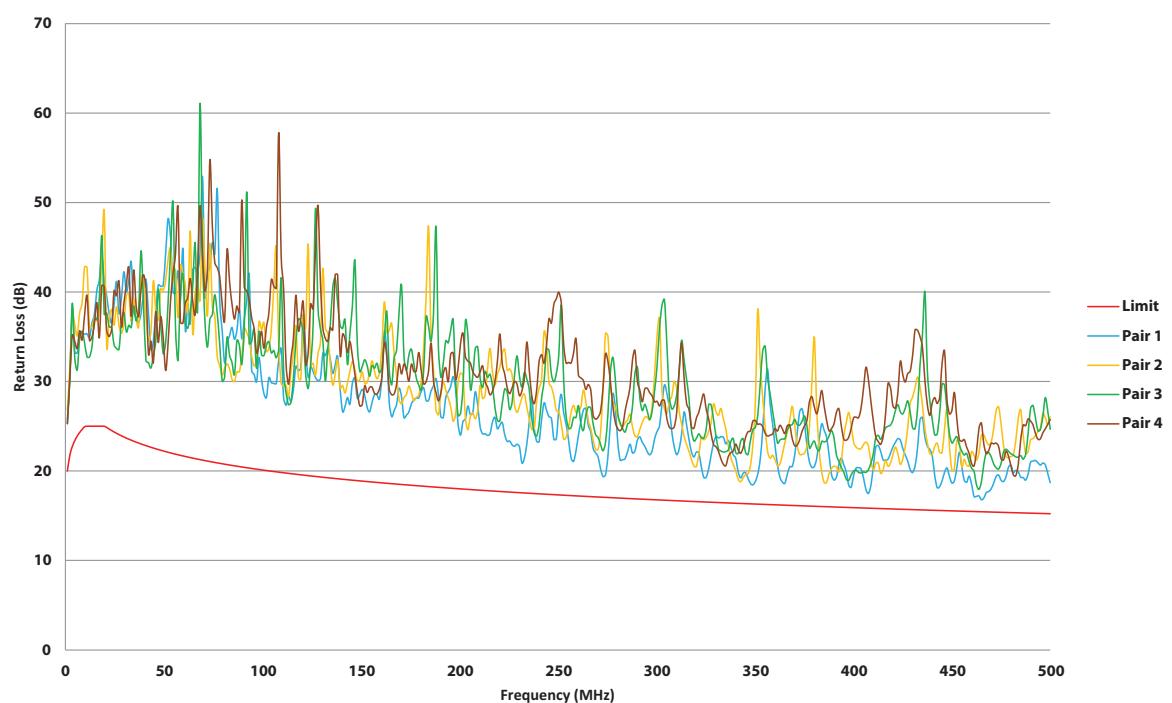
**Insertion Loss****NEXT**

### Power Sum NEXT

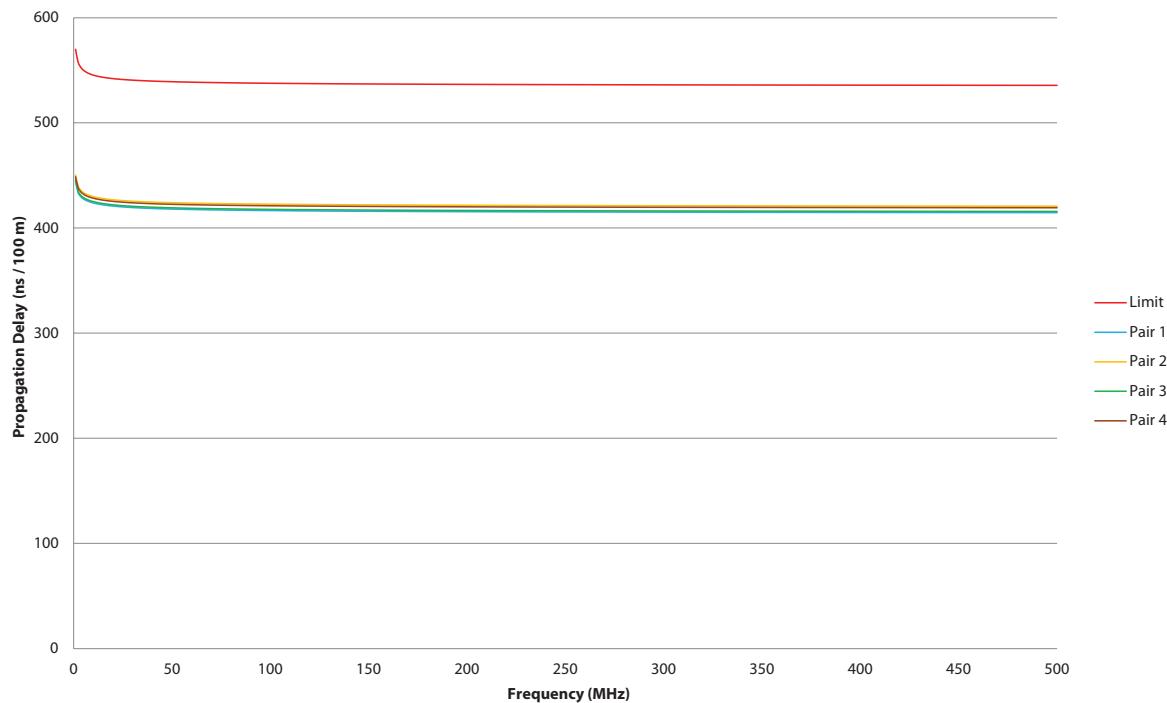


### ACR-F

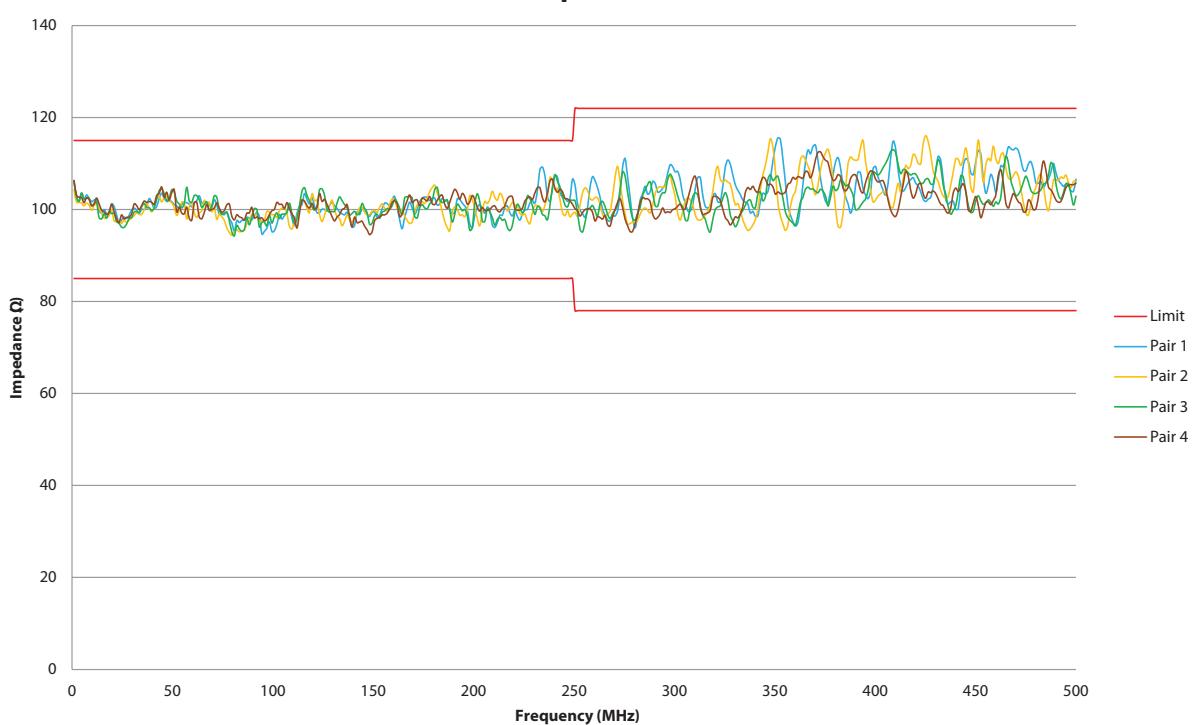


**Power Sum ACR-F****Return Loss**

### Propagation Delay



### Impedance



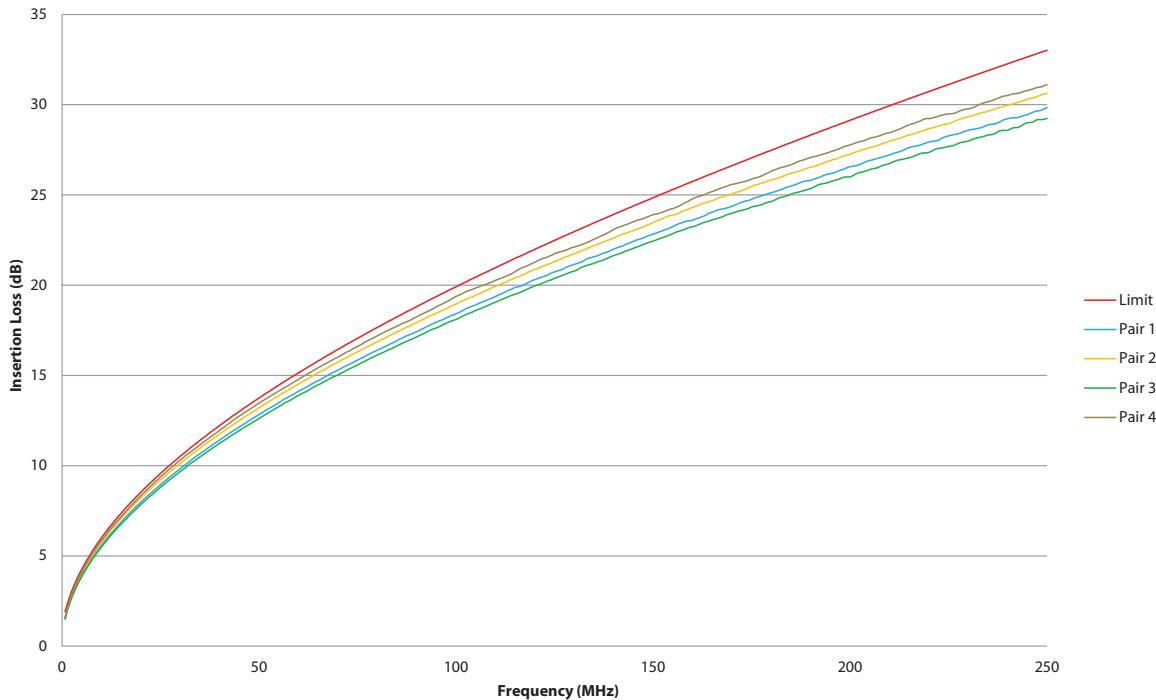
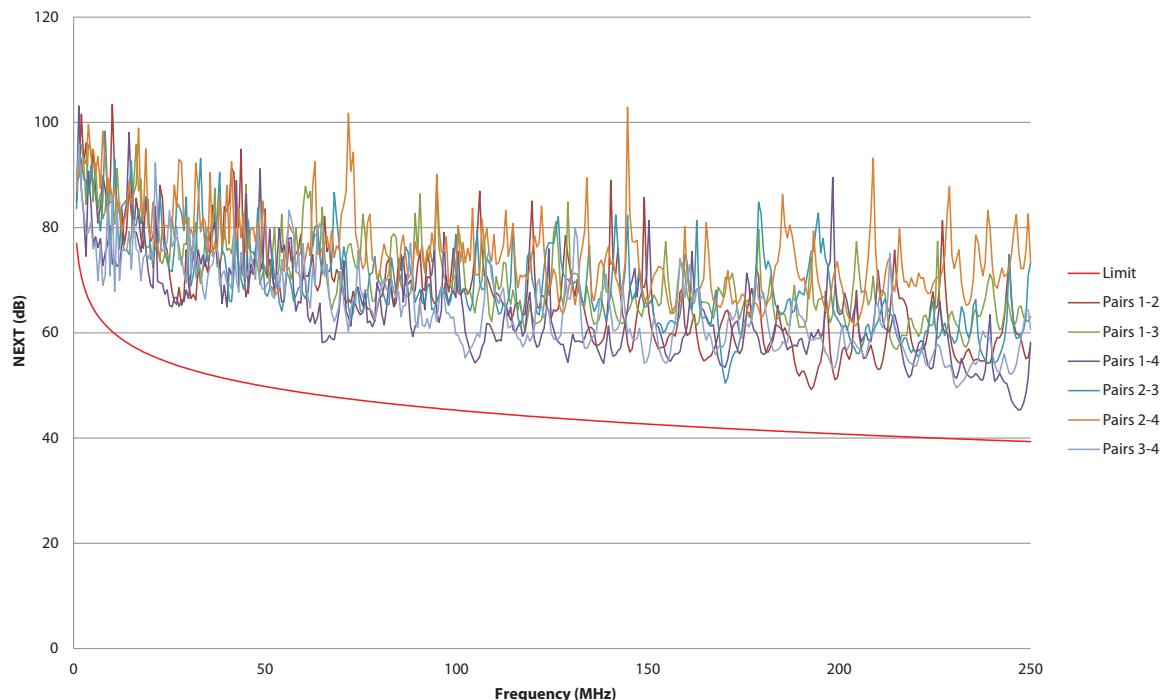


## Excel Category 6 Typical Performance Charts

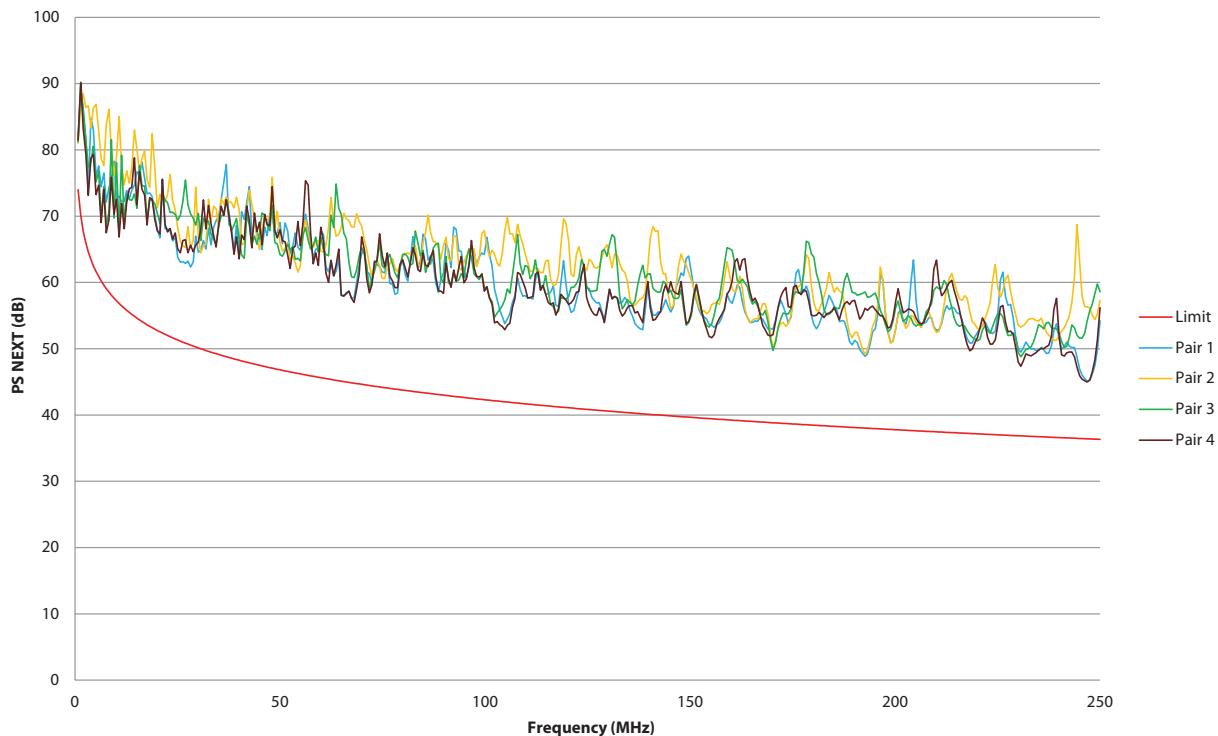
### 100-071 Excel Category 6 U/UTP LSOH Cable

S2

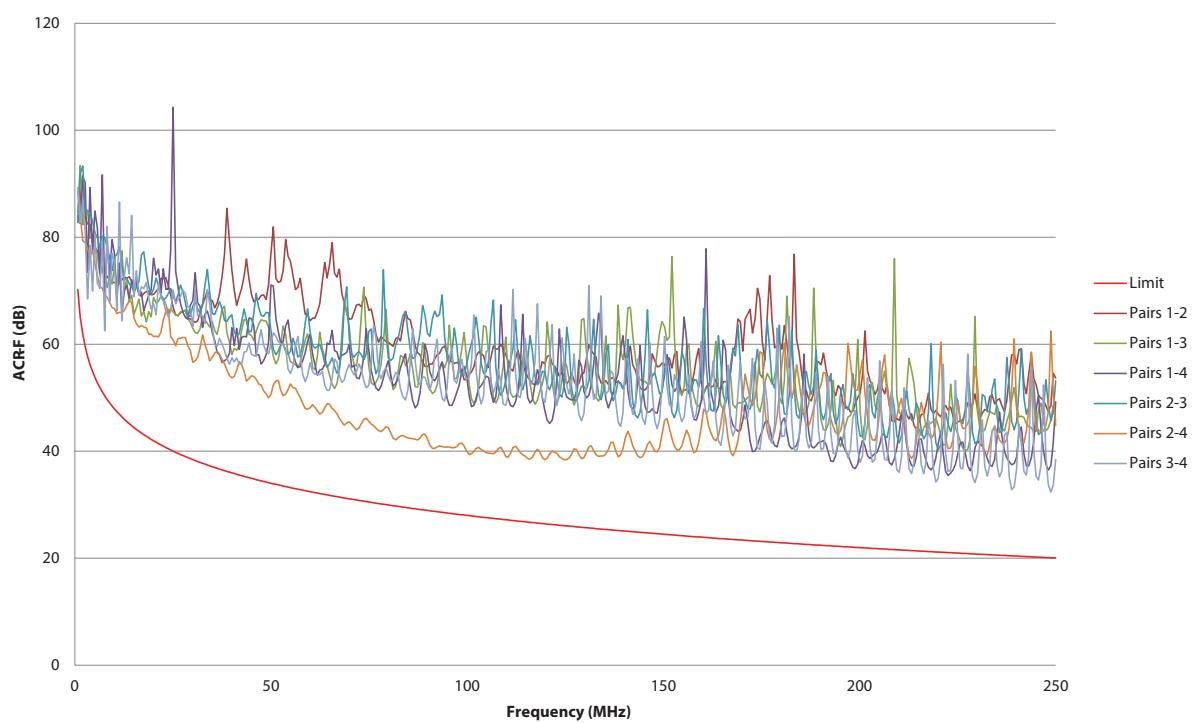
The following graphs show full frequency sweep cable tests carried out on a Network Analyser with cable adapters. The limits required for cable defined in IEC 61156 are indicated by red lines (—). IEC 61156 is the cable standard referenced in ISO/IEC 11801:2002. The test is of a 100m length of cable without connecting hardware (jacks, modules or patch panels) and the broader the gap between the red "limit line" and the standard "under test line" the better the performance of the product under test. This 'gap' is often referred to as headroom and indicates performance above that required by the standard.

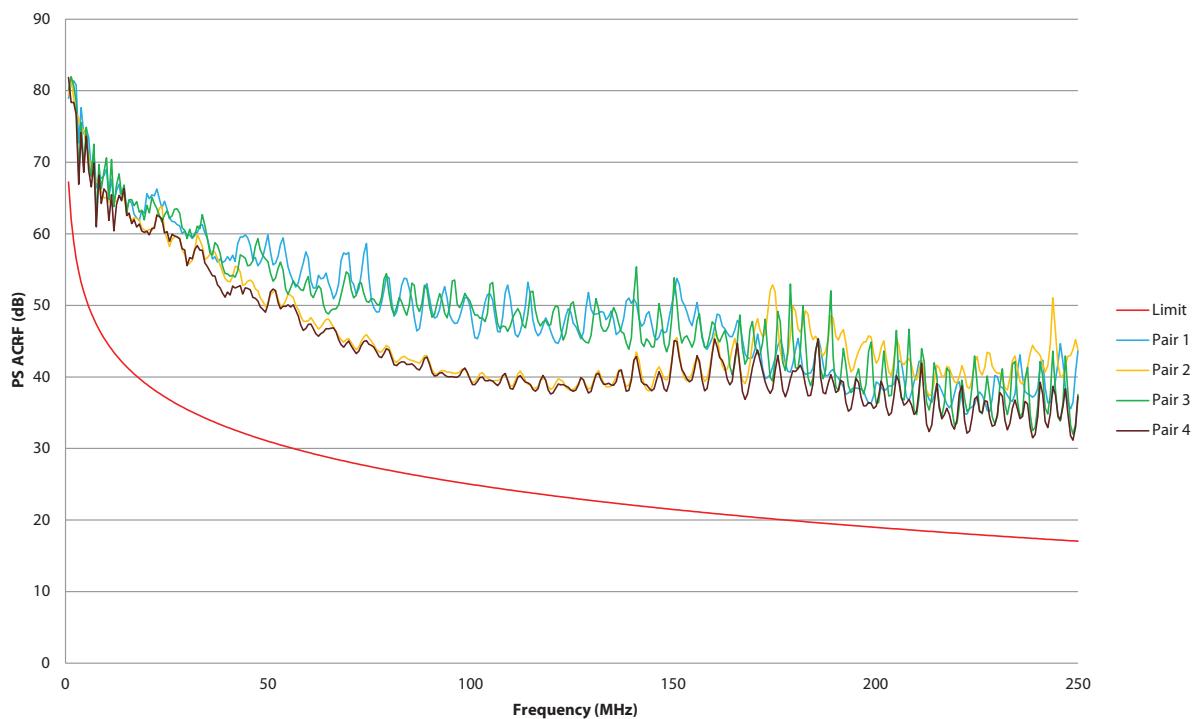
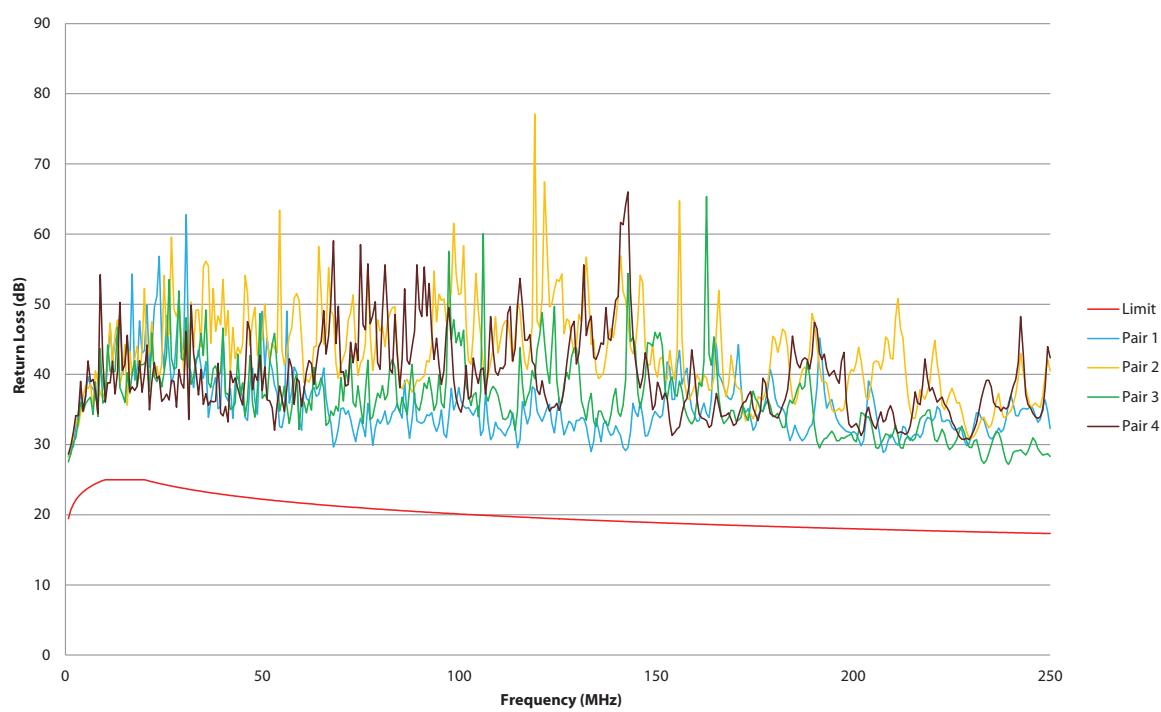
**Insertion Loss****NEXT**

### Power Sum NEXT

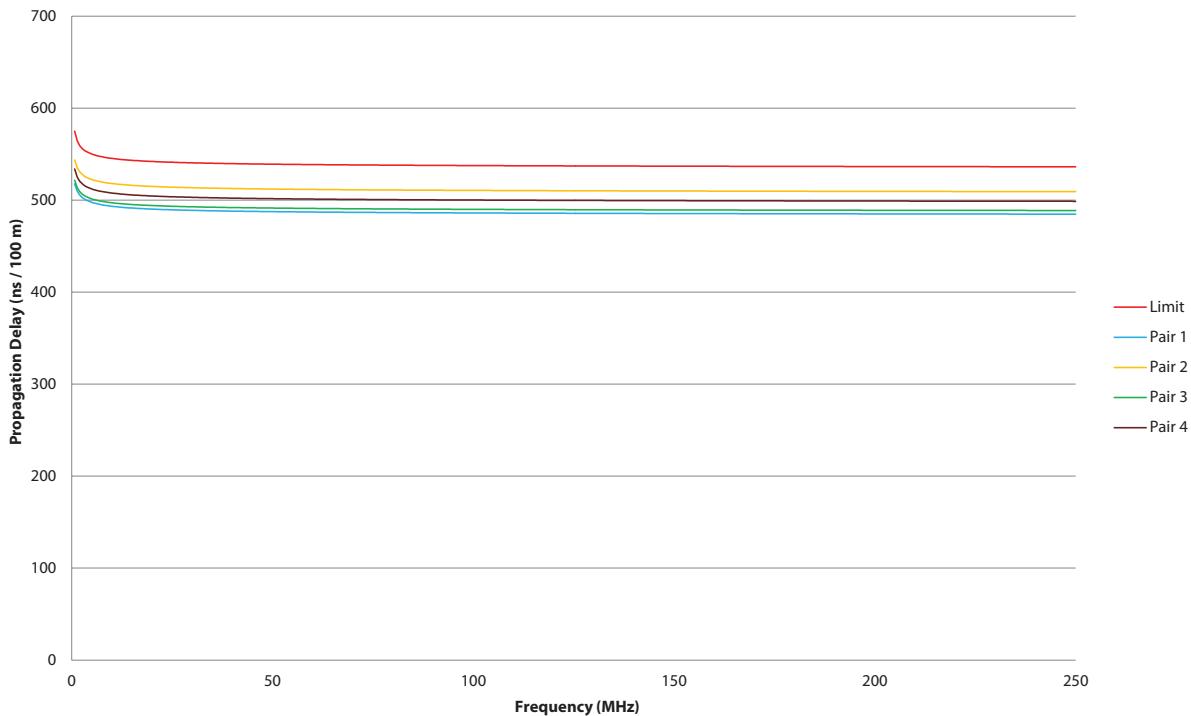


### ACR-F

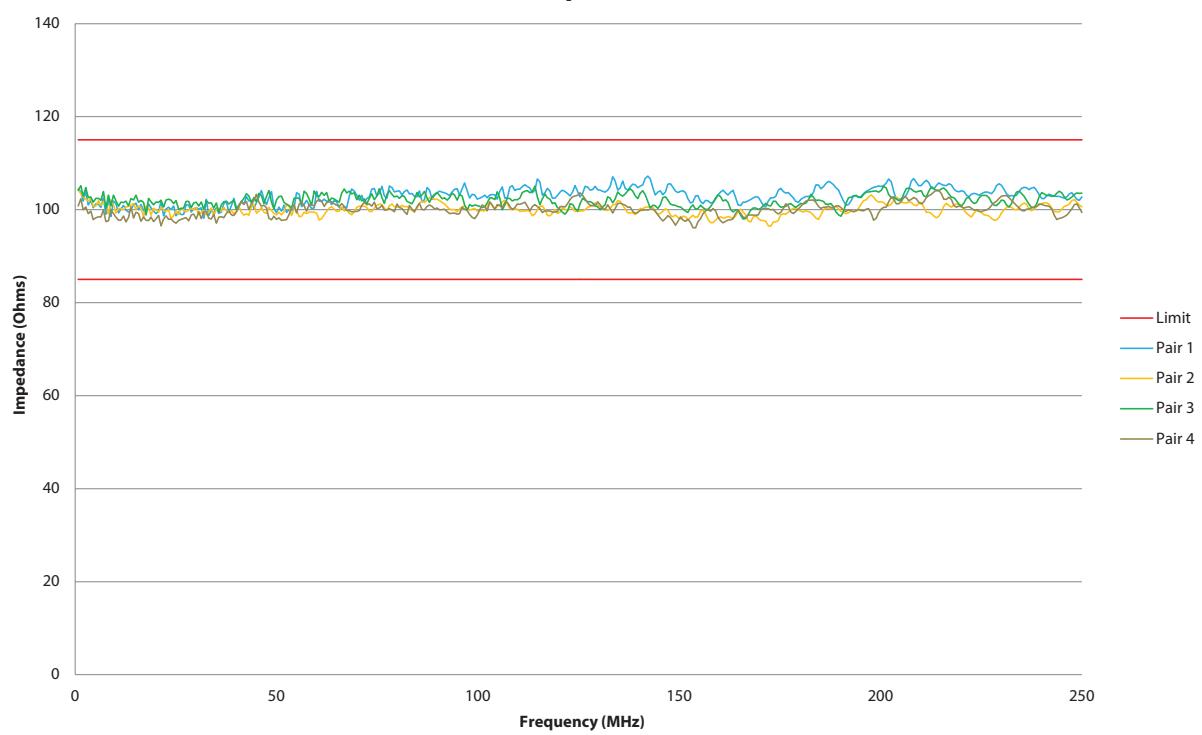


**Power Sum ACRF****Return Loss**

### Propagation Delay



### Impedance





## Excel Patch Panel - Product Selector

The Excel range offers a broad choice of PCB Board Patch Panel designs

S2

Patch Panels		Rear management tray	Enhanced Slide Label System	Cage nuts and 1-96 label kit included	25 Year Warranty available
Excel Category 6 Unscreened P/N <a href="#">100-304</a> 24 port - Black P/N <a href="#">100-306</a> 48 port - Black		✓		✓	✓
Excel Category 6 Unscreened Right Angle Panel P/N <a href="#">100-302</a> 24 port - Black P/N <a href="#">100-394</a> 48 port - Black		✓		✓	✓
Excel Plus Category 6 Unscreened P/N <a href="#">100-372</a> 24 port - Black P/N <a href="#">100-380</a> 48 port - Black			✓	✓	✓
Excel Plus Category 6 Unscreened Modular Panel - Loaded P/N <a href="#">100-015</a> 24 port - Black		✓			✓
Excel Category 6 Screened P/N <a href="#">100-013</a> 24 port - Black		✓		✓	✓
Excel Category 5e Unscreened P/N <a href="#">100-720</a> 16 port - Black P/N <a href="#">100-726</a> 24 port - Black P/N <a href="#">100-722</a> 32 port - Black P/N <a href="#">100-728</a> 48 port - Black				✓	✓
Excel Category 5e Unscreened Through Coupler P/N <a href="#">100-309</a> 24 port - Black				✓	✓
Excel Category 5e Unscreened P/N <a href="#">100-450</a> 24 port - Blue P/N <a href="#">100-451</a> 24 port - Red P/N <a href="#">100-452</a> 24 port - Green P/N <a href="#">100-453</a> 48 port - Blue P/N <a href="#">100-454</a> 48 port - Red P/N <a href="#">100-455</a> 48 port - Green				✓	✓
Excel Category 5e Unscreened P/N <a href="#">100-470</a> 24 port - Black P/N <a href="#">100-480</a> 48 port - Black			✓	✓	✓
Excel Category 5e Unscreened Right Angle Panel P/N <a href="#">100-460</a> 24 port - Black P/N <a href="#">100-497</a> 48 port - Black		✓		✓	✓
Excel Plus Category 5e Unscreened Right Angle Panel P/N <a href="#">100-490</a> 24 port - Black		✓	✓	✓	✓
Excel Category 5e Screened Right Angle Panel P/N <a href="#">100-736</a> 24 port - Black		✓		✓	✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of [www.excel-networking.com](http://www.excel-networking.com)

# Excel Modular Panel - Product Selector

The Excel Modular Panel range is compatible with a range of Keystone style jacks

S2



Patch Panels							
Excel 16 Port Unloaded Keystone Patch Panel Frame - Black	Excel 24 Port Unloaded Keystone Patch Panel Frame - Black	Excel 16 Port Unloaded Keystone Patch Panel Frame - Chrome	Excel 24 Port Unloaded Keystone Patch Panel Frame - Chrome	Excel 24 Port Unloaded Keystone Angled Patch Panel Frame - Black	Excel 24 Port Unloaded Keystone Angled Patch Panel Frame - Chrome	Excel 24-port Keystone V Patch Panel Frame, Black	Excel 24-port Keystone Patch Panel Frame, 0.5U
P/N <a href="#">100-025</a>	P/N <a href="#">100-026</a>	P/N <a href="#">100-027</a>	P/N <a href="#">100-028</a>	P/N <a href="#">100-023</a>	P/N <a href="#">100-024</a>	P/N <a href="#">100-040</a>	P/N <a href="#">100-041</a>
<b>Modules</b>							
Excel Angled Butterfly Keystone Jack - Toolless P/N <a href="#">100-185</a> Chrome - Screened - Category 6 <sub>A</sub> P/N <a href="#">100-213</a> Black - Unscreened - Category 6 P/N <a href="#">100-214</a> Chrome - Screened - Category 6					✓	✓	
Excel Butterfly Keystone Jack - Toolless P/N <a href="#">100-181</a> Chrome Low Profile Screened - Category 6 <sub>A</sub> P/N <a href="#">100-182-WT</a> White Low Profile Unscreened - Category 6 <sub>A</sub> P/N <a href="#">100-182-BK</a> Black Low Profile Unscreened - Category 6 <sub>A</sub> P/N <a href="#">100-180</a> Chrome - Screened - Category 6 <sub>A</sub> P/N <a href="#">100-210</a> Chrome - Screened - Category 6 P/N <a href="#">100-215-WT</a> White Low Profile Unscreened - Category 6 P/N <a href="#">100-215-BK</a> Black Low Profile Unscreened - Category 6 P/N <a href="#">100-906</a> Chrome - Screened - Category 5e P/N <a href="#">100-202-WT</a> White Low Profile Unscreened - Category 5e P/N <a href="#">100-202-BK</a> Black Low Profile Unscreened - Category 5e		✓	✓	✓	✓	✓	✓
Excel Unscreamed Keystone Jack IDC P/N <a href="#">100-156</a> White - Unscreened - Category 6 <sub>A</sub> P/N <a href="#">100-156-BK</a> Black - Unscreened - Category 6 <sub>A</sub> P/N <a href="#">100-011</a> White - Unscreened - Category 6 P/N <a href="#">100-011-BK</a> Black - Unscreened - Category 6 P/N <a href="#">100-010</a> White - Unscreened - Category 5e P/N <a href="#">100-010-BK</a> Black - Unscreened - Category 5e		✓	✓	✓	✓		✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of [www.excel-networking.com](http://www.excel-networking.com)



## Excel Mounting Hardware - Product Selector

Excel offers a range of Keystone Jacks with compatible straight or angled shutters and faceplate mounting options

S2



### Shutter

#### Euromod 25 x 50 mm

#### 6c

#### Excel Office

##### Excel White Keystone Shutter

P/N 100-014



##### Excel Black Keystone Shutter

P/N 100-014-BK



##### Excel White Angled Shutter

P/N 100-175



##### Excel Black Angled Shutter

P/N 100-175-BK



##### Excel White Angled Shutter

P/N 100-020



##### Excel White Keystone 6c Shutter

P/N 100-018



##### Excel White Angled 6c Shutter

P/N 100-022



##### Excel Office Angled Shutters

P/N 100-280 &amp; 100-280-GE



### Keystone

#### Excel Category 6<sub>A</sub> Screened Keystone Toolless Jack

P/N [100-180](#) - Chrome

#### Euromod 25 x 50 mm

✓

#### Excel Category 6<sub>A</sub> Low Profile Screened Keystone Toolless Jack

P/N [100-181](#) - Chrome

#### Euromod 25 x 50 mm

✓

#### Excel Category 6<sub>A</sub> Low Profile Unscreened Keystone Toolless Jack

P/N [100-182-WT](#) - WhiteP/N [100-182-BK](#) - Black

#### Euromod 25 x 50 mm

✓

#### Excel Category 6<sub>A</sub> Unscreened Keystone Jack

P/N [100-156](#) - WhiteP/N [100-156-BK](#) - Black

#### Euromod 25 x 50 mm

✓

#### Excel Category 6 Screened Keystone Jack

P/N [100-210](#) - Chrome

#### Euromod 25 x 50 mm

✓

#### Excel Category 6 Unscreened Keystone Jack

P/N [100-011](#) - WhiteP/N [100-011-BK](#) - Black

#### Euromod 25 x 50 mm

✓

#### Excel Category 6 Low Profile Unscreened Keystone Toolless Jack

P/N [100-215-WT](#) - WhiteP/N [100-215-BK](#) - Black

#### Euromod 25 x 50 mm

✓

#### Excel Category 5e Screened Keystone Toolless Jack

P/N [100-906](#) - Chrome

#### Euromod 25 x 50 mm

✓

#### Excel Category 5e Low Profile Unscreened Keystone Toolless Jack

P/N [100-202-WT](#) - WhiteP/N [100-202-BK](#) - Black

#### Euromod 25 x 50 mm

✓

#### Excel Category 5e Unscreened Keystone Jack

P/N [100-010](#) - WhiteP/N [100-010-BK](#) - Black

#### Euromod 25 x 50 mm

✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of [www.excel-networking.com](http://www.excel-networking.com)

# Excel Mounting Hardware - Product Selector Modules - Euromod

S2



		Face Plate					
		Excel Single Gang Bevelled	Excel Single Gang	Excel Double Gang Bevelled	Excel Double Gang	Excel Office Single Gang c/w 2 half blanks	Excel Office Double Gang c/w 2 half blanks
		P/N <a href="#">100-712</a>	P/N <a href="#">100-714</a>	P/N <a href="#">100-716</a>	P/N <a href="#">100-718</a>	P/N <a href="#">100-270</a>	P/N <a href="#">100-271</a>
<b>Module</b>							
Excel Category 6 Unscreened P/N <a href="#">100-300</a> - White P/N <a href="#">100-298</a> - Black		✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Excel Category 6 Unscreened Low Profile P/N <a href="#">100-366</a> - White			✓	✓	✓	✓	
Excel Category 5e Unscreened P/N <a href="#">100-700</a> - White P/N <a href="#">100-730</a> - Blue P/N <a href="#">100-731</a> - Red P/N <a href="#">100-732</a> - Green		✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Excel Category 5e Unscreened Low Profile P/N <a href="#">100-760</a> - White P/N <a href="#">100-763</a> - Black P/N <a href="#">100-737</a> - Blue P/N <a href="#">100-738</a> - Red P/N <a href="#">100-739</a> - Green			✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Excel Category 5e Screened P/N <a href="#">100-706</a> - White			✓	✓	✓	✓	
Excel Voice Modules Secondary - Euro Style P/N <a href="#">100-781</a> - White PABX - Euro Style P/N <a href="#">100-783</a> - White PSTN - Euro Style P/N <a href="#">100-785</a> - White PSTN - Euro Style, Left Hand Polarised P/N <a href="#">100-796</a> - White			✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	
Excel Office Category 6 Unscreened Low Profile P/N <a href="#">100-276</a> - White						✓	✓
Excel Office Category 5e Unscreened Low Profile P/N <a href="#">100-275</a> - White						✓	✓

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## Excel Mounting Hardware - Product Selector Modules - 6c

S2



Module	Face Plate	
	Excel Single Gang 6c Faceplate P/N <a href="#">100-670</a>	Excel Double Gang 6c Faceplate P/N <a href="#">100-671</a>
Excel Category 6 Unscreened RJ45 Module P/N <a href="#">100-301</a> - White		✓
Excel Category 5e Unscreened RJ45 Modules P/N <a href="#">100-758</a> - White P/N 100-759 - Black P/N <a href="#">100-733</a> - Blue P/N <a href="#">100-734</a> - Red P/N 100-735 - Green		✓ ✓ ✓ ✓ ✓ ✓
Excel Voice Module Secondary - 6c Style <a href="#">100-789</a> - White		✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of [www.excel-networking.com](http://www.excel-networking.com)

# Excel Mounting Hardware - Faceplate Product Selector



S2

Shutter							
Euromod 25 x 50 mm				6c		Excel Office	
Excel White Keystone Shutter	Excel Black Keystone Shutter	Excel White Angled Shutter	Excel White Angled Shutter	Excel White Keystone 6c Shutter	Excel White Angled 6c Shutter	Excel Office White Angled Shutter	Excel Office grey Angled Shutter
P/N <a href="#">100-014</a>	P/N <a href="#">100-014-BK</a>	P/N <a href="#">100-175</a>	P/N <a href="#">100-020</a>	P/N <a href="#">100-018</a>	P/N <a href="#">100-022</a>	P/N <a href="#">100-280</a>	P/N <a href="#">100-280-GE</a>
<b>Face Plate</b>							
Excel Single Gang Bevelled Faceplate P/N <a href="#">100-712</a>		✓	✓	✓	✓		✓
Excel Single Gang Flat Faceplate P/N <a href="#">100-714</a>		✓	✓	✓	✓		✓
Excel Double Gang Bevelled Faceplate P/N <a href="#">100-716</a>		✓	✓	✓	✓		✓
Excel Double Gang Faceplate P/N <a href="#">100-718</a>		✓	✓	✓	✓		✓
Excel Single Gang 6c Faceplate P/N <a href="#">100-670</a>					✓	✓	
Excel Double Gang 6c Faceplate P/N <a href="#">100-671</a>					✓	✓	
Excel Office Single Gang Faceplate c/w 2 half blanks P/N <a href="#">100-270</a>			✓				✓
Excel Office Double Gang Faceplate c/w 2 half blanks P/N <a href="#">100-271</a>			✓				✓
Excel Office Single Gang Faceplate c/w 2 half blanks - grey P/N <a href="#">100-270-GE</a>		✓		✓	✓		✓
Excel Office Double Gang Faceplate c/w 2 half blanks - grey P/N <a href="#">100-271-GE</a>		✓		✓	✓		✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of [www.excel-networking.com](http://www.excel-networking.com)

S2



# Excel Third Party Verification

## Section 3

S3

### In this Section:

[What is Third Party Verification?](#)

[What's the difference between Component and Channel verification?](#)

[Who is Delta?](#)

[Excel Third Party Verification](#)

[Verification Certificates](#)

### Pages

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### What is Third Party Verification?

Third party verifications are an independent 'tick in the box', verifying either a product or a set of products' compliance with a particular standard.

Excel has invested in such test and verification programmes for over 15 years, working closely with laboratories such as Delta and 3P based in Denmark, and ETL in America.

S3

### What's the difference between Component and Channel verification?

Excel Category 6 and Category 6<sub>A</sub> systems are amongst a handful in the industry with both channel and component verification.

In both cases, products are provided to the laboratory for testing to ISO, EN & TIA cabling standards. Within these standards documents are performance requirements for both a channel, as found in most cabling installations, and for the components, which make up these channels.

So, for example, a manufacturer can provide the lab with a number of individual components – cable, keystone, patch panel, patch cord – and request that these be tested in isolation against the requirements of the standard. This is component level certification.

Alternatively the manufacturer may provide a set of these components terminated in their factory to a 4 connector channel model as typically found in the field. A review of the market will show that a reasonable number of cabling system manufacturers can provide channel compliance certificates. Channel compliance is an easier certificate to gain, as manufacturers can 'tweak' the performance of certain components to compensate for poorer performance elsewhere in the channel. For example, a cable could be designed to perform well above the standard to compensate for a keystone jack that does not meet, or marginally meets the required specification.

With component certification there is no hiding place. Each product is tested to meet the standard and this really is the ultimate performance test for a manufacturer looking to promote third party verification as a key feature of its systems' performance and quality standards.

### Who is Delta?

EC VERIFIED from Delta is the ultimate independent mark of global approval for cables and connecting hardware. It guarantees that the products approved by Delta as an independent third party testing laboratory have been tested to all international relevant standards in the most exacting way, under rigorous control, and with regular inspection of the manufacturer's production quality. Some of Europe's most experienced engineers and technicians work on the products in the best equipped modern laboratories. It stands for undisputed world-wide quality assurance.

# Excel Third Party Verification

Standards compliance and system performance are core to the Excel brand values. To support this Excel works closely with third party test laboratories such as Delta, ETL, and 3P.

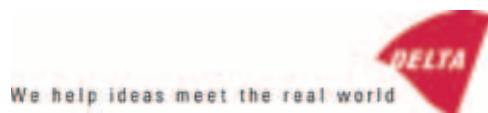
Please note that the majority of certificates are issued annually, our website has all the current and new certificates updated on a regular basis. Please visit [www.excel-networking.com](http://www.excel-networking.com)

Enclosed are copies of our current 3rd party verification, references for which are below:

<u><a href="#">Excel Category 7<sub>A</sub> Product Range</a></u>		
Laboratory	Ref No	Compliance
Delta	2014-408	Category 7 <sub>A</sub> screened cable (S/FTP) - LSOH
<u><a href="#">Excel Category 6<sub>A</sub> Product Range</a></u>		
Delta	2014-333	Class E <sub>A</sub> screened 4 connector channel
Delta	2014-332	Class E <sub>A</sub> screened 3 connector permanent link
Delta	2014-124A	Category 6 <sub>A</sub> screened cable (F/FTP) S-Foil - LSOH
Delta	2014-125A	Category 6 <sub>A</sub> screened cable (U/FTP) S-Foil - LSOH
Delta	2014-215	Category 6 <sub>A</sub> unscreened cable (U/UTP) - LSOH
Delta	2014-130	Category 6 <sub>A</sub> screened patch leads (F/FTP) - LSOH
Delta	2014-313	Category 6 <sub>A</sub> screened patch leads (S/FTP) - LSOH
Delta	2014-302	Category 6 <sub>A</sub> screened angled toolless keystone and patch panel frame
Delta	2014-163	Category 6 <sub>A</sub> screened toolless keystone jack - standard
Delta	2014-200	Category 6 <sub>A</sub> screened toolless keystone jack - low profile
Delta	2014-355	Category 6 <sub>A</sub> unscreened toolless keystone jack - low profile
Delta	2014-428	Category 6 <sub>A</sub> unscreened keystone jack and patch panel frame
<u><a href="#">Excel Category 6 Product Range</a></u>		
Delta	2014-323	Class E unscreened 4 connector channel
Delta	2014-322	Class E unscreened 4 connector channel
Delta	2014-321	Class E unscreened 6 connector channel
ETL	3188083CRT-001	Category 6 unscreened 6 connector channel
Delta	2014-541	Category 6 screened cable (F/UTP) - LSOH
ETL	3162833CRT-002b	Category 6 screened cable (F/UTP) - 23AWG - LSOH
Delta	2014-326	Category 6 unscreened cable (U/UTP) - LSOH
ETL	100738055CRT-001h	Category 6 unscreened cable (U/UTP) - LSOH
Delta	2014-593	Category 6 unscreened cable (U/UTP) - 24AWG - PVC
Delta	2014-325	Category 6 unscreened cable (U/UTP) - 23AWG - PVC
ETL	3019559CRT-003b	Category 6 unscreened cable (U/UTP) - 23AWG - PVC
Delta	2015-018	Category 6 screened patch leads (F/UTP) - LSOH
Delta	2014-161	Category 6 unscreened patch leads (U/UTP) - LSOH
ETL	3185574CRT-001	Category 6 unscreened patch leads (U/UTP) - LSOH
ETL	3119086CRT-002	Category 6 unscreened patch leads (U/UTP) - LSOH
Delta	2014-162	Category 6 screened angled toolless keystone jack
Delta	2014-365	Category 6 screened toolless keystone jack
ETL	3188590CRT-001b	Category 6 screened toolless keystone jack
Delta	2014-429	Category 6 unscreened toolless keystone jack - low profile
ETL	3187559CRT-001	Category 6 unscreened keystone jack outlet
3P	3P Excel Identification 100-011/100-011BK	Category 6 unscreened keystone jack outlets
<u><a href="#">Excel Category 5e Product Range</a></u>		
Delta	2015-007	Category 5e unscreened cable (U/UTP) - LSOH
Delta	2014-199	Category 5e unscreened cable (U/UTP) - PVC
ETL	3119075CRT-001	Category 5e unscreened cable (U/UTP) - PVC
ETL	3187166CRT-002	Category 5e unscreened cable (U/UTP)
Delta	2014-310	Category 5e screened patch leads (F/UTP) - LSOH
Delta	2014-160	Category 5e unscreened patch leads (U/UTP) - LSOH
ETL	3188590CRT-001a	Category 5e screened toolless keystone jack
ETL	101037957CRT-001	Category 5e unscreened toolless keystone jack - low profile
3P	Excel Identification 100-010	Category 5e unscreened keystone jack outlet



S3



# Compliance Statement

No. 2015-018

## Data communication cords, Category 6

Company  
Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Check** - is the certificate issued in the name of the system you are purchasing.

### Product description

Screened Category 6 RJ45 cords (equipment, patch, and work area) characterised up to 250 MHz

Product identification  
100-4XX Excel Category 6 F/UTP Screened Patch Leads

**Check** - is the Part Code shown the part you are purchasing.

### Generic cabling and cabling components standard - Category 6 balanced cord requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

**Check** - has the product been tested to the current & relevant standards.

Technical report  
DELTA-T210091, DANAK-19/14918

EC Cabling product ID  
5604

CS valid until  
14 January 2016

**Check** - is certificate valid.

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

**Check** - Regular maintenance schedules ensure ongoing Third Party "Check Ups"

Hørsholm, 14 January 2015

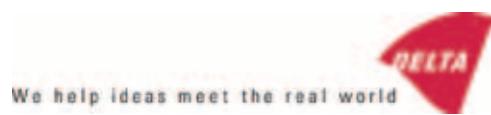
Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

DELT A  
Ventighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





S3

# Compliance Statement

No. 2014-408

## Data communication cable, Category 7A

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Screened cable (S/FTP) characterised up to 1000 MHz  
Horizontal floor wiring cable, 100 Ω  
4 individually foil screened twisted pairs with overall braid screen  
Flame retardant, halogen free

**Product identification**

100-910  
100-912

**Generic cabling and cabling components standards - Category 7A cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-9-1:2012

**Standards for flammability, halogen acidity, and smoke performance**

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

**Technical report**

DELTA-T209614, DANAK-19/14542

**DELTA product ID**

5570

**CS valid until**

2 October 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 2 October 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

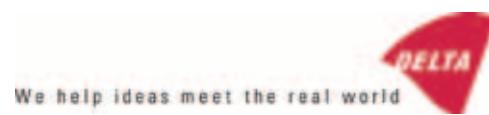
**DELTA**  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





S3



# Compliance Statement

No. 2014-333

## Screened Channel, Class EA

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Channel Identification (4 connector model)****Horizontal Cable:**

100-196 Excel Category 6A Screened F/FTP "S" Foil Cable LS0H

**Terminal Cord and Patch Cord:**

100-154 Excel Category 6A Screened F/FTP LS0H Patch Lead, Booted, 5m, Grey

100-148 Excel Category 6A Screened F/FTP LS0H Patch Lead, Booted, 1m, Grey

**Consolidation Point Cable and Equipment Cord:**100-133 Excel Category 6A Solid Core (F/FTP) screened harness/switch link leads – 30m  
(cut to length and jack added)**Telecommunication Outlet and Patch Panel Jacks:**

100-181 Excel Category 6A Low Profile Screened Keystone Jack - Toolless

**Generic cabling standards - Class EA Channel requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007, including amendment A1:2010
- ANSI/TIA-568-C.2:2009

including all channel alien crosstalk parameters (PS ANEXT and PS AACR-F)

**Technical report**

DELTA-T208190-05, DANAK-19/14253

**EC Cabling product ID**

5347

**CS valid until**

1 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 29 July 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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S3

# Compliance Statement

No. 2014-332

## Screened Permanent Link, Class EA

**Company**  
Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Permanent Link Identification (3 connector model)

#### Horizontal Cable:

100-196 Excel Category 6A Screened F/FTP "S" Foil Cable LS0H

#### Consolidation Point Cable:

100-133 Excel Category 6A Solid Core (F/FTP) screened harness/switch link leads – 30m  
(cut to length and jack added)

#### Telecommunication Outlet, CP, and Patch Panel Jacks:

100-181 Excel Category 6A Low Profile Screened Keystone Jack – Toolless

### Generic cabling standards - Class EA Permanent Link requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007, including amendment A1:2010
- ANSI/TIA-568-C.2:2009

#### Technical report

DELTA-T208190-04, DANAK-19/14207

#### EC Cabling product ID

5673

#### CS valid until

1 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 29 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

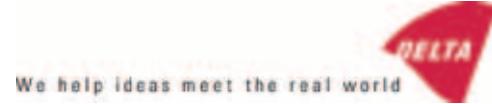
**DELTA**  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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S3



# Compliance Statement

No. 2014-124A

## Data communication cable, Category 6A

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Screened cable (F/FTP) characterised up to 500 MHz  
Horizontal floor wiring cable, 100 Ω  
4 and 2x4 individually foil screen twisted pairs with overall foil screen  
Flame retardant, halogen free

**Product identification**

100-196 Excel Category 6A F/FTP "S" Foil Cable LS0H  
100-197 Excel Dual Category 6A F/FTP "S" Foil Cable LS0H

**Generic cabling and cabling components standards - Category 6A cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-10-1:2012
- ANSI/TIA-568-C.2:2009

**Standards for flammability, halogen acidity, and smoke performance**

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

**Technical report**

DELTA-T207972-01, DANAK-19/13993

**DELTA product ID**

5509, 5532

**CS valid until**

25 March 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis. This certificate has been revised.

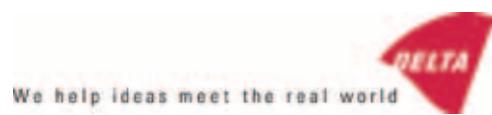
Hørsholm, 7 July 2014

  
Lars Lindskov Pedersen  
Test Manager  
Claude Videt  
Project Manager**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





# Compliance Statement

No. 2014-125A

## Data communication cable, Category 6A

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Product description

Screened cable (U/FTP) characterised up to 500 MHz  
Horizontal floor wiring cable, 100 Ω  
4 and 2x4 twisted pairs with individually foil screen  
Flame retardant, halogen free

### Product identification

100-191 Excel Category 6A U/FTP "S" Foil Cable LS0H  
100-194 Excel Dual Category 6A U/FTP "S" Foil cable LS0H

### Generic cabling and cabling components standards - Category 6A cable requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-10-1:2012
- ANSI/TIA-568-C.2:2009

### Standards for flammability, halogen acidity, and smoke performance

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

### Technical report

DELTA-T207972-02, DANAK-19/13994

### DELTA product ID

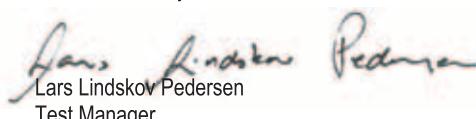
5510, 5533

### CS valid until

25 March 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis. This certificate has been revised.

Hørsholm, 7 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

### DELTA

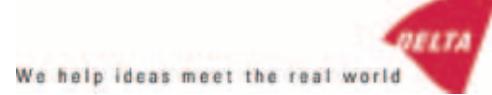
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2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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S3



# Compliance Statement

No. 2014-215

## Data communication cable, Category 6A

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened cable (U/UTP) characterised up to 500 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, halogen free

**Product identification**

100-189 Excel Category 6A Unscreened U/UTP Cable

**Generic cabling and cabling components standards - Category 6A cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
  - IEC 61156-5:2009 (Ed. 2.0)
  - EN 50173-1:2011
  - EN 50173-2:2007 including amendment A1:2010
  - EN 50288-11-1:2012
  - ANSI/TIA-568-C.2:2009
- including all cable alien crosstalk parameters (PS ANEXT and PS AACR-F)

**Standards for flammability, halogen acidity, and smoke performance**

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

**Technical report**

DELTA-T208253, DANAK-19/14126

**DELTA product ID**

5738

**CS valid until**

20 May 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 20 May 2014

Lars Lindskov Pedersen  
Test Manager

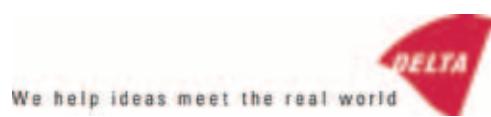
Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





# Compliance Statement

No. 2014-130

## Data communication cords, Category 6A

**Company**  
Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Product description

Screened Category 6A RJ45 cords (equipment, patch, and work area) characterised up to 500 MHz

### Product identification

Excel Category 6A Screened (F/FTP) Patch Lead

### Generic cabling and cabling components standard - Category 6A balanced cord requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

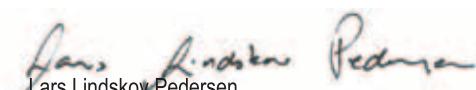
**Technical report**  
DELTA-T207832, DANAK-19/13960

**EC Cabling product ID**  
5524

**CS valid until**  
1 May 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 28 March 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

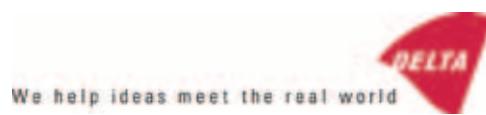
**DELTA**  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

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S3



## Compliance Statement

No. 2014-313

### Data communication cords, Category 6A

#### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

#### Product description

Screened Category 6A RJ45 cords (equipment, patch, and work area) characterised up to 500 MHz

#### Product identification

100-2\*\* Excel Category 6A S/FTP Patch Cord (\*\* denotes colour and length)

#### Generic cabling and cabling components standard - Category 6A balanced cord requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2;2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

#### Technical report

DELTA-T208521, DANAK-19/14310

#### EC Cabling product ID

5761

#### CS valid until

7 July 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 7 July 2014

Lars Lindskov Pedersen  
Test Manager

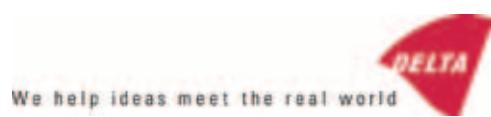
Claude Videt  
Project Manager

#### DELTA

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





# Compliance Statement

No. 2014-302

## Connecting Hardware, Category 6A

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Product description

Screened Category 6A RJ45 Jack and Patch Panel characterised up to 500 MHz, 100 Ω

### Product identification

Cat. 6A Jack. Part number: 100-185  
Cat. 6A Panel. Part number: 100-024

### Generic cabling and cabling components standards - Category 6A connector requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-51:2010
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

### Technical report

DELTA-T208497, DANAK-19/14290

### EC Cabling product ID

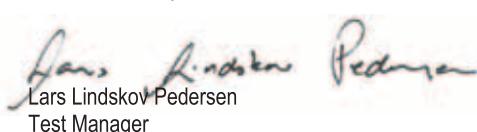
5400

### CS valid until

6 July 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 3 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

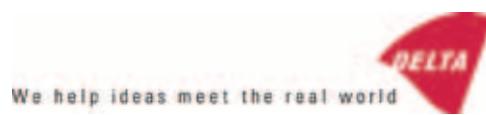
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Denmark

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S3



# Compliance Statement

No. 2014-163

## Connecting Hardware, Category 6A

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Screened Category 6A RJ45 Keystone Jack characterised up to 500 MHz, 100 Ω

**Product identification**

100-180

**Generic cabling and cabling components standards - Category 6A connector requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-51:2010
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

including all connector alien crosstalk parameters (PS ANEXT and PS AFEXT)

**Technical report**

DELTA-T208110-02, DANAK-19/14058

**EC Cabling product ID**

5028

**CS valid until**

24 April 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 24 April 2014

Lars Lindskov Pedersen  
Test Manager

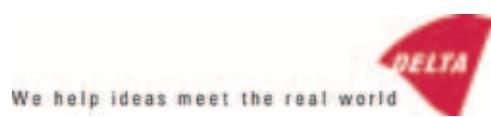
Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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# Compliance Statement

No. 2014-200

## Connecting Hardware, Category 6A

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

### Product description

Screened Category 6A RJ45 Jack characterised up to 500 MHz, 100 Ω

### Product identification

100-181

### Generic cabling and cabling components standards - Category 6A connector requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-51:2010
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

including all connector alien crosstalk parameters (PS ANEXT and PS AFEXT)

### Technical report

DELTA-T208219, DANAK-19/14114

### EC Cabling product ID

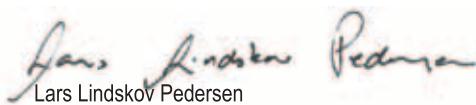
5648

### CS valid until

15 May 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 15 May 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

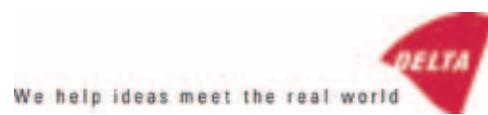
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Venlighedsvej 4  
2970 Hørsholm  
Denmark

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Fax +45 72 19 40 01  
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S3



# Compliance Statement

No. 2014-355

## Connecting Hardware, Category 6A

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Unscreened Category 6A RJ45 Jack and Patch Panel characterised up to 500 MHz, 100 Ω

**Product identification**

100-182-BK & 100-182-WT

**Generic cabling and cabling components standards - Category 6A connector requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-41:2010
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

including all connector alien crosstalk parameters (PS ANEXT and PS AFEXT)

**Technical report**

DELTA-T209171, DANAK-19/14398

**EC Cabling product ID**

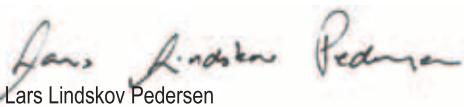
5672

**CS valid until**

13 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 13 August 2014

  
Lars Lindskov Pedersen

Test Manager

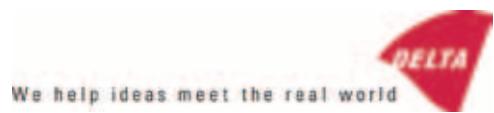
  
Claude Videt  
Project Manager

**DELT**A

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





S3

# Compliance Statement

No. 2014-428

## Connecting Hardware, Category 6A

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

### Product description

Unscreened Category 6A RJ45 Jack and Patch Panel characterised up to 500 MHz, 100 Ω

### Product identification

Cat. 6A Jack. |Part number: 100-156  
Cat. 6A Panel. |Part number: 100-026

### Generic cabling and cabling components standards - Category 6A connector requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-41:2010
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

including all connector alien crosstalk parameters (PS ANEXT and PS AFEXT)

### Technical report

DELTA-T209669-01, DANAK-19/14569

### EC Cabling product ID

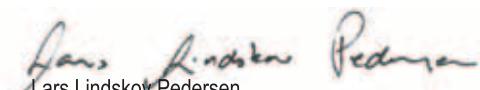
5257

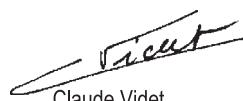
### CS valid until

10 October 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 10 October 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

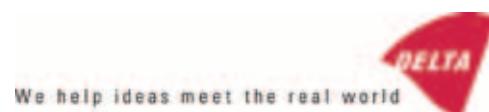
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Venlighedsvej 4  
2970 Hørsholm  
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S3



# Compliance Statement

No. 2014-323

## Unscreened Channel, Class E

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Channel Identification (4 connector model)****Horizontal Cable:**

100-071 Excel Category 6 unscreened (U/UTP) cable LS0H

**Telecommunication Outlet and Patch Panel Jacks:**

100-011 Excel Category 6 unscreened UTP Keystone Jack

**Consolidation Point Cable / Equipment Cord:**

100-367 Excel Category 6 solid core unscreened UTP patch lead LS0H, booted, cut to length and terminated with jack 100-011 (5 m / 2 m)

**Terminal Cord and Patch Cord:**

100-314 Excel Category 6 unscreened UTP patch lead LS0H, booted (5 m)

100-311 Excel Category 6 unscreened UTP patch lead LS0H, booted (2 m)

**Generic cabling standards - Class E Channel requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007, including amendment A1:2010
- ANSI/TIA-568-C.2:2009

**Technical report**

DELTA-T207291, DANAK-19/13592

**EC Cabling product ID**

5694

**CS valid until**

1 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

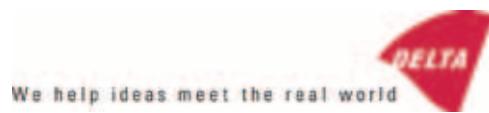
Hørsholm, 28 July 2014

  
Lars Lindskov Pedersen  
Test Manager  
Claude Videt  
Project Manager**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

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Fax +45 72 19 40 01  
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S3

# Compliance Statement

No. 2014-322

## Unscreened Channel, Class E

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Channel Identification (4 connector model)

#### Horizontal Cable:

100-071 Excel Category 6 unscreened (U/UTP) cable LS0H

#### Telecommunication Outlet and Patch Panel Jacks:

100-215 Excel Category 6 unscreened U/UTP Low Profile Toolless Keystone Jack, Butterfly Style

#### Consolidation Point Cable:

100-367 Excel Category 6 solid core unscreened UTP patch lead LS0H, booted, cut to length and terminated with jack 100-215

#### Terminal Cord and Patch Cord:

100-357 Excel Category 6 unscreened UTP patch lead LS0H, booted (4 m)

100-310 Excel Category 6 unscreened UTP patch lead LS0H, booted (1 m)

#### Equipment Cord:

100-312 Excel Category 6 unscreened UTP patch lead LS0H, booted (3 m), terminated with jack 100-215

### Generic cabling standards - Class E Channel requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007, including amendment A1:2010
- ANSI/TIA-568-C.2:2009

### Technical report

DELTA-T208190-02, DANAK-19/14205

### EC Cabling product ID

5140

### CS valid until

1 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 28 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

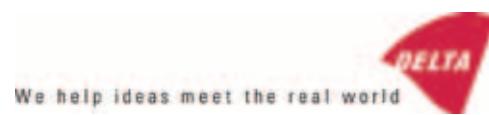
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Venlighedsvej 4  
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Denmark

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S3



# Compliance Statement

No. 2014-321

## Unscreened Channel, Class E

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Channel Identification (6 connector model)****Horizontal Cable:**

100-071 Excel Category 6 unshielded (U/UTP) cable LS0H

**Telecommunication Outlet and Patch Panel Jacks:**

100-215 Excel Category 6 unshielded U/UTP Low Profile Toolless Keystone Jack, Butterfly Style

**Consolidation Point Cables:**

100-310 Excel Category 6 unshielded UTP patch lead LS0H, booted (1 m), terminated with jack 100-215

100-312 Excel Category 6 unshielded UTP patch lead LS0H, booted (3 m), terminated with jack 100-215

**Patch Cords:**

100-310 Excel Category 6 unshielded UTP patch lead LS0H, booted (1 m), terminated with jack 100-215

**Terminal Cord / Equipment Cord:**

100-357 Excel Category 6 unshielded UTP patch lead LS0H, booted (4 m)

100-312 Excel Category 6 unshielded UTP patch lead LS0H, booted (3 m)

**Generic cabling standards – Class E Channel requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007, including amendment A1:2010
- ANSI/TIA-568-C.2:2009

**Technical report**

DELTA-T208190-01, DANAK-19/14204

**EC Cabling product ID**

5141

**CS valid until**

1 August 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 28 July 2014

  
Lars Lindskov Pedersen

Test Manager

  
Claude Videt

Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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Intertek



3933 US Route 11  
Cortland, New York 13045 USA  
Phone Number: (800) 345-3851  
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S3

### ETL Verified Certificate of Conformance Number: 3188083CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK  
Contact: Mr. Jason Rudge

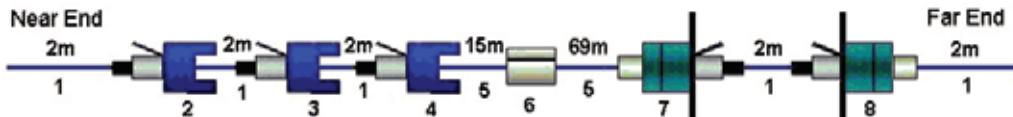
**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK  
Contact: Mr. Jason Rudge

**Verification/Report Number:** 3182868CRT-002

**Product Tested:**

6-Connectors Channel



Component ID	Manufacturer	Part Number	Description
1	Excel	100-3XX where "XX" denotes the color	Patch Cord
2	Excel	100-020	Keystone Jack
3	Excel	100-007	Keystone Jack
4	Excel	100-021	Keystone Jack
5	Excel	100-071	Horizontal Cable
6	Excel	100-200	110 Block
7	Excel	100-372 (24 Ports) and 100-380 (48 Ports)	Patch Panel
8	Excel	100-304 (24 Ports) and 100-306 (48 Ports)	Patch Panel

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 with the applicable electrical transmission characteristics

**Product(s) Literature May Include:** ETL Verified 6-Connector Channel to ANSI/TIA-568-B.2-1 Category 6, along with channel illustration, and parts numbers.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 8/24/2009

**Date Revised:** 7/20/2012

**Approved By:**

John Cash, Technician

Antoine Pelletier, Team Leader

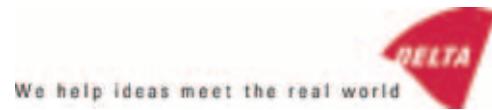
**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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S3



# Compliance Statement

No. 2014-541

## Data communication cable, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Screened cable (F/UTP) characterised up to 350 MHz\*  
Horizontal floor wiring cable, 100 Ω  
4 and 2x4 twisted pairs with overall foil screen  
Flame retardant, halogen free

**Product identification**

100-076 Excel Category 6 F/UTP Foil Cable LS0H  
100-077 Excel Dual Category 6 F/UTP Foil cable LS0H

**Generic cabling and cabling components standards - Category 6 cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-5-1:2013
- ANSI/TIA-568-C.2:2009

**Standards for flammability, halogen acidity, and smoke performance**

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

**Technical report**

DELTA-T209930, DANAK-19/14800

**DELTA product ID**

5444

**CS valid until**

5 December 2015

\*Transmission parameters comply with extended limits up to 350 MHz. This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 5 December 2014

  
Lars Lindskov Pedersen  
Test Manager  
Claude Videt  
Project Manager

DELTA  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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S3

## ETL Verified Certificate of Conformance Number: 3162833CRT-002b

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3162833CRT-002

**Product Tested:** 4 pair, 23 AWG, FTP, LSZH, Non-Plenum, Horizontal (solid) Cable.

**Model(s) and or Brand Name:** 100-073

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 1/14/2009

**Date Revised:** 12/28/2009

**Approved By:**

Kathy Heath, Program Coordinator

Antoine Pelletier, Engineer

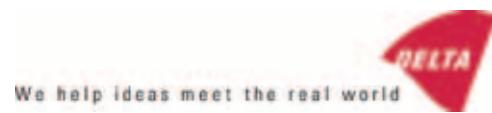
**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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S3



# Compliance Statement

No. 2014-326

## Data communication cable, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened cable (U/UTP) characterised up to 250 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, halogen free

**Product identification**

100-071

**Generic cabling and cabling components standards - Category 6 cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-6-1:2013
- ANSI/TIA-568-C.2:2009

**Standards for flammability, halogen acidity, and smoke performance**

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

**Technical report**

DELTA-T209036-02, DANAK-19/14347

**DELTA product ID**

5168

**CS valid until**

18 July 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 18 July 2014

  
Lars Lindskov Pedersen

Test Manager

  
Claude Videt

Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





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Cortland, New York 13045 USA  
Phone Number: (800) 345-3851  
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S3

### ETL Verified Certificate of Conformance Number: 100738055CRT-001h

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Simon Robinson

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Simon Robinson

**Verification/Report Number:** 100738055CRT-001d, 100738055CRT-001e and 100738055CRT-001f

**Product Tested:** 4 pair, 23 AWG, UTP, LSZH, Non-Plenum, Horizontal (solid) Cable.

**Model(s) and or Brand Name:** 100-071

**Standard(s)/Specification:** ANSI/TIA-568-C.2, ISO/IEC 11801 and EN 50173-1 Category 6 with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-C.2, ISO/IEC 11801 and EN 50173-1 Category 6.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 5/29/2012

**Approved By:**

John Cash, Technician

Antoine Pelletier, Team Leader

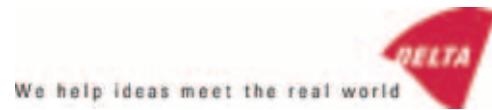
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S3



# Compliance Statement

No. 2014-593

## Data communication cable, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened cable (U/UTP) characterised up to 250 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, PVC jacket

**Product identification**

100-069

**Generic cabling and cabling components standards - Category 6 cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-6-1:2013
- ANSI/TIA-568-C.2:2009

**Standards for flame retardancy**

- IEC 60332-1-1:2004
- IEC 60332-1-2:2004

**Technical report**

DELTA-T210015, DANAK-19/14876

**DELTA product ID**

5317

**CS valid until**

22 December 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 22 December 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





# Compliance Statement

No. 2014-325

S3

## Data communication cable, Category 6

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

### Product description

Unscreened cable (U/UTP) characterised up to 250 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, PVC jacket

### Product identification

100-070

### Generic cabling and cabling components standards - Category 6 cable requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-6-1:2013
- ANSI/TIA-568-C.2:2009

### Standards for flame retardancy

- IEC 60332-1-1:2004
- IEC 60332-1-2:2004

### Technical report

DELTA-T209036-01, DANAK-19/14346

### DELTA product ID

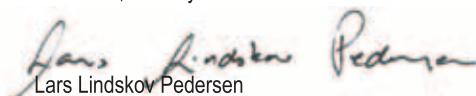
5167

### CS valid until

18 July 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 18 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

DELTA  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)



S3



3933 US Route 11  
Cortland, New York 13045 USA  
Phone Number: (800) 345-3851  
Fax Number: (607) 758-6637  
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### **ETL Verified Certificate of Conformance Number: 3019559CRT-003b**

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3019559-002

**Product Tested:** 4 pair, 23 AWG, UTP, CMR, Non-Plenum Riser, Horizontal (Solid) Cable.

**Model(s) and or Brand Name:** 100-070

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 10/1/2008

**Date Revised:** 12/28/2009

**Approved By:**

  
\_\_\_\_\_  
Kathy Heath, Program Coordinator

  
\_\_\_\_\_  
Antoine Pelletier, Engineer

**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

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S3

# Compliance Statement

No. 2015-018

## Data communication cords, Category 6

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

### Product description

Screened Category 6 RJ45 cords (equipment, patch, and work area) characterised up to 250 MHz

### Product identification

100-4XX Excel Category 6 F/UTP Screened Patch Leads

### Generic cabling and cabling components standard - Category 6 balanced cord requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

### Technical report

DELTA-T210091, DANAK-19/14918

### EC Cabling product ID

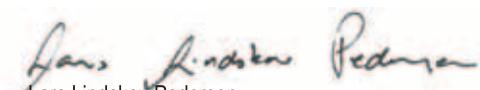
5604

### CS valid until

14 January 2016

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 14 January 2015

  
Lars Lindskov Pedersen

Test Manager

  
Claude Videt  
Project Manager

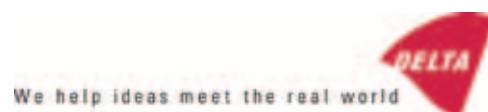
DELTA  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

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S3



# Compliance Statement

No. 2014-161

## Data communication cords, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened Category 6 RJ45 cords (equipment, patch, and work area) characterised up to 250 MHz

**Product identification**

100-3xx & 100-4xx (xx denotes the length and colour)

**Generic cabling and cabling components standard - Category 6 balanced cord requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

**Technical report**

DELTA-T208089-02, DANAK-19/14051

**EC Cabling product ID**

5373

**CS valid until**

19 April 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 15 April 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELT**A

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
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S3

### ETL Verified Certificate of Conformance Number: 3185574CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3048445

**Product Tested:** 4 pair, 24 AWG, UTP, CMR, Non-Plenum Riser, Patch Cord.

**Model(s) and or Brand Name:** Patch Cord 100-3XX (Length = 1 ft to 25 ft)

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 June 2002 with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6 June 2002.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 8/27/2009

**Date Revised:** 12/28/2009

**Approved By:**

Kathy Heath, Program Coordinator

Antoine Pelletier, Engineer

**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

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### **ETL Verified Certificate of Conformance Number: 3119086CRT-002**

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Andrew Percival

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Andrew Percival

**Verification/Report Number:** 3048445

**Product Tested:** 4 pair, 24 AWG, UTP, CMR, Non-Plenum Riser, Patch Cord.

**Model(s) and or Brand Name:** Patch Cord 100-3XX (XX Denotes Length .05 meter to 20 meter)

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 June 2002 with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6 June 2002.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 4/27/2007

**Date Revised:** 12/28/2009

**Approved By:**

\_\_\_\_\_  
Kathy Heath, Program Coordinator

\_\_\_\_\_  
Antoine Pelletier, Engineer

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# Compliance Statement

No. 2014-162

## Connecting Hardware, Category 6

**Company**  
Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Screened Angled Category 6 RJ45 Keystone Jack characterised up to 250 MHz, 100 Ω

**Product identification**  
100-214

**Generic cabling and cabling components standards - Category 6 connector requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-5:2010 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

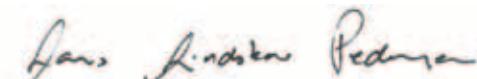
**Technical report**  
DELTA-T208110-01, DANAK-19/14057

**EC Cabling product ID**  
5056

**CS valid until**  
24 April 2015

This product has been tested by EC Cabling Group of DELTA and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 24 April 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

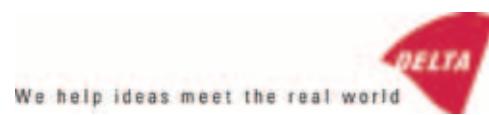
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2970 Hørsholm  
Denmark

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S3



# Compliance Statement

No. 2014-365

## Connecting Hardware, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

**Product description**

Excel Screened Category 6 RJ45 Tool-less Keystone Jack characterised up to 250 MHz, 100 Ω

**Product identification**

100-210

**Generic cabling and cabling components standards - Category 5e/6 connector requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-5:2010 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

**Technical report**

DELTA-T209229, DANAK-19/14436

**EC Cabling product ID**

5217

**CS valid until**

27 August 2015

This product has been tested by EC Cabling Group of DELTA and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 27 August 2014

  
Lars Lindskov Pedersen  
Test Manager  
Claude Videt  
Project Manager**DELT**A

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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S3

### ETL Verified Certificate of Conformance Number: 3188590CRT-001b

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3180796CRT-001h

**Product Tested:** Telecommunications Connecting Hardware

**Model(s) and or Brand Name:** Category 6 Shielded Jack part number 100-210

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 with the applicable electrical transmission characteristics

**Product package marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6 and the product model(s) and or brand name.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 9/15/2009

**Date Revised:** 12/28/2009

**Approved By:**

\_\_\_\_\_  
Kathy Heath, Program Coordinator

\_\_\_\_\_  
Antoine Pelletier, Engineer

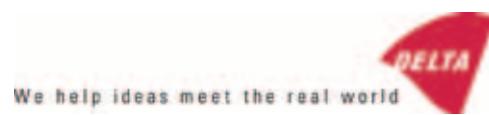
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S3



# Compliance Statement

No. 2014-429

## Connecting Hardware, Category 6

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened Category 6 RJ45 Keystone Jack characterised up to 250 MHz, 100 Ω

**Product identification**

Unscreened Cat. 6 Keystone Jack. Part number: 100-215-WT, 100-215-BK

**Generic cabling and cabling components standards - Category 6 connector requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 60603-7-4:2010 (Ed.2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009

**Technical report**

DELTA-T209669-02, DANAK-19/14570

**EC Cabling product ID**

5576

**CS valid until**

10 October 2015

This product has been tested by DELTA EC Cabling Group and complies with the electrical requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The testing included measurement of NEXT with a compliant test plug and calculation of all the 14 test cases in both measurement directions. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis once a year.

Hørsholm, 10 October 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
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Phone Number: (800) 345-3851  
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S3

### ETL Verified Certificate of Conformance Number: 3187559CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3182869CRT-002a

**Product Tested:** Telecommunications Connecting Hardware

**Model(s) and or Brand Name:** Cat. 6 RJ45 connecting hardware, part number 100-011

**Standard(s)/Specification:** ANSI/TIA-568-B.2-1 Category 6 with the applicable electrical transmission characteristics

**Product package marking shall include:** ETL Verified to ANSI/TIA-568-B.2-1 Category 6 and the product model(s) and or brand name.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 8/11/2009

**Date Revised:** 12/28/2009

**Approved By:**

\_\_\_\_\_  
Kathy Heath, Program Coordinator

\_\_\_\_\_  
Antoine Pelletier, Engineer

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S3

3P  
THIRD PARTY TESTING

# Compliance Statement

Unscreened Category 6  
ISO/IEC, EN & TIA/EIA Connecting Hardware

Excel Identification 100-011 / 100-011-BK

Category 6, Unscreened, Keystone Jack  
Electrical Transmission Performance

Excel

Excel House, Junction Six Industrial Park, Electric Avenue,  
Birmingham B6 7JJ, United Kingdom

Compliance Statement No. 107376F

This Unscreened RJ 45 Keystone Jack with board identification "PB-1028-27QR-C63/Au" has been tested by 3P Third Party Testing and complies with the Category 6 transmission requirements of 2<sup>nd</sup> edition ISO/IEC Generic Cabling Standard 11801, CENELEC Generic Cabling Standard EN 50173-1:2007, ANSI/TIA/EIA Generic Cabling Standard 568-B.2-1, 1<sup>st</sup> edition IEC Connecting Hardware Standard 60603-7-4 and IEC 60512-26-100. The qualification activity includes factory and assembly line inspection and passing of mated pair requirement using the complete specified Category 6 de-embedded NEXT range of RJ 45 plugs. The Compliance Statement may be suspended or withdrawn if the keystone jack fails to pass a Maintenance Testing performed at 12 month intervals.

Hoersholm, 7<sup>th</sup> January 2014

*Ole Lambertsen*

Ole Lambertsen  
Test Responsible

Hoersholm, 7<sup>th</sup> January 2014

*Poul Villien*

Poul Villien  
Coordinating Manager

Independent Testing - For End User Confidence



We help ideas meet the real world

# Compliance Statement

No. 2015-007

S3

## Data communication cable, Category 5e

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

### Product description

Unscreened cable (U/UTP) characterised up to 100 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, halogen free

### Product identification

100-066

### Generic cabling and cabling components standards - Category 5e cable requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-3-1:2013
- ANSI/TIA-568-C.2:2009

### Standards for flammability, halogen acidity, and smoke performance

- IEC 60332-1-[1,2]:2004
- IEC 60754-[1,2]
- IEC 61034-[1,2]

### Technical report

DELTA-T210059, DANAK-19/14900

### EC Cabling product ID

5456

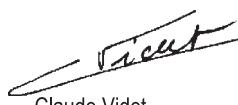
### CS valid until

7 January 2016

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 7 January 2015

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

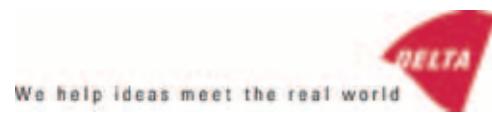
DELTA  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





S3



# Compliance Statement

No. 2014-199

## Data communication cable, Category 5e

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened cable (U/UTP) characterised up to 100 MHz  
Horizontal floor wiring cable, 100 Ω  
4 twisted pairs  
Flame retardant, PVC jacket

**Product identification**

100-065

**Generic cabling and cabling components standards - Category 5e cable requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2009 (Ed. 2.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-3-1:2013
- ANSI/TIA-568-C.2:2009

**Standards for flame retardancy**

- IEC 60332-1-1:2004
- IEC 60332-1-2:2004

**Technical report**

DELTA-T208218, DANAK-19/14113

**DELTA product ID**

5092

**CS valid until**

13 May 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance schedule, which implies that DELTA EC Cabling performs a quality audit of the manufacturer's production and QA sites. The maintenance testing of the product is performed on a sample basis.

Hørsholm, 13 May 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





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Cortland, New York 13045 USA  
Phone Number: (800) 345-3851  
Fax Number: (607) 758-6637  
Web: www.intertek.com

S3

### ETL Verified Certificate of Conformance Number: 3119075CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Andrew Percival

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Andrew Percival

**Verification/Report Number:** 3099277CRT-003

**Product Tested:** 4 pair, 24 AWG, UTP, CM, Non-Plenum, Horizontal (solid) Cable.

**Model(s) and or Brand Name:** UTP Cable 100-065 PVC

**Standard(s)/Specification:** ANSI/TIA-568-B.2 Category 5e with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2 Category 5e.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 7/23/2007

**Date Revised:** 12/28/2009

**Approved By:**

Kathy Heath, Program Coordinator

Antoine Pelletier, Engineer

**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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Web: [www.intertek.com](http://www.intertek.com)

### **ETL Verified Certificate of Conformance Number: 3187166CRT-002**

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3104631CRT-005

**Product Tested:** 4 pair, 24 AWG, UTP, CM, Non-Plenum, Horizontal (solid) Cable.

**Model(s) and or Brand Name:** 100-068

**Standard(s)/Specification:** ANSI/TIA-568-B.2 Category 5e with the applicable electrical transmission characteristics

**Jacket marking shall include:** ETL Verified to ANSI/TIA-568-B.2 Category 5e.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 9/9/2009

**Date Revised:** 12/28/2009

**Approved By:**

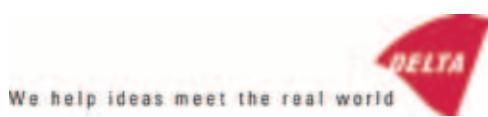
\_\_\_\_\_  
Kathy Heath, Program Coordinator

\_\_\_\_\_  
Antoine Pelletier, Engineer

**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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# Compliance Statement

No. 2014-310

## Data communication cords, Category 5e

### Company

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham, B6 7JJ  
United Kingdom

### Product description

Screened Category 5e RJ45 cords (equipment, patch, and work area) characterised up to 100 MHz

### Product identification

BBSxxxMPLyy (xxx denotes the length and yy denotes the colour)

### Generic cabling and cabling components standard - Category 5e balanced cord requirements

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

### Technical report

DELTA-T208501, DANAK-19/14302

### EC Cabling product ID

5549

### CS valid until

5 July 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 3 July 2014

  
Lars Lindskov Pedersen  
Test Manager

  
Claude Videt  
Project Manager

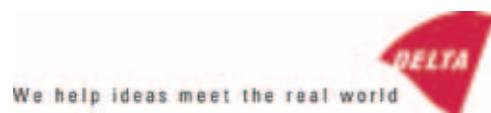
DELTA  
Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
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S3



# Compliance Statement

No. 2014-160

## Data communication cords, Category 5e

**Company**

Excel  
Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
United Kingdom

**Product description**

Unscreened Category 5e RJ45 cords (equipment, patch, and work area) characterised up to 100 MHz

**Product identification**

BBxxxMPLyy (xxx denotes the length and yy denotes the colour)

**Generic cabling and cabling components standard - Category 5e balanced cord requirements**

- ISO/IEC 11801:2011 (Ed. 2.2)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- ANSI/TIA-568-C.2:2009
- IEC 61935-2:2010 (Ed. 3.0) (transmission requirements)

**Technical report**

DELTA-T208089-01, DANAK-19/14051

**EC Cabling product ID**

5372

**CS valid until**

19 April 2015

This product has been tested by DELTA EC Cabling Group and complies with the requirements of the above specified standards and "Terms and conditions for the EC VERIFIED programme for Generic and Coaxial Cabling", DQP231006. The product takes part in a maintenance of certification schedule, which implies that DELTA EC Cabling performs a sample test of the product once a year.

Hørsholm, 15 April 2014

Lars Lindskov Pedersen  
Test Manager

Claude Videt  
Project Manager

**DELTA**

Venlighedsvej 4  
2970 Hørsholm  
Denmark

Tel. +45 72 19 40 00  
Fax +45 72 19 40 01  
[www.madebydelta.com/cable](http://www.madebydelta.com/cable)





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Phone Number: (800) 345-3851  
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S3

### ETL Verified Certificate of Conformance Number: 3188590CRT-001a

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Jason Rudge

**Verification/Report Number:** 3180796CRT-001o

**Product Tested:** Telecommunications Connecting Hardware

**Model(s) and or Brand Name:** Category 5e Shielded Keystone Jack part number 100-906

**Standard(s)/Specification:** ANSI/TIA-568-B.2 Category 5e with the applicable electrical transmission characteristics

**Product package marking shall include:** ETL Verified to ANSI/TIA-568-B.2 Category 5e and the product model(s) and or brand name.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 9/15/2009

**Date Revised:** 12/28/2009

**Approved By:**

\_\_\_\_\_  
Kathy Heath, Program Coordinator

\_\_\_\_\_  
Antoine Pelletier, Engineer

**This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.**

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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Fax Number: (607) 758-6637  
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### ETL Verified Certificate of Conformance Number: 101037957CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

**Applicant:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Simon Robinson

**Manufacturer:**

Excel  
Excel House  
Junction Six Industrial Park, Electric Avenue  
Birmingham B6 7JJ, UK

Contact: Mr. Simon Robinson

**Verification/Report Number:** 3180796CRT-001n

**Product Tested:** Telecommunications Connecting Hardware

**Model(s) and or Brand Name:** Category 5e keystone Jack 100-202-XX

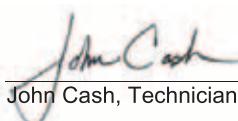
**Standard(s)/Specification:** ANSI/TIA-568-C.2 Category 5e with the applicable electrical transmission characteristics

**Product package marking shall include:** ETL Verified to ANSI/TIA-568-C.2 Category 5e and the product model(s) and or brand name.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

**Date Verified:** 1/21/2013

**Approved By:**

  
John Cash, Technician

  
Antoine Pelletier, Team Leader

This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.

**NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.**

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3P  
TESTING  
THIRD PARTY

# Compliance Statement

Unscreened Category 5e  
ISO/IEC, EN & TIA Connecting Hardware

Excel Identification 100-010  
Category 5e, Unscreened, Keystone Jack  
Electrical Transmission Performance

Excel  
Excel House, Junction Six Industrial Park, Electric Avenue,  
Birmingham B6 7JJ, United Kingdom

Compliance Statement No. 109454F

This Unscreened ISO/IEC, EN & TIA Connecting Hardware having board identification "PB-1028-20-L-G3 Cat 5e" has been tested by 3P Third Party Testing and complies with the Category 5 transmission requirements of edition 2.2 of ISO/IEC 11801 and CENELEC EN 50173-1:2011, and the Category 5e transmission requirements of ANSI/TIA 568-C.2 and 2<sup>nd</sup> Edition IEC 60603-7-2. The requirements are passed using the total range of re-embedded vectors specified in ANSI/TIA-568-C.2 and IEC 60512-27-100. The qualification activity includes factory and assembly line inspection. The Compliance Statement will be suspended or withdrawn if the keystone jack fails to pass a Maintenance of Qualification Testing that is concluded not later than 31<sup>st</sup> January 2016.

Hoersholm, 13<sup>th</sup> January 2015

*Ole Lambertsen*

Ole Lambertsen  
Test Responsible

Hoersholm, 13<sup>th</sup> January 2015

*Poul Villien*

Poul Villien  
Coordinating Manager

S3



# CleverSPACE

## Angled Keystone

Patch lead management is important, but so is the use of rack space, thanks to the innovative Excel angled keystone jack range, you can have both. Available in Category 6 and 6A, our design allows for up to 48% increase in the port density compared to traditional panels.

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and money?**

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without compromise.

# Excel Fibre Optic Cabling Systems

## Section 4

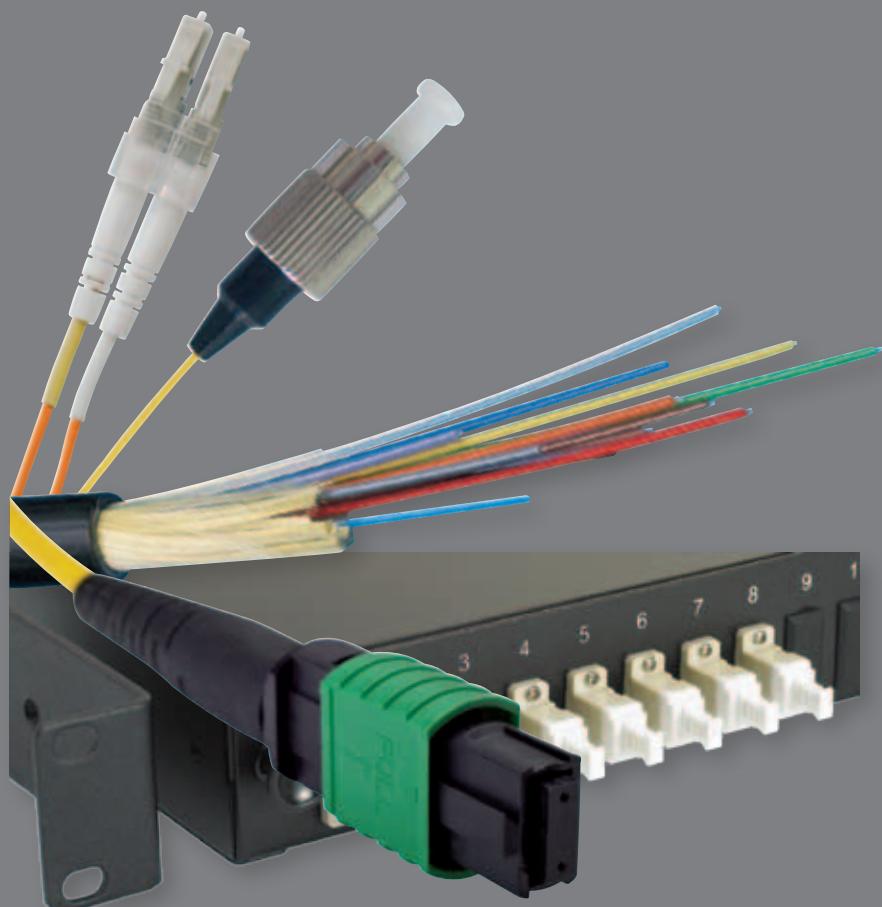
### In this Section:

- [Fibre Optic Systems - Overview](#)
- [Fibre Cabling Standards - Overview](#)
- [Excel Fibre Optic Cabling Systems](#)
- [Excel Mixed Use Patch Panel Frames](#)
- [Blown Fibre System Overview](#)
- [Excel Blown Fibre](#)

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## Overview of Fibre Optics

Fibre optic refers to the medium that utilises light for the transmission of signals. Within the infrastructure data cabling environment this is predominately all-silica optical fibre cables. The other constructions include plastic optical fibre and plastic clad optical fibre. This section refers to all-silica optical fibre systems only.

In the simplest terms, optical fibre transmission is a series of pulses of light representing the 1s & 0s of binary encoding. The optical fibre guides and contains the light ensuring it travels from the transmitter to the receiver. As with copper infrastructure cabling systems, the portfolio consists of cable and connecting hardware of different categories and classes.

S4

Fibre optic systems have the benefit over copper with respect to the maximum achievable distance. Copper is limited, for a standards compliant installation, in general to a maximum of a 100m channel, whereas fibre may support some applications for several kilometres. For this reason fibre optic has traditionally been used in the backbone, typically linking telecommunication rooms, and copper for the horizontal. The backbone encompasses links between buildings. Cables that link buildings have additional challenges. If there is any metallic component, either the conductor medium or any part of the construction, then earth bonding has to be considered. Fibre optic cables are offered with an all dielectric construction, meaning total non-conductive. This mitigates the need of earth bonding and any over-volt protection requirement. Additionally, as the physical size of the fibre cores are so small (the constructions are discussed later) the resulting strength members, yarns, water blocks etc are reduced in size compared with the equivalent copper cable.

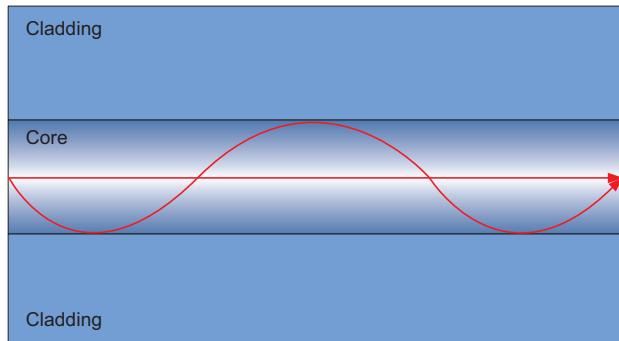
The backbone is not the exclusive use of fibre optic cabling. Customers are deploying fibre in the horizontal element of the infrastructure; sometimes referred to as Fibre To The Desk (FTTD).

### Multimode & Singlemode

Fibre optic cabling can be split into two families – Multimode and Singlemode. 'Mode' means path, so the light travels down multi and single paths respectively. Multimode can use the less expensive LED and VCSEL light sources to transmit the signal. This is referred to as 'overfilled' as the source is broad and floods the modes (and some of the cladding, hence overfilled). The core is manufactured with a graded index. This means that the central light path is 'slower' than the outer paths, which drastically reduces modal dispersion which is one of the limiting factors for the performance of multimode.

Singlemode requires a laser to transmit the signal along a single path. Lasers offer a high powered signal that can be transmitted for greater distances. However, the active equipment is a higher price than that of multimode.

**Multimode Fibre**

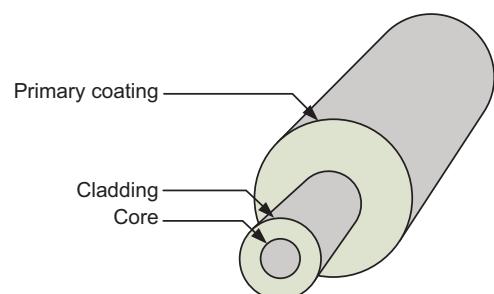


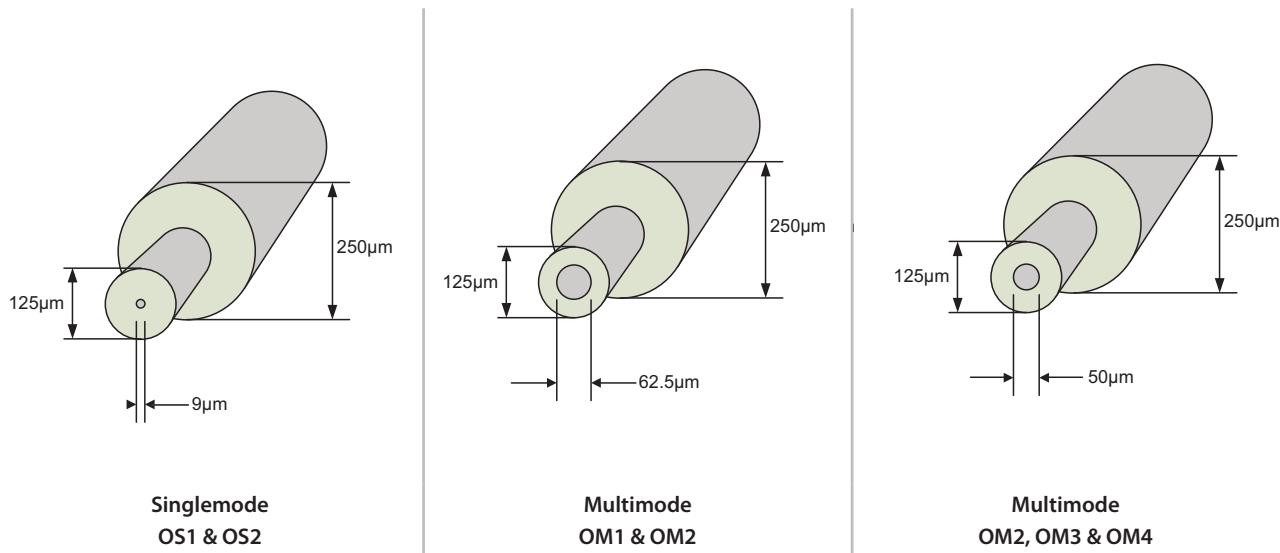
**Singlemode Fibre**



The fibre core comprises of a core and a cladding. This cladding is then covered by a primary coating.

The core is the medium that the light is transmitted along. The cladding is part of the manufacture of the glass. Typically, the cladding is of a consistent size for multimode and singlemode; namely 125 $\mu\text{m}$ . Likewise, the primary coating is usually 250 $\mu\text{m}$  for both multimode and singlemode. The primary coating can be coloured to differentiate between the cores within a cable.





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## Cabled Optical Fibre

The term Cabled Optical Fibre refers to the constructed cable product. Once the fibre core is coated (primary, secondary coating, etc) and is encased with the strength members, wraps and sheaths, the product becomes the Cabled Optical Fibre. The performance of fibre optic is affected by the construction, hence the same core manufactured into different Cabled Optical Fibres will have different performances.

The grades of optical fibres, that are detailed by the ITU (International Telecommunications Union), are used to construct the Cabled Optical Fibre categories of cable. The same grade of fibre cabled with a different construction may be a different category of cabled optical fibre.

## Singlemode

Singlemode fibre is typically 9/125μm and currently readily available in two categories – OS1 & OS2. OS1 is available in both loose tube and tight buffer constructions. The newer OS2 cabled optical fibre is a low water peak grade of fibre (ITU G.652D). Until recently Excel tight buffered fibre cable along with the majority of the market, would support OS1 only. Recent developments of the product has improved the performance and Excel tight buffered singlemode fibre supports OS2. OS2 tight buffered cable is rare in the market. The low water peak refers to the improved performance around the 1383 nm window. The nature of singlemode having one path for the light, and that the transmitting source is a laser, results in a high power and therefore greater distances being achieved. The smaller core size used in singlemode necessitates tighter tolerances being employed for the production of the connector components and couplers.

## Multimode

Two common dimensions exist for multimode, 62.5/125μm and 50/125μm. As can be seen in the Fibre Cabling Standards section, OM2 is available in either of these two sizes (although 62.5/125μm is rare). Care must be taken not to mix the sizes within a system as they are not interoperable. All of the Excel OM2 Optical Fibre products are 50/125μm (check if adding to a non Excel installation). For new installations the recommendation is to standardise on OM3. Consideration should be given to OM4 for support of the emerging 40 & 100 Gigabit Ethernet standards. These will be accomplished with parallel optics which will influence the connector selection.

μm

1μm (or 1 micrometres) is 0.000001m or  $1 \times 10^{-6}$ m. Although the correct name is micrometres it is often referred as microns which is the 'slang' term.



## Loose Tube & Tight Buffer Cable Construction

The traditional use of fibre was in external environments. The cable is made up of a central steel strength member around which the primary coated optical fibre is housed in a number of tubes. The various components of the construction have different rates of expansion and contraction due to temperature changes. This is accommodated by housing a number of loose primary coated fibres (typically up to 12) within a series of tubes that spiral around the central strength member. By having the tubes spiral, and the primary coated fibre loose within the tube, it allows for the difference in expansion due to temperature of the steel, tube, fibre, yarn, sheath etc. The tubes containing the fibre may be gel filled to block the ingress of water when installed in external situations. Alternatives to having a central steel strength member is to have steel wire armour or corrugated steel armour that is around the tubes and under the outer sheath. Aramid yarns are used in the construction for strength and their dielectric properties allow the option of having an all dielectric cable to be installed.

S4

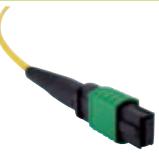
The concern with loose tube arises when the cable is required to be mounted vertically. As the primary coated fibre is only typically 250µm in diameter (0.25mm), and is loose within the tube, there is a limit to the vertical rise that is achievable. One solution is to introduce a loop (sympathetic to the bend radius) at regular intervals, say every 10m vertically.

For this reason tight buffered fibre is more commonly used in internal installations where the ability to route the cable in different planes is required and the temperature change variation is less. The primary coated fibre is surrounded by a secondary coating, usually consisting of two layers, that typically has an overall diameter of 900µm. Secondary coated fibre is suitable where it is housed in trays or within patch panels where it is not subject to repeated handling. For cable construction the secondary coated fibre optic cores are surrounded with aramid yarn and an overall jacket sheath. The jacket is offered in various sheaths depending upon the environment – for example Low Smoke Zero Halogen (LSOH) for internal use.

A ruggedised cord consisting of the secondary coated fibre with the aramid yarn and outer jacket is typically 2-3mm diameter. This gives very good protection in a compact form with flexibility. These cabled optical fibre units are popular for patch cords often with two single ruggedised units bonded together in a 'shotgun' formation for duplex cords.

## Connectors – ST, SC, LC, MTP

A variety of connectors are available for use with optical fibre. The following is a selection of the commonly used ones.

	<b>ST</b> – the ST connector uses a bayonet to secure the connector in place. Within the infrastructure cabling standards the ST is recognised for legacy installs but is not to be used for new installations.
	<b>SC</b> – the SC connector is stated in the infrastructure cabling standards as the connector to be used in new installations (along with small form factor connectors). The SC connector can be used on its own as a simplex connector or joined with a clip with a second to form a duplex connector.
	<b>LC</b> – the LC connector is one of the new small form factor connectors. Out of the available small form factor connectors the LC appears to be the one being adopted. As with the SC it is available in a simplex or, with the addition of a clip, a duplex version. The physical size of a duplex LC adapter is the same as a simplex SC adapter. Also a quad LC adapter can fit in the aperture required to mount a duplex SC adapter. This has ensured the popularity of the LC over other small form factor connectors as it has the ability to use existing SC mounting hardware.
	<b>MTP</b> – also referred to as MPO a multiple fibre connector which presents 12 or more fibre cores within a single connector. Excel uses the connector manufactured by US Conec branded MTP® Elite as it is a connector with superior quality and performance. The MTP® Elite connector is used in pre-terminated installations and has become popular as a way to support the parallel optics applications being developed (40 & 100 Gigabit Ethernet).

## Terminating connectors

The termination of the connectors on the end of the fibre can be achieved by either splicing a pigtail to the end or by directly installing a connector. Direct installing of the connector involves preparing the fibre to bare the core and cladding. This is then fixed into the ferrule with adhesive. The adhesive used takes many forms, including hot melt, cold cure and hot cure to name a few. The end face is then polished and inspected until the desired standard is achieved. This is a very labour dependant method relying on the skill of the installer. It also puts a larger demand on the installer to maintain consistency.

Fusion splicing a factory manufactured pigtail onto the fibre is the alternative method. The pigtail is a 1-2m length of fibre with the desired connector pre-attached by Excel. As these are factory made, the quality of the termination and consistency can be assured and maintained. The fusion splicer then joins the ends of the pigtail and the fibre cable together using an electrical spark. The splice is covered with a heat shrink splice protector. The modern fusion splicer aligns the fibres and splices the core together automatically. This ensures consistency and a high quality through the whole installation. A proficient operator can perform in excess of 100 fusion splices in a day, including preparation of the cable and final mounting in the patch panel.

## Diverse routing

The fibre optic network is often used in the backbone and data centres. In both these instances the network plays a critical part of the business. It is for this reason that a level of redundancy should be designed into the network design. Effectively, a risk assessment needs to be carried out before designing the network. This risk assessment should include what the risk is to the business if the network fails (this will highlight the level of importance and investment that is prepared to be committed to the network). Complementing this, the physical risks need to be assessed. Whether it is a single fibre core breakage, connecting equipment failure or the proverbial JCB digging up a buried cable, these are all physical risks. The risks can then be mitigated to some extent with Diversity, Redundancy and Capacity. Physical diversity is achieved by connecting the hardware with two or more different connections. The routing of these diverse links needs to be planned so that they do not follow the same route or share the same containment. That way, if there is a breakage in one link the other may be used. Networking equipment is often supplied that has two or more connections and can be configured to automatically switch routing. Although the active equipment may use all of the diverse routing in normal operation, the network is designed such that this offers the levels of redundancy should sections of the physical networks be compromised. The level of redundancy required should be identified in the risk assessment. As the traffic levels and demands increase on the network, a good design will allow capacity to accommodate this. In short, "Design for Tomorrow not Today".

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## Testing

Testing of the installed fibre optic network is vital as it assures compliance with the design. Please refer to the Section 9 – Excel Installation Guidelines for detailed information on how to carry out fibre testing to meet the requirements of the Excel Warranty program. It is important that within the specification, and before the installation is undertaken, the required fibre optic testing is detailed.

Fibre optic testing can be broadly split into two levels.

Tier 1 – Loss Testing. Loss testing measures the overall attenuation and is compared with the loss budget calculated for the designed link to determine whether it passes or fails. The loss budget, depending on the test being carried out, is calculated from the length and number of connectors and splices. Some tests do not require a loss budget to be calculated but state a maximum length and loss permitted. The loss test is carried out using a light source and power metre.

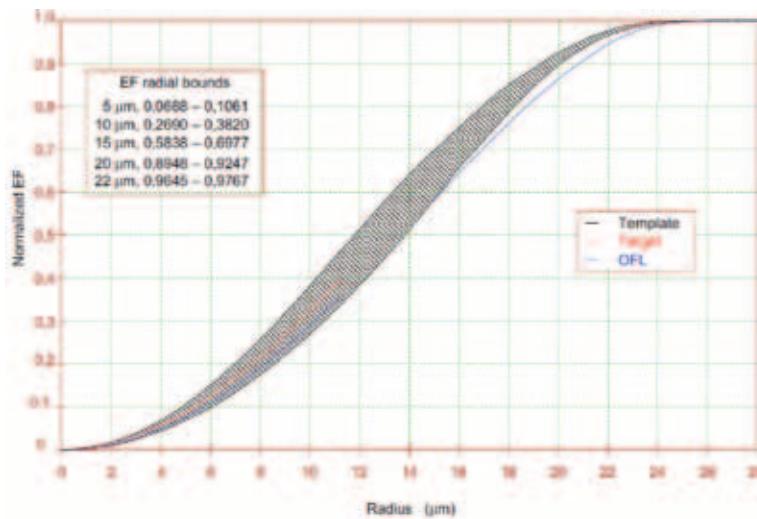
Tier 2 – Characterisation. Characterisation of the fibre optic link comprises the requirements of Tier 1 testing with the addition of an Optical Time Domain Reflectometer (OTDR) trace to be taken. The Tier 1 test measures the overall loss. The OTDR offers a loss trace in the time domain. As the speed of light is a known constant and fibre cable has stated Refractive Index (stated on the specification sheet of the cabled optical fibre), the OTDR translates this into a distance measurement. With the OTDR, individual events (splices or connections) can be evaluated. Some applications not only dictate the maximum overall loss, but they also state the maximum individual loss per connector. The OTDR is able to provide this information either automatically or by manual interpretation. The OTDR trace may also be used in the future for assessment of suitability for new applications.

## Encircled Flux

Within the two tiers mentioned above loss testing is a necessity. It is important when testing, that this carried out correctly to ensure the validity of the results. Loss Testing is carried out with a light source at one end of the link or channel and a power meter at the other. Mode is the path or paths that the light signal takes down the core. In the case of singlemode, this is with a laser and is one path. Therefore singlemode testing is with an appropriate laser based light source. And as it is one path, the path that is used by all equipment when in service will be the same.

Multimode, on the other hand, has many paths. Modern fibre optic equipment uses a VCSEL (Vertical Cavity Surface-Emitting Laser), which is a low power device designed for use with multimode fibre. As the device is a form of laser it does not use all of the modes for the transmission of the signal. Therefore when testing it is important that all of the modes are tested to ensure that it will support the selected application. This is referred to as flooding the core. Historically this was achieved by using a mandrel wrap on the lead from the light source. The mandrel wrap is of a specific size and a certain number of turns around it are made depending on the core size and category. With the aforementioned new applications it has become necessary to define the fill of the core more precisely. This is by specifying that the launch leads are Encircled Flux (EF)compliant.

Encircled Flux is defined in the standards as "fraction of cumulative near-field power to the total output power as a function of radial distance from the optical centre of the core". This means that the proportion of the light power is defined based on the position from the middle of the core. These power levels, as they are defined from the centre of the core are around the centre, hence the term Encircled. This forms a template of the upper and lower limits. An example of a template, as shown in IEC 61280-4(2009) can be seen on the next page:



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This graph shows how the Overfilled Light (OFL) condition falls outside the template at the higher radius.

The templates are specified for the different fibres and light wavelength used. The graph is an example of 50 $\mu$  core fibre at a wavelength of 850 nm.

## EF requirements

### 50 $\mu$ Core – OM2, OM3 & OM4

850 nm			
Radius $\mu\text{m}$	EF lower bound	Target	EF upper bound
10	0.2785	0.3350	0.3915
15	0.5980	0.6550	0.7119
20	0.9105	0.9193	0.9295
22	0.9690	0.9751	0.9812

### 1300 nm

Radius $\mu\text{m}$	EF lower bound	Target	EF upper bound
10	0.2792	0.3366	0.3940
15	0.5996	0.6567	0.7138
20	0.9072	0.9186	0.9300
22	0.9663	0.9728	0.9793

### 62.5 $\mu$ Core – OM1 & OM2

850 nm			
Radius $\mu\text{m}$	EF lower bound	Target	EF upper bound
10	0.1683	0.2109	0.2535
15	0.3695	0.4390	0.5085
20	0.6337	0.6923	0.7509
26	0.9245	0.9350	0.9455
28	0.9710	0.9783	0.9856

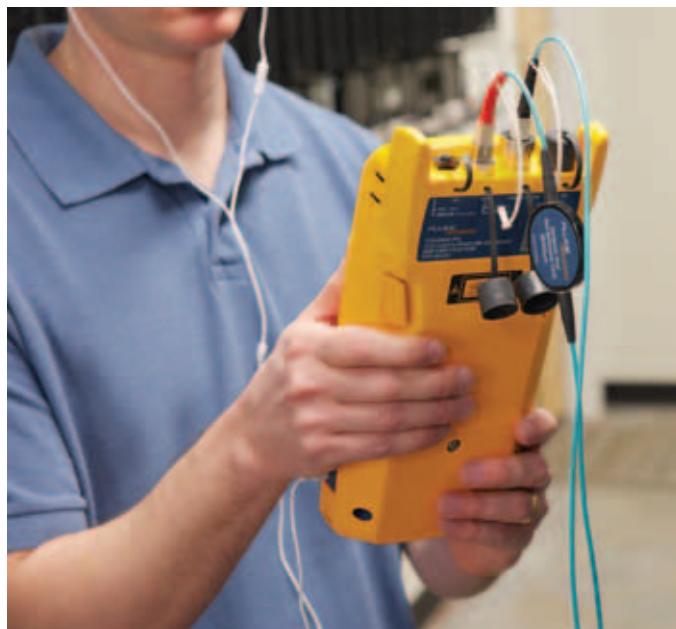
### 1300 nm

Radius $\mu\text{m}$	EF lower bound	Target	EF upper bound
10	0.1680	0.2119	0.2558
15	0.3699	0.4409	0.5119
20	0.6369	0.6945	0.7521
26	0.9254	0.9357	0.9460
28	0.9708	0.9782	0.9856

As the above are defined more stringently than previous methods of multimode testing this reduces the level of uncertainty. This is important as the demands on the fibre because of multi connector designs and higher applications means that the margins are tighter than previously experienced. By reducing the uncertainty it means that the testing accuracy is improved and links and channels can truly be measured to assure support for the application.

Both EN50346 – Information technology – Cabling installation – Testing of installed cabling & ISO 11801 – Information technology – Generic cabling for premises state that fibre testing shall be carried out in accordance of ISO/IEC 14763-3 & Amendment 1 – Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of optical fibre cabling. ISO/IEC 14763-3 calls for Multimode fibre to be tested with EF compliant devices.

Example of EF Test Reference Cord attached to a Fluke DSX-5000



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## Aramid Yarn

Aramid Yarn is a heat resistant, very strong synthetic yarn. This offers many properties that make it attractive in cabled optical fibre construction. The exceptional strength to weight ratio being one. Kevlar™ is a brand of aramid fibre that is popularly recognised for strength and use in body armour.



## Fibre Cabling Standards - Overview

Fibre optic cable and connecting hardware is available in many different types and specifications. The ISO and CENELEC standards bodies have created categories that define these components. Categories include OM1, OM2, OS1, etc. Categories of components following specific conditions and parameters are connected to form Classes of channels. Classes include OF-300, OF-500, OF-2000 etc. The Class, as it specifies the physical and optical parameters, has a selection of application protocols associated with it. As new applications are developed they are designed to fit within the existing categories and classes. The benefit to the end user client is that a system designed and installed to a specified category/class will support all current and future applications designed for it.

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### Attenuation limits for optical fibre cabling channels

Class	Type of optical fibres	Maximum channel attenuation dB			
		Multimode		Singlemode	
		850 nm	1300 nm	1310 nm	1550 nm
OF-300	OM1, OM2, OM3, OM4, OS1, OS2	2.55	1.95	1.80	1.80
OF-500	OM1, OM2, OM3, OM4, OS1, OS2	3.25	2.25	2.00	2.00
OF-2000	OM1, OM2, OM3, OM4, OS1, OS2	8.5	4.5	3.50	3.50
OF-5000	OS1, OS2			4.00	4.00
OF-10000	OS1, OS2			6.00	6.00

There are currently three basic material combinations used in the manufacture of fibre cables. These are all-silica optical fibre, plastic optical fibre and plastic clad silica optical fibre. The majority of infrastructure cabling used in LAN and Data Centre applications carried out uses the first, all-silica optical fibre.

### All-silica optical fibre

All-silica optical fibre is available in two versions which are multimode (OM) and singlemode (OS). Multimode and singlemode are further divided into Categories.

#### Multimode (MM)

Multimode cabled optical fibre is currently constructed using two glass sizes. These are 62.5/125µm and 50/125µm. For a given category they have minimum bandwidths.

Category	Size	Bandwidth		
		Overfilled launch		Effective laser launch
		850 nm	1300 nm	
OM1	62.5/125µm	200 MHz.km	500 MHz.km	
OM2	62.5/125µm and 50/125µm	500 MHz.km	500 MHz.km	
OM3	50/125µm	1500 MHz.km	500 MHz.km	2000 MHz.km
OM4	50/125µm	3500 MHz.km	500 MHz.km	4700 MHz.km

#### Singlemode (SM)

The Excel OS2 singlemode is manufactured from a G.652.D (low water peak) grade of glass core. Excel can offer OS2 in both Loose Tube and Tight Buffer construction due to the superior construction methods. Most manufacturers can only support OS1 in a Tight Buffer construction.

Wavelength	Maximum attenuation	
	OS1	OS2
1310 nm	1.0 dB/km	0.4 dB/km
1383 nm		0.4 dB/km
1550 nm	1.0 dB/km	0.4 dB/km

## Supported applications

The following are Ethernet applications supported by different classes and categories of fibre optics and their maximum channel lengths. Other applications are supported, refer to the latest edition of BS EN 50173-1.

Multimode				
Ethernet Application	OM1	OM2	OM3	OM4
1000BASE-SX (Gigabit)	275 m	550 m	550 m	1100 m*
10GBASE-SR/SW (10 Gigabit)	32 m	82 m	300 m	550 m
40GBASE-SR4 (40 Gigabit)			100 m	150 m
100GBASE-SR10 (100 Gigabit)			100 m	150 m
100GBASE-SR4 (100 Gigabit)				100 m**

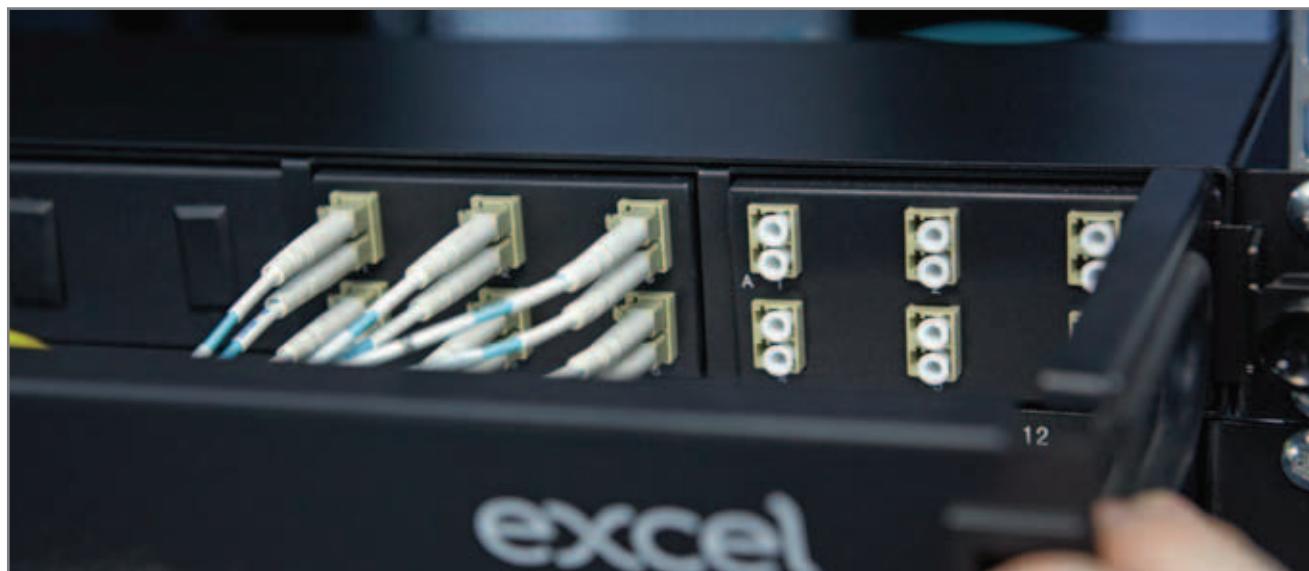
\* distance specific to Excel fibre

\*\* under development, correct at time of publication

Singlemode		
Ethernet Application	OS1	OS2
1000BASE-LX (Gigabit)	2,000 m	5,000 m
10GBASE-LX4 & LR/LW (10 Gigabit)	2,000 m	10,000 m
10GBASE-ER/EW (10 Gigabit)	2,000 m	22,250 m
100GBASE-LR4 (100 Gigabit)	10,000 m	10,000 m
100GBASE-ER4 (100 Gigabit)	40,000 m	40,000 m

## Cabled Optical Fibre

Cabled Optical Fibre refers to the complete cable including the glass, jacket, strength member, and any other component. This term is required because all of these elements, whether the construction is tight buffer or loose tube, affect the performance.



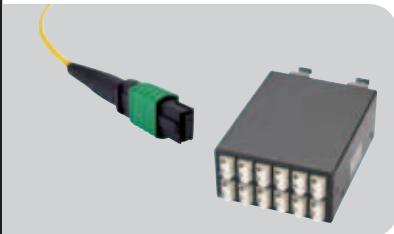


# Excel Fibre Optic Cabling Systems

When installed by an accredited Excel Partner the Excel fibre range is covered by a 25 year system and application warranty.

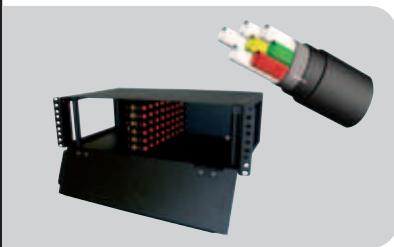
The [Excel Fibre Optic Cabling](#) range includes:

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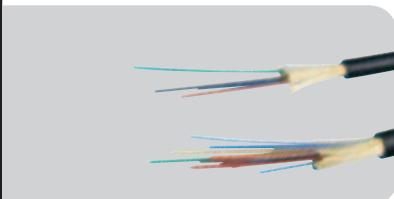
### [Excelerator MTP System](#)

- Provides a reliable, rapidly deployed solution to high density fibre cabling
- Choice of OM3, OM4 and OS2 systems
- Unloaded panel accepts up to 5 fibre optic cassettes
- Angled cassette patch panel also available
- MTP® Trunk cables offer pre-terminated factory tested optical fibre
- Uses the US Conec MTP® Elite connector



### [Excel Blown Fibre System](#)

- Strategic partnership with Prysmian Cables & Systems
- Provides a flexible, low total life cost and 'peace of mind' solution
- The flexibility offered by blown fibre solutions can substantially minimise network build costs
- Increase network design flexibility
- Reduce initial expenditure/control on-going expenditure



### [Excel Internal/External Grade Fibre Cables](#)

- Available in a choice of loose tube or tight buffer
- Available in OM1/OM2/OM3/OM4/OS2
- CST Fibre cable available
- SWA Fibre cable available
- Core counts from 4 to 24



### [Excel Fibre Optic Patch Cords](#)

- Available in OM1/OM2/OM3/OM4/OS2
- Connector types include ST, SC, LC and UPC
- All patch cords come with an LSOH outer sheath
- Supplied with a test report detailing insertion loss
- Individually bagged and labelled



### [Excel Pigtails](#)

- Available in OM1/OM2/OM3/OM4/OS2
- Pigtail types include ST, SC, LC, FC, MPO and APC
- Choice of 1m or 2m lengths
- Supplied with a short strain relief boot
- Supplied with a test report detailing insertion loss



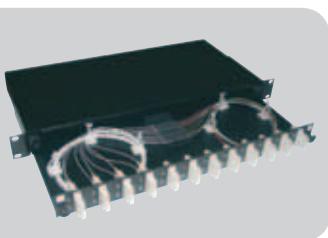
#### Excel Fibre Optic Connectors

- Available in singlemode and multimode
- Simplex options in ST, SC, LC and FC
- Duplex options in SC and LC
- Highest quality ceramic ferrule
- Both 900µm pigtail and 2 or 3mm cable boots included
- Strain relief boots included



#### Excel Fibre Optic Adaptors

- Available in ST, SC, LC and FC
- Choice of singlemode or multimode on SC, SC/APC, LC, LC Quad and FC Adaptors



#### Excel Fibre Optic Patch Panels

- Choice of port density
- Range includes ST, SC, LC, FC and MPO
- Available in multimode and singlemode
- Multiple pre stamped cable entry positions on rear
- Supplied with a cable management kit and cage nuts



#### Excel Cold Cure Termination System

- Designed to provide a fast curing, no heat termination method on site
- Consists of an anaerobic adhesive and alcohol base activator



#### Excel Fibre Optic Patch Boxes

- Available in ST, SC (Duplex) and LC connector styles
- One piece body construction eliminates fibre snagging
- Ideal for conduit or cable gland entry



#### Excel Fibre Optic Wall Mounted Enclosures

- Designed for high-density, secure terminations
- Available in ST, SC Duplex, FC and LC in-line adaptor plates
- Manufactured with a one piece body, an interchangeable plate and hinged lockable doors



## Excel Fibre Optic Patch Panels

The Excel Fibre Optic patch panels come in a range of configurations. This includes different adapter types and quantities. Each patch panel is supplied with an accessory kit.

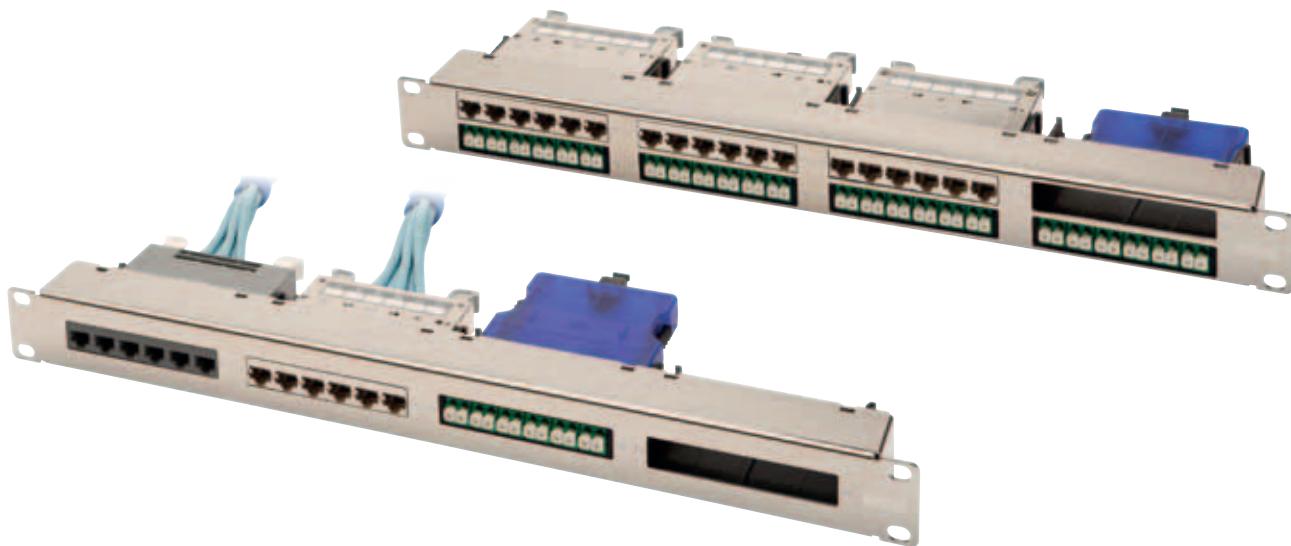
### Excel Fibre Optic Patch Panel Configurations

ST - Simplex				SC - Simplex			SC - Duplex		
Adaptors	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode
4	4	<a href="#">200-377</a>	<a href="#">200-427</a>				8	<a href="#">200-401</a>	<a href="#">200-480</a>
6							12	<a href="#">200-405</a>	<a href="#">200-481</a>
8	8	<a href="#">200-378</a>	<a href="#">200-428</a>				16	<a href="#">200-406</a>	<a href="#">200-482</a>
12	12	<a href="#">200-379</a>	<a href="#">200-429</a>	12	<a href="#">200-486</a>	<a href="#">200-484</a>	24	<a href="#">200-407</a>	<a href="#">200-483</a>
16	16	<a href="#">200-382</a>	<a href="#">200-430</a>						
24	24	<a href="#">200-384</a>	<a href="#">200-431</a>	24	<a href="#">200-487</a>	<a href="#">200-485</a>	48	<a href="#">200-408</a>	<a href="#">200-411</a>
Empty			<a href="#">200-950</a>			<a href="#">200-952</a>			<a href="#">200-951</a>

LC - Duplex				Quad - Duplex			
Adaptors	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode	
4	8	<a href="#">200-460</a>	<a href="#">200-470</a>				
6							
8	16	<a href="#">200-462</a>	<a href="#">200-472</a>				
12	24	<a href="#">200-464</a>	<a href="#">200-474</a>				
16							
24	48	<a href="#">200-466</a>	<a href="#">200-476</a>	96	<a href="#">200-489</a>	<a href="#">200-488</a>	
Empty			<a href="#">200-952</a>			<a href="#">200-951</a>	

## Excel Mixed Use Patch Panel Frames

The Excel Mixed Use Panel provides the ability to have fibre and copper presented in one panel offering complete flexibility in the installation. The Excel Mixed Use Panel accepts 6 port copper or fibre modules – the modules are available in a choice of Category 6<sub>A</sub> Screened, Category 6 Screened and Unscreened, LC fibre and MTP.



The Excel Mixed Panel is suitable for installations from data centres where the mixed use panel may aid separation of the routes of cabling, to a remote wall box that has a small number of fibre and copper links, its design provides a versatile and flexible solution that will suit many applications.

The construction of the panel has a chrome colour finish and comes in a choice of a 4 or 8 module panel using only 1U of rack space.

### Features

- 4 & 8 Module Patch Panels
- Accepts Copper & Fibre 6 Port Cassettes
- 25 Year system warranty available

Part Number	Description
100-230	Excel 1U Mixed Use Patch Panel Frames - 4 Module - Unloaded
100-231	Excel 1U Mixed Use Patch Panel Frames - 8 Module - Unloaded
201-600	Excel 6 Port Duplex (12 Fibre) OM3 LC Module
201-601	Excel 6 Port Duplex (12 Fibre) OM4 LC Module
201-602	Excel 6 Port Duplex (12 Fibre) OS2 LC Module
201-610	Excel 6 Port Duplex (12 Fibre) OM3 LC to MTP Module
201-611	Excel 6 Port Duplex (12 Fibre) OM4 LC to MTP Module
201-612	Excel 6 Port Duplex (12 Fibre) OS2 LC to MTP Module
100-235	Excel 6 Port Category 6 Unscreened Module
100-236	Excel 6 Port Category 6 Screened Module
100-237	Excel 6 Port Category 6 <sub>A</sub> Screened Module



Diagram shows fibre (left) and copper (right) modules loaded into the Mixed Use Panel

## Blown Fibre

### The History

Blown fibre Systems as we know them were originally developed by Pirelli in partnership with British Telecom (BT). Pirelli has spun off its cabling division renaming it Prysmian and has continued to evolve and develop the system resulting in more and more benefits.

Today, BT still owns the intellectual property and Prysmian is able to market the product providing an umbrella licence. Part of the agreement is that only trained personnel install the product, and this training is vital, not only to ensure performance, but also to ensure good practices and safety.

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Originally designed for the carrier network, the system is now breaking into the enterprise market and is particularly useful in campus installations, including both industrial and office campuses. Recently, with the growth in data centres, the benefits of quick repair, expansion and upgrades are being realised.

### Real Benefits

At its simplest, blown fibre uses a series of fitted ducts issued to install fibre between locations. The foundation is the installation of a duct network (the ducts are available in various tube counts and construction meaning internal, direct bury and direct install grades between required locations). The aim is to install the duct cable so that every location is linked, either point to point or, more efficiently, in a loop. Provision should be included for redundant ducting to allow for future expansion. The duct can easily be re-configured if the design evolves or changes.

The key to a good installation in the enterprise market is to work from the destinations back to the source(s), rather than the traditional method of starting with a large multi-core and breaking it down. This will assure that the minimum number and category of fibre is accounted for with sufficient future tube capacities. Blown fibre is very easy to install and modify, and there are huge time savings.

The major benefits to blown fibre are very easy to pinpoint and the comparison to more conventional installation methods is vast.

### Investment

One of the key benefits is by initially investing in a well designed future proofed duct network; the fibre core costs and termination can be deferred until actually needed. Then, when a network requires expanding, the new fibre units are blown in quickly and without physical disruption to the fabric of the building or campus. Money is not tied up in having the fibre cores installed, and terminated, for a number of years when they are not being used (and may never be used) and redundant fibre units can be very quickly removed using the same blowing equipment, making the ducts available for the future. As and when new grades of fibre are developed this can be quickly and easily deployed as necessary.

This approach to staged deployment assists both initial budgeting and future investments. Network Managers can invest on day one in a duct network which is populated with fibres as required. As business needs change, either in terms of capacity or performance required, more fibre, or a different class of fibre, can be installed quickly and easily, often when the rest of the network continues to operate.

### Repair and Upgrade

Whether there is a need to replace a damaged cable or upgrade a larger section of the infrastructure, blown fibre makes it very simple. Blown fibre can be described as a 'plug and play' solution as that is exactly how the duct cable is joined with push fit connectors. The ducts are installed and the fibre is blown in, it only then needs to be spliced and then the job is complete and ready for use. If damage occurs to the duct cable and fibre the 'Mean Time to Repair' is very fast. Simply locate the damage, open up the outer sheath of the duct cable using standard cable tools, locate the damaged duct(s), cut the duct, blow the fibre unit out, join the duct with push fit connectors (the section of duct cable can be cut out and replaced if needs be), blow in the replacement fibre unit, terminate & test and then the fibre is ready for reconnection. What used to take days, now can be reduced to hours to repair. And if some of the ducts have intact fibre units they do not need to be disconnected or compromised. This is hugely advantageous for data centres where time is critical and may be subject to costly Service Level Agreements (SLA).

How long does it actually take? It can take just a few minutes to remove old fibre and new fibre is blown in at 30 metres per minute, meaning that the whole process, including termination and testing, can be completed within the hour.

## Building the System

In an industry where Moves, Adds and Changes (MACs) are inevitable, contingency planning becomes vital and finding a solution that can allow easy modifications is a much preferable choice.

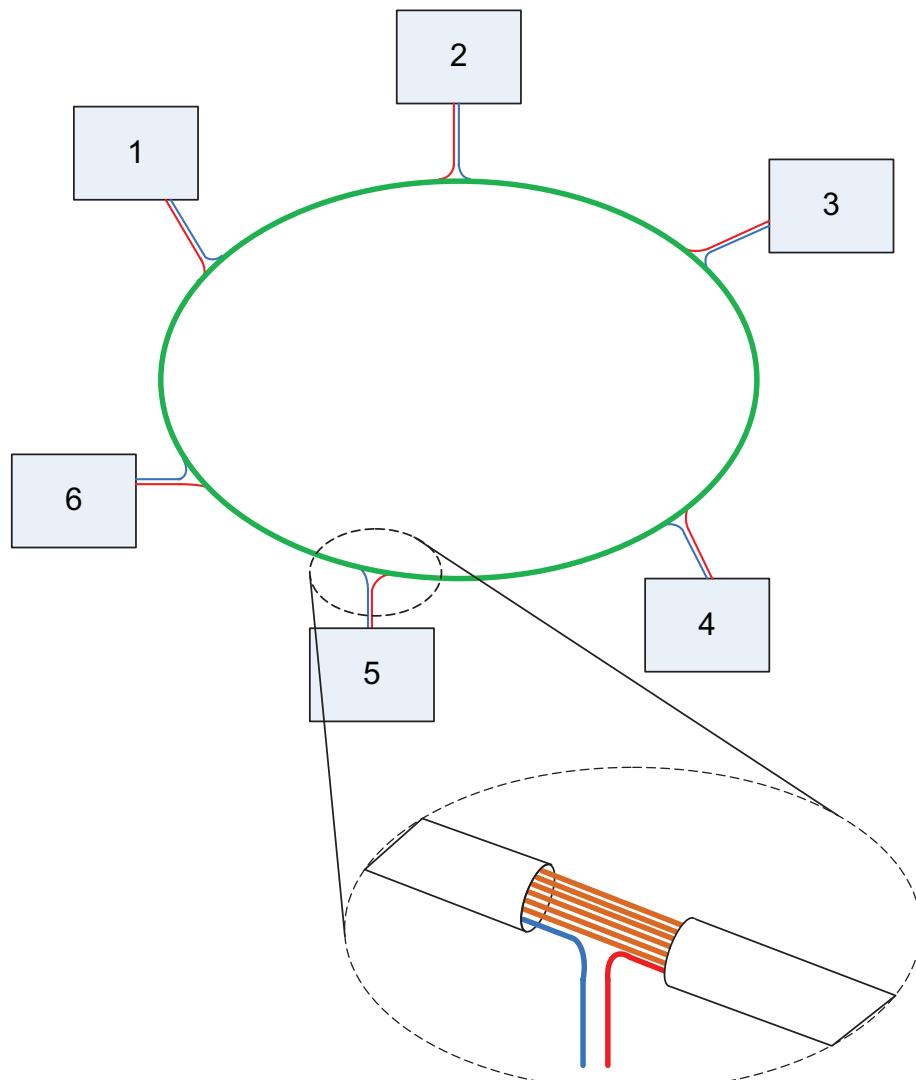
The need for maintenance in itself is greatly reduced by using blown fibre. Blowing fibre is a smooth process as the cable travels effortlessly down a tube, with no interference. In comparison, using the more traditional pulling method can cause damage to the cable which may shorten its life and may not be evident on day one. The stress it faces means that the need for maintenance becomes far more likely and its warranty becomes vulnerable. Stress is eliminated when the blown technique is used, as air transports the cable through its tube, supporting the fibre core along its entire length, greatly increasing its longevity. The tube cable is installed, with the usual pulling forces applied to any cable, without the fibre unit in place.

## Diversity

A robust network should have more than one path for cable, ensuring that if one path goes down a second can pick up the feed. This can be achieved with any installation method, but blown fibre provides far greater advantages.

Consider the requirement to link satellite cabinets back to the main communications room. These may not even be in the same building, for example in a campus environment. Traditionally, multiple fibres would be installed between the cabinets or buildings. Almost every combination of connectivity would need to be considered. If the position of the 'main' communications room is swapped, or connectivity between two locations was not considered, this can be a time consuming and a costly exercise.

With blown fibre each individual tube can carry a fibre unit consisting of 12 cores. Let us assume that the initial requirement is for no more than 12 cores to each location. The practice for the blown fibre installation is to install tube cable(s) with a total number of tubes in excess of the number of locations linked to them all in a ring. Ideally twice the number of tubes, to allow for a future expansion or upgrade. So, with this ring, a fibre unit can be installed clockwise and anti-clockwise between two locations offering diversity and only tying up one tube. Tubes that are not required at a location are not cut. The spares are there for upgrades or expansion. If an 8 core is installed and this becomes insufficient then a spare tube could be used to install say a 12 core. When the service is cut over, the 8 core should be recovered. That way the spare capacity of the system is maintained.





<b>Duct</b>	Multiple blown fibre ducts contained within a single sheath. Ducts are available in Internal, Direct Install and Direct Bury grades with different duct counts. The ducts do not include the fibre unit (fibre optic cores).
<b>Fibre Unit</b>	Multiple cores of fibre bonded together into a single unit for blowing into the tube cable. The fibre is bonded together with an easy to remove substrate. Fibre units are available in different categories of fibre optic including OM3, OS2 and a combination thereof if required. Fibre units can be made with any fibre optic core manufactured or sourced by Prysmian.
<b>Dark Fibre</b>	Fibre optic cable that is installed surplus to the immediate requirement. Usually the fibre optic is not terminated and it is referred to as 'Dark Fibre' as no light is shone down it. If terminated and used, the fibre optic is no longer 'Dark' fibre.

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Blown fibre truly is a more cost effective, easier and more flexible approach. Fundamentally, as only the tubes are put in on day one, it means that the whole cable can be manipulated as needed, offering numerous advantages. Using conventional methods, the cable is fixed in place so the flexibility is non-existent and, should a MAC be required, the time and cost implications could be huge.

### Future proofed

The ease of modification alone means blown fibre provides a future proofed solution, but further to that Prysmian is also able to turn any optical fibre they make or source into a fibre unit. A system installed a few years ago, before OS2 even existed, can still utilise OS2 today, and the unknown ahead of us will still be able to fit into systems that are being installed today.

## Blown Fibre from Excel

### Excel partners with Prysmian to offer their Sirocco® Blown Fibre Solution

The Sirocco® Blown Fibre System provides a simple solution to manage evolving network demands without the need for high initial capital expenditure or extensive network planning. Sirocco® enables optical networks to adapt to changing business requirements. Sirocco® allows optical fibres to be deployed on demand from one point of a network to another (internal or external) using compressed air to blow optical fibre into pre-installed tubes.

The flexibility offered by blown fibre solutions can substantially minimise today's network build costs. With the many uncertainties in the market, such as future trends in technology, demand from customers, people movement and financial confidence, Sirocco® can provide a flexible, low total life cost and 'peace of mind' solution.

### Just some of the key benefits include:

- It uses new, innovative technology and state of the art equipment
- It uses multiple fibres
- Fibres that are blown out can be reused
- The blows can be cascaded
- It is a total cable solution
- It offers integrity and extra length
- The tube can be tested before the fibre is blown in

### About Prysmian

- Prysmian is a leading player in the industry of high-technology cables and systems for energy and telecommunications
- The Prysmian Group sales exceeded 3.7 billion Euros in 2009
- Prysmian boasts a global presence with subsidiaries in 39 countries and 56 plants in 24 countries
- Prysmian has 7 Research & Development Centres in Europe, USA and South America, and 12,000 employees

### 25 Year Warranty

When the Sirocco blown fibre system is installed by an accredited Excel Partner, who has also attended the Prysmian Sirocco training course, the installation is covered by the standard Excel 25 year product and application warranty.



The Sirocco Blown Fibre System is made up of the following key elements:

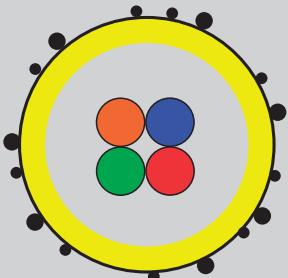


#### Blown Fibre Tube Cable

- HDPE low friction tubes
- Aluminium tape layer acts as a moisture barrier
- Rapid dedicated customer connections using proven mechanical protection of HDPE
- Low friction internal coating for maximum fibre blowing distance
- Each tube accommodates one fibre unit (up to 12 fibres in a unit)
- Can be customised to suit user requirements (e.g. tube style, sheath colour, print legend)

#### Blown Fibre Units (EPFU)

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- The fibres are contained in a soft inner acrylate layer which cushions the fibres, an outer harder layer which protects the fibre from damage and a low friction layer that assists in improving blowing distance, which is typically in excess of 1000 metres in a single direction
- The Sirocco units are available in lengths up to 6000 metres supplied in portable plastic pans for ease of use
- Available in 2, 4, 8 and 12 fibre units
- The Sirocco units can be supplied in whatever type of fibre is required, including hybrid solutions with a mixture of fibre types
- Colour coding indicates the type of fibre (singlemode yellow, 50/125 turquoise/blue and 62.5/125 magenta/red) except for 12 fibre which, with its alternative low friction coating, is coloured grey
- Available in OS2 singlemode and OM1, OM2, OM3 and OM4 multimode constructions

#### Connectivity

The Sirocco system provides an extensive range of connectivity products including:

- Full range of 19" Sirocco Patch Panels
- Choice of internal and external Customer Splice Boxes
- Compact Termination Boxes
- Tube Distribution Closures
- Blown Fibre Gas Seal Units

#### Connectors

A full range of connectors for use in the installation of the Sirocco system including:

- Tube Connectors
- Tube End Connectors
- Water Blocking Connectors
- Gas Seal Connectors
- Tube Sealing Caps
- Reducer Connectors
- Bulkhead Connectors

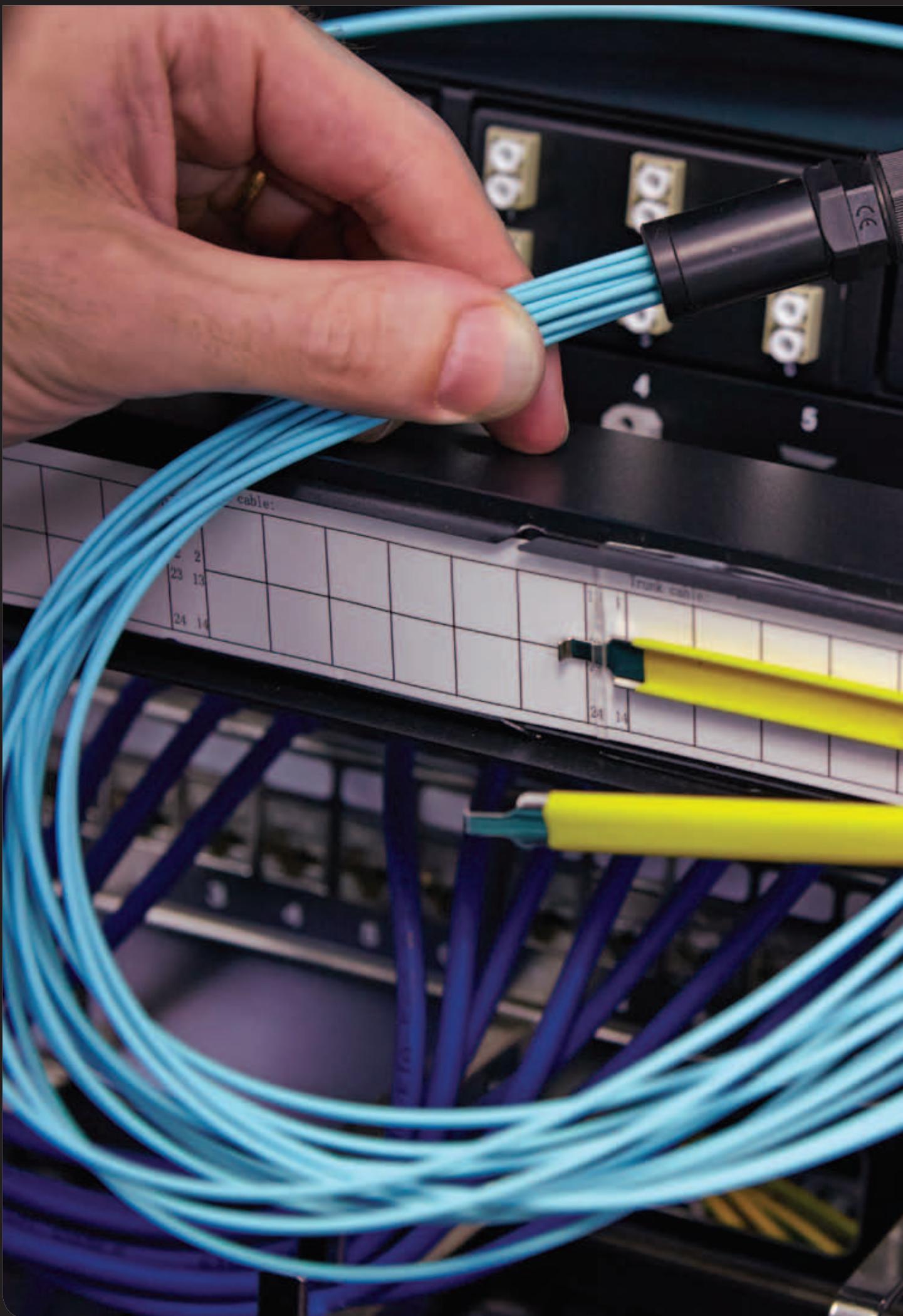
#### Installation Equipment

- Sirocco Blowing Head - used in conjunction with the compressor to blow in the EPFU
- Sirocco Compressor - available as an electric or petrol version
- Sirocco Stilt - tests the Sirocco Tube integrity and length prior to installation of the fibre
- Installation kits are available to buy or hire

For further details please visit [www.excel-networking.com](http://www.excel-networking.com)



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# Excel Pre-terminated Solutions

## Section 5

### In this Section:

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### Pre-terminated Solutions

The conventional way to deliver a copper or fibre infrastructure cabling system has been for the cable, connecting hardware and accessories to be installed and terminated onsite. The installation is typically programmed in to fit in with all other project works. Projects maybe subject to unforeseen delays, and as the infrastructure cabling packages are usually towards the end of the project, these may be under greater pressure to speed up to ensure the overall project is not delayed.

S5



### The Benefits of Excel Pre-terminated Solutions

Pre-terminated solutions are ideal for projects with limited time available onsite for installation or for rapid deployment projects, such as a disaster recovery.

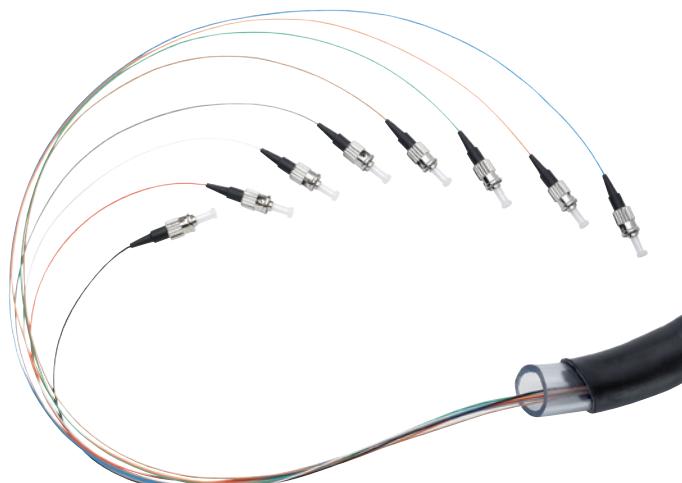
Excel's pre-terminated solution provides a fully traceable and warranted system and could reduce the installation time as much as 75%.

A range of benefits are available from most pre-terminated solutions, time saving and repeatable quality being two of the most obvious. But the Excel offering brings much more as the system is more flexible than any others, ultimately allowing the customer to retain control of cost and design.



#### Benefits at a glance:

- Simple to use, specify and install
- Choose from the extensive range of Excel standard products
- Choice of Copper or Fibre
- Cost effective – Warranted - 25 year warranty when installed by a qualified Excel Partner
- Traceable – cable batch, engineer, cable test
- Saves time – reduces installation time by at least 75%
- Environmentally friendly - Eliminates waste onsite
- Maximises cable usage
- Reduces logistics time on site – e.g. storing/unloading, labelling



## Labelling

Each pre-terminated assembly has a unique serial number to enable tracking through the entire manufacturing process. The serial number label is attached to the cable in an agreed location so as not to be visible after the installation is complete. The 'end user' labelling can be installed during the Excel manufacturing process with options to label cable, shutter, faceplate, GOP box and patch panel before reaching site.

## Manufacturing process

The pre-terminated assemblies are manufactured in the Excel facility under controlled conditions, assuring the highest quality of product, matching the customer's specification and configuration.

## Testing

The pre-terminated assemblies are 100% tested during manufacture to the specified standard. All testing is carried out by trained staff using calibrated equipment with the latest firmware and software installed. All results are recorded and supplied for inspection. The exception to a full certification test being carried out is where single ended pre-termination is ordered. In these cases the factory testing will be agreed beforehand with the minimum of continuity being verified.

Each pre-terminated cable is given a unique reference number and is provided with a full test certificate, supplied in a choice of soft or hard copy.

Tender Specifications will typically require full testing of the system once it has been installed in its final position. This should be completed in line with the testing methodology contained within our Installation Guidelines in Section 9.



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## Logistics

Excel is more than aware that successful projects rely on seamless logistics. The planning and delivery can make or break the project. This is why Excel is able to work with installers to schedule deliveries to meet the programme, ensuring the smooth running of the installation, by eliminating onsite storage which adds handling time and takes up valuable space.

## Fast, Easy and Flexible

Excel allows the installer or user to retain control when deciding on the product sets used within a copper or fibre optic pre-terminated system. We do not offer restricted or pre-term only product sets with inflated costs, or specific installation practices. The customer selects the product, pays the same price per component as a standard install, and Excel provides the termination and labelling service at a very competitive cost, alternatively integrators may choose to purchase products and pre-term themselves off site.

Following on from a detailed site survey of the premises, the customer will establish the lengths of cables required in each area.

Once the products and the configuration for each area have been identified, then the cable assemblies are manufactured by Excel's skilled work force in a controlled environment. Each one is produced to the customer's specific requirements and is tested to ensure 100% reliability.



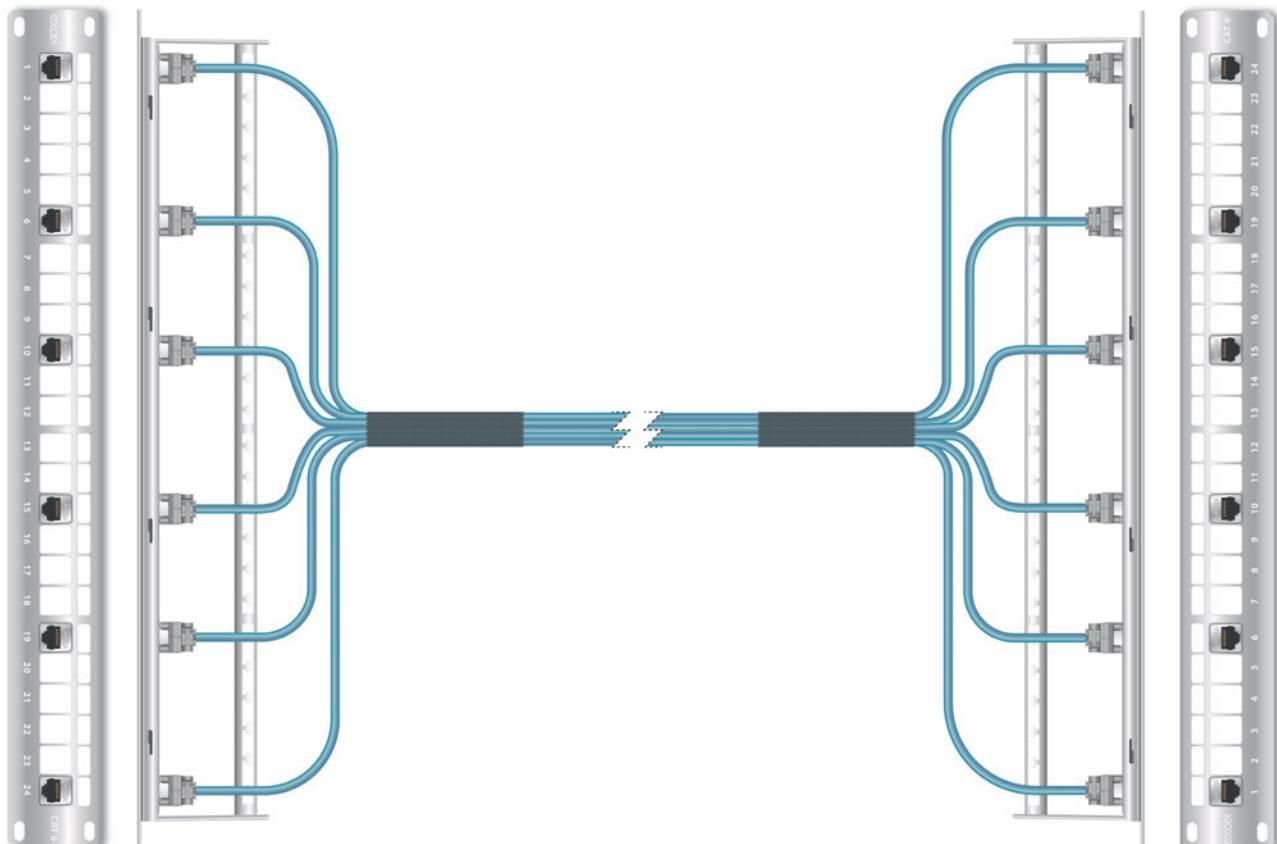
# Excel Copper Pre-terminated Solutions

## Introduction

Excel is able to offer pre-termination solutions from across the entire range. This covers components from the [Category 5e](#), [6](#) and [6A](#) portfolio in either unscreened or screened variants. The cables may be bundled in quantities to suit the installation for example in bundles of 2, 4, 6, 8, 12, 16 or 24 way links. The following are examples of product set scenarios which can be provided as pre-terminated system designs.

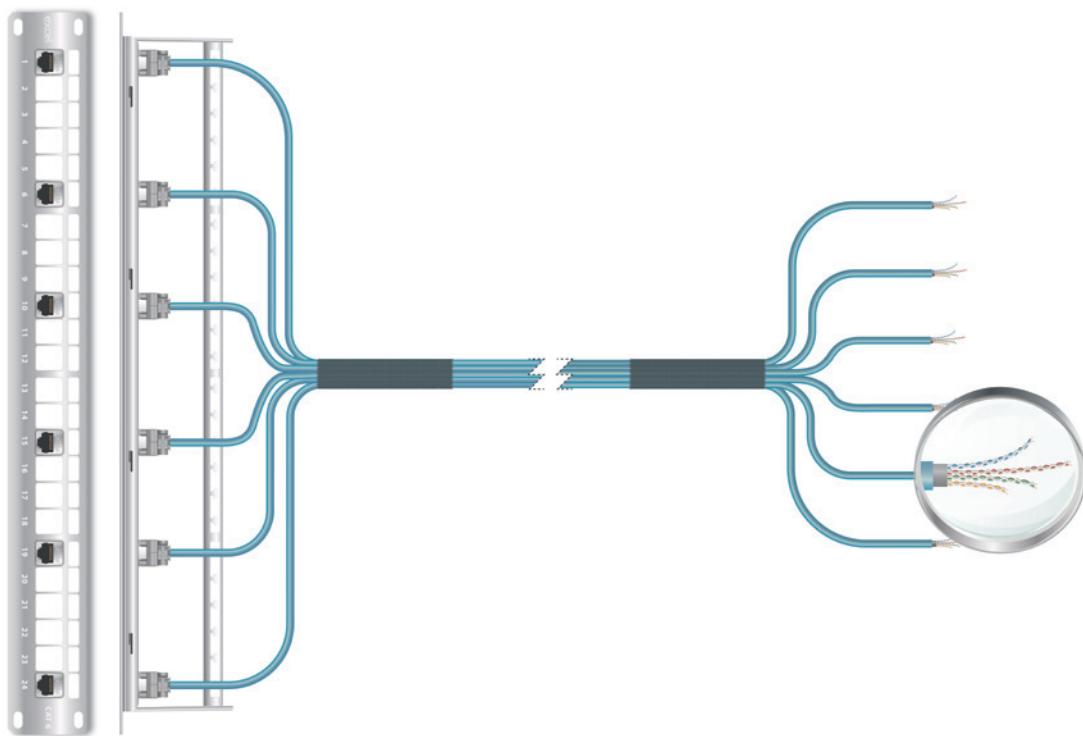
### Panel to Panel

Main Equipment Room (MER's) and Data Centre designs call for links to be made between racks. A panel to panel style allows for installation to take place quickly and easily. Today almost all projects require deployment as fast as possible. Whilst panel-to-panel is the optimum solution, if accurate lengths are not available, Excel offers a panel to open end allowing the remote connector or panel to be terminated in the field. By introducing the Excel pre-terminated solution you can reduce time on site by as much 75%, ensuring the customers network is up and running in the minimum amount of time.



## Panel to Open

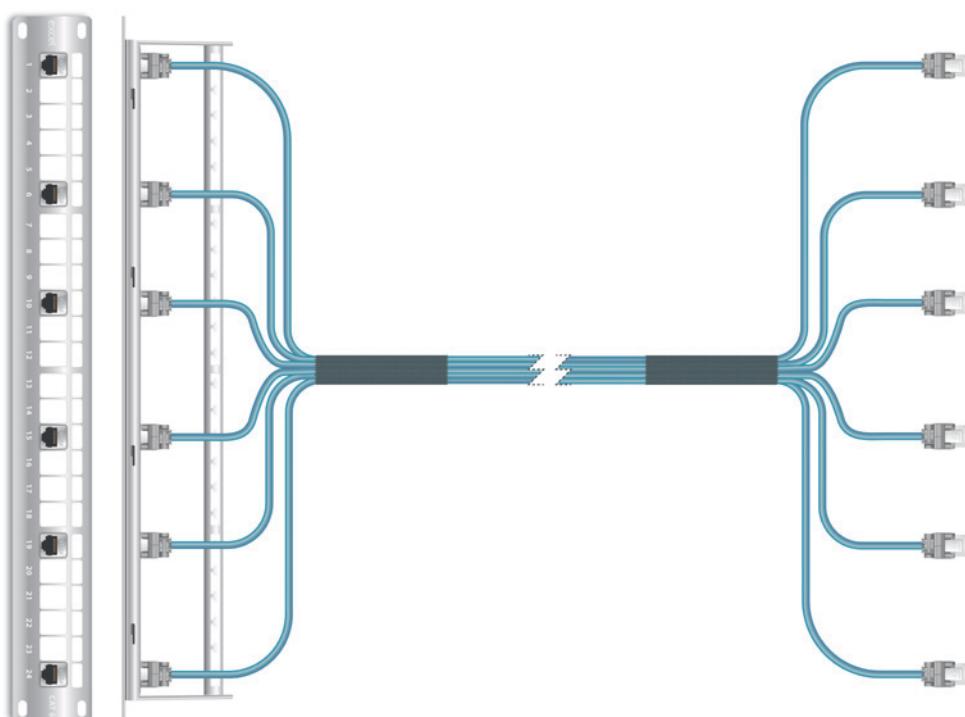
Panel to Open allows for the remote connector or panel to be terminated in the field.



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## Panel to Jack

When deploying data outlets from a patching field via horizontal distribution out to the work area in a inter-connect configuration and the site allows for accurate measurement of runs to be calculated, this can be the ideal solution to use. The remote terminated jacks can then be housed and presented in dado [trunking](#), [floor boxes](#) or [GOP boxes](#) where desired with the use of [Excel mounting hardware](#).

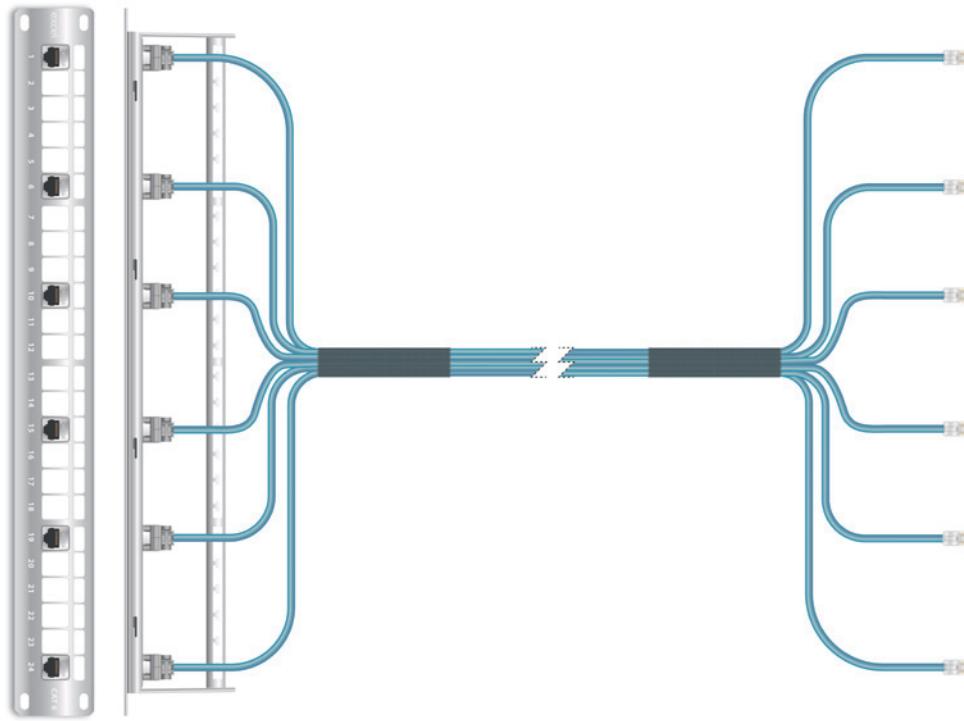




### Switch / Harness Links

The [switch/harness link](#) configuration is made up of a panel-to-plug link, the links are then dressed together to create a loom. This solution is deployed mainly in the Main Equipment Rooms allowing for a cross-connect deployment.

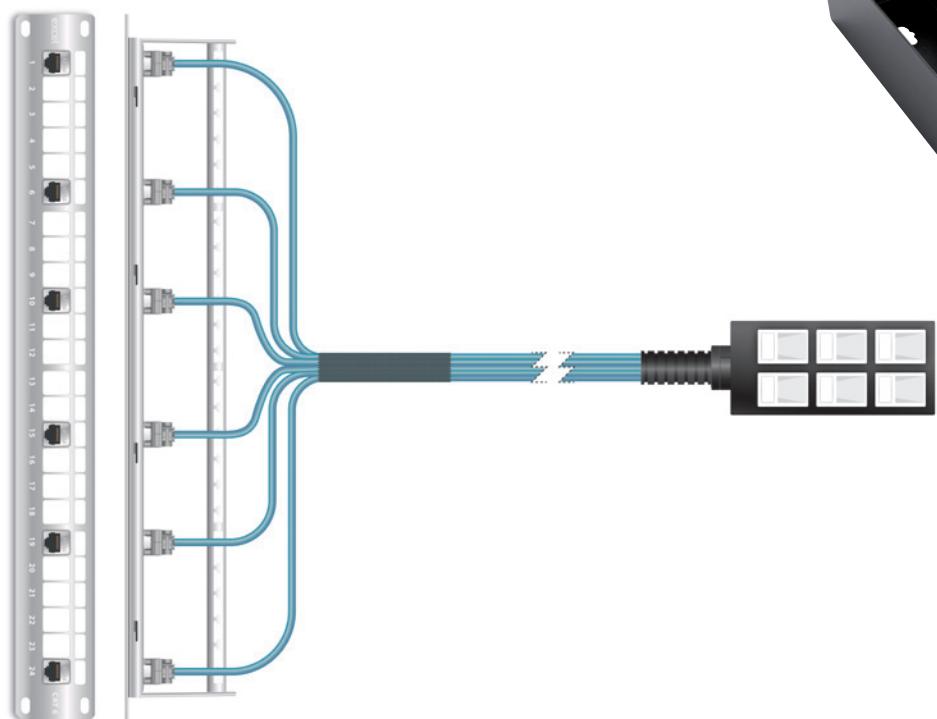
Solid core RJ45 to RJ45 leads can be supplied when there is the need to create switch harness links on site.



S5

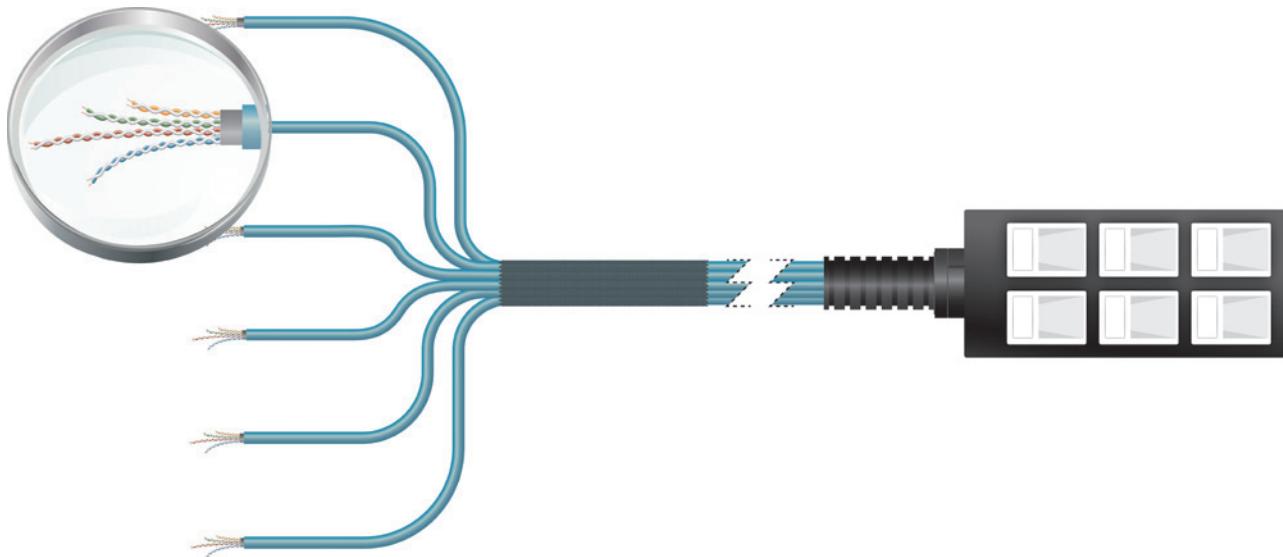
### Panel to GOP Box

With [Excel GOP boxes](#), a common request received is the option to have these supplied pre-terminated. The assembly is supplied to site with the outlet jacks already terminated onto the cable and fitted within the GOP box. The flexible conduit is also in place. The patch panel jacks are installed ready for them to be inserted into the panels.



## GOP Box to Open

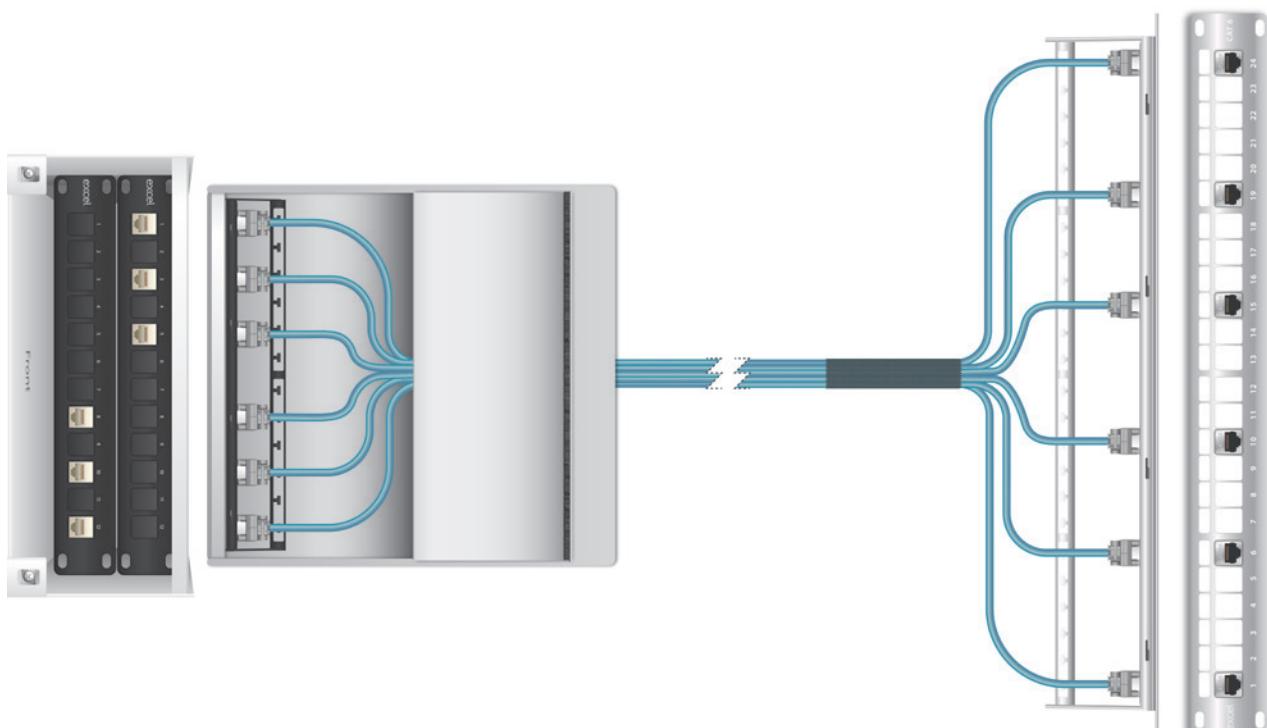
The [GOP box](#) to open configuration is a common form of pre-terminated solution and ideal for ‘flood’ wiring a complete floor on a grid basis allowing total flexibility for multiple re-configurations of the furniture layout. The GOP box is usually fitted to the end of a 5m length of flexible conduit that is secured to an anchor plate thereby allowing the GOP box to be moved and even brought through a grommet hole in the raised floor and secured to the desk furniture. The loom is then pulled back to the Secondary Equipment Room (SER) and terminated. This approach is an ideal solution for tight project timescales.



S5

## Consolidation Point

When creating a structured cabling system that has to be flexible, due to the frequency of moves, additions and changes (MAC's) such as in schools or the health sector, the use of a consolidation point can be deployed. This solution allows for changes to happen locally to the work area without the need to access the remote data centre. The consolidation unit can also be used for staged developments within new pre-fabricated buildings. The cables can be deployed within the structure and patched together once the building is in situ.





### Enquiring couldn't be simpler!

Before we can quote for a copper pre-terminated solution we require a few basic facts from you:

1. Do you require Category **6A**, **6** or **5e** in U/UTP, F/UTP or F/FTP?
2. What cable lengths are required?
3. Specify the number of overall terminations ie. 2, 4, 6, 8, 12, 16 or 24 way looms, panel to panel etc
4. Where do they need to be delivered?
5. When do you require them?

Once we have this information we will be able to provide you with a full quotation.

Opposite is a Copper Pre-terminated Check List to help you establish what you actually need.

# Excel Copper Pre-terminated Checklist



Company Name:			
Contact Name:	Project/Customer Name:		
Date of Enquiry:	Date Required:		

Category:	Category 5e <input type="checkbox"/>	Category 6 <input type="checkbox"/>	Category 6 <sub>A</sub> <input type="checkbox"/>	Category 7 <sub>A</sub> <input type="checkbox"/>
	Screened <input type="checkbox"/>	Unscreened <input type="checkbox"/>		

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## Configuration

**Note:** Use part numbers for exact configuration.

Inter-Cab Links			
Keystone to Keystone (for use with unloaded panels and Angled V Panels)			
Keystone to Keystone (Angled Jacks)			
Keystone to Mixed Use Module			
Mixed Use Module to Mixed Use Module			
Harness/Switch Links			
Plug to Keystone			
Plug to Mixed Use Module			
Solid Core Patch Leads			
Plug to Plug			
Length		Qty	
Horizontal			
GOP to Open (spares will be covered by rubber blanks)	GOP Size 2/4/6 Outlet Number 2/4/6		
Keystone – Keystone			
GOP – Keystone			
GOP – Mixed Use Module (only available in Category 6 and 6 <sub>A</sub> )			
Mixed Use Module – Keystone (only available in Category 6 and 6 <sub>A</sub> )			
Cable Bundle Size			
4/6/12 etc			
GOP Umbilical Length			
(Flexible Conduit Length, standard is 5M)			
Bundle Wrap Method			
Insulating Tape (standard)	<input type="checkbox"/>	Velcro	<input type="checkbox"/>
Sock	<input type="checkbox"/>		
<b>Note:</b> For installation purposes insulating tape is the easiest to pull in, as Hook & Loop tends to snag on itself.			



Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	
Length		Length		Length	
Qty		Qty		Qty	

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**Cable Label Location****Note:** All Labels will be positioned 50mm from each end of the cable

Cable label scheme required

**Packaging**

Stillage Cages	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Spinners Required	Yes <input type="checkbox"/>	No <input type="checkbox"/>

**Note:** Standard Packaging below 10M coiled in a Bag and Boxed. Above this length choice of; Drum or Coiled in Bag.

# EXCELERATOR

## Excel Excelsior Fibre Pre-terminated Solutions

The [Excelsior range](#) of pre-terminated fibre optic solutions, have been designed for simple and quick deployment and are manufactured to the highest standards and are fully tested before being delivered to site.

They are available in the following options, in all instances lengths requested are measured from tip to tip of connector, if the specification calls for staggered fan outs we will use the furthest distance from connector tip to connector tip, as the overall cable length.

### Conventional Fibre

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#### Distribution & Breakout Cables

Excelsior pre terminated [Distribution](#) and [Breakout cables](#) are constructed from customer defined multi core 900 $\mu$ m micron tight buffered distribution cable. Standard options available are designed to meet most requirements and include choices of multimode and singlemode, core counts and connector style's.

Typically cables are terminated on both ends, the 'fan out' assembly will be staggered in groups of cores. Unless specified otherwise the longest fan out will measure 0.65 metres from the gland assembly to the tip of connector. The fan outs are protected by means of a transparent protection tube to which a ring style pulling eye is fixed to the remote end of the cable assembly.

Unless requested all cable lengths are measured from tip to tip of connectors, where fan outs are staggered, this length is measured from longest fan out core to longest fan out core.

Assemblies are generally supplied with matched connectors at ends A and B, however Excel can supply mixed connector styles for example LC to SC if required.

Each cable is fitted with strain relief cable glands so that they may be fitted directly to the rear of an Excel Fibre Optic Patch Panel. A generic cable identification label is affixed to each end of the assembly 50 mm from the gland, customer specific labelling schemes can be applied on request.

Excelsior Pre-Terminated [Distribution](#) and [Breakout cables](#) are extremely robust, yet compact and flexible in design. This together with the range of core counts, and connectivity available make them ideal for use as a link from inside a patch panel to inside a patch panel, inside panel to consolidation points, or rack to rack links.

#### Cable Diameter

The following table details the outside diameter of the cable used in each assembly, together with the diameter of the transparent protective tube which should be taken into account if installing or pulling cables into confined spaces.

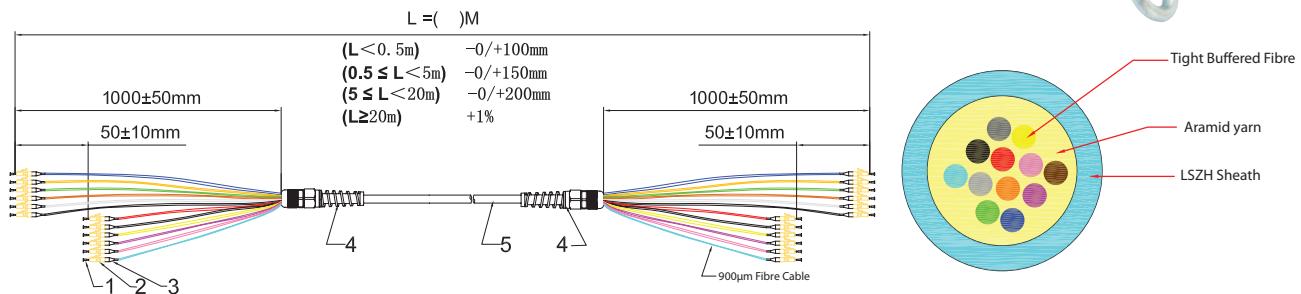
The cable diameters shown apply to all multimode and single mode cable. Cables with core counts of 48 and 72 are constructed from 12 fibre sub units, below 48 core each cable is constructed from the required number of cores packed within Kevlar and a single outer sheath.

No Of Fibre Cores	Cable Diameter (mm)	Cable Weight kg/km	Tube Diameter (mm)
8	5.6	27	19
12	6.2	38	25
16	6.8	42	25
24	7.8	61	25
48	17.0	170	45
72	21.0	300	45



## Distribution Cable

Tight buffered distribution cable is available from 4 core through to 48 core in OM3, OM4 and OS2, specification terminated with SC or LC connectors. This makes this option ideal for backbone panel to panel and intra-building links.

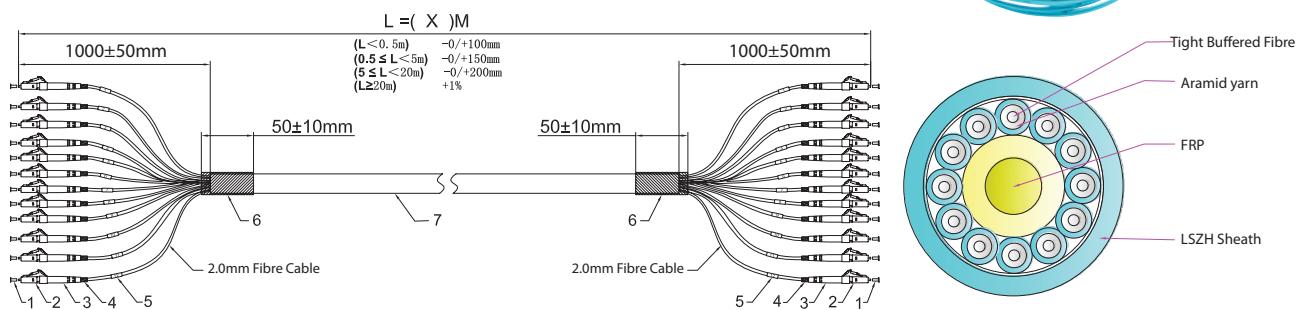


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Drawing Ref	Description	Qty
1	LC (or connector as specified) Dust Cover	Core Count Specific
2	LC (or connector as specified) 0.9mm connector	Core Count Specific
3	LC (or connector as specified) 0.9mm strain relief boot	Core Count Specific
4	Gland / splitter assembly, Black	2
5	Distribution cable LSOH. Core count and Performance category customer specified	Customer specified

## Breakout cables

2mm buffered ruggedised fibre contained within an outer sheath, available in increments from 2 core through to 48 core in OM3, OM4 and OS2 specification terminated with SC or LC connectors. This option is designed for direct equipment to equipment or patching connectivity.



Drawing Ref	Description	Qty
1	LC (or connector as specified) Dust Cover	Core Count Specific
2	LC (or connector as specified) connector	Core Count Specific
3	LC (or connector as specified) 2mm strain relief boot	Core Count Specific
4	2.0MM Fanout Fibre Cable, 0.5Mtr as standard	Core Count Specific
5	Identification Cable	Core Count Specific
6	Heatshrink, Black	2
7	Break-out cable LSOH. Core count and Performance category customer specified	Customer specified

## Mini Breakout cables

Excelerator pre terminated Mini Break-out cables are constructed from multi core tight buffered fibre cable

Standard cable assemblies are designed to offer a high degree of flexibility through available features and options and include choices of multimode and singlemode, core counts and connector style's allowing each cable to be manufactured to fit the exact application.

Typically cables are terminated on both ends with matched connectors at ends A and B, however Excel can supply mixed connector styles for example LC to SC if required.

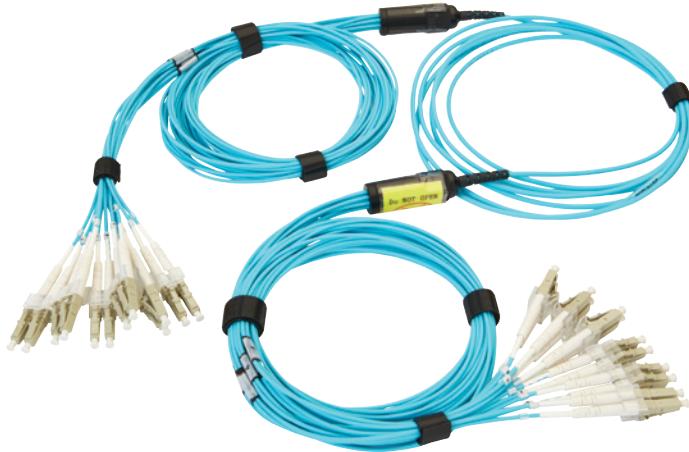
As standard the length of each fan out for all core counts between 8 and 48 core cables is 1 metre +/- 50mm, whether 2.0mm diameter tight buffered cable or 900 micron tubes.

The 900 micron tubes are staggered in groups of 6 or 12 cores to aid with dressing within the fibre panels with the distance between each group being 35mm. They are protected by means of a transparent protection tube to which a ring style pulling eye is fixed to one end of the cable assembly. 2.0mm fan outs are constructed to the same length.

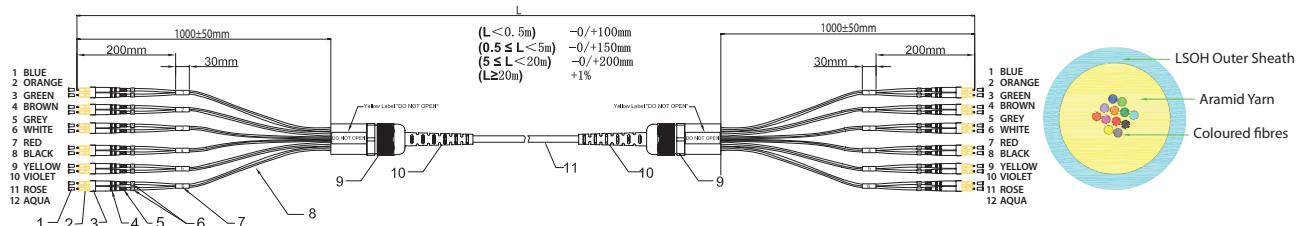
Unless requested all cables lengths are measured from tip to tip of connectors, where fan outs are staggered, this length is measured from longest fan out core to the longest fan out core.

Each cable is fitted with strain relief cable glands so that they may be fitted directly to the rear of an Excel Fibre Optic Patch Panel. A generic cable identification label is affixed to each end of the assembly 50 mm from the gland; customer specific labelling schemes can be applied on request.

Excelerator Pre-Terminated Mini Break-out cables are extremely compact, lightweight and robust. This together with the range of core counts, and connectivity available make them ideal for use as link from patch panel to equipment, patch panel to patch panel, patch panel to consolidation points, or rack to rack links.



S5



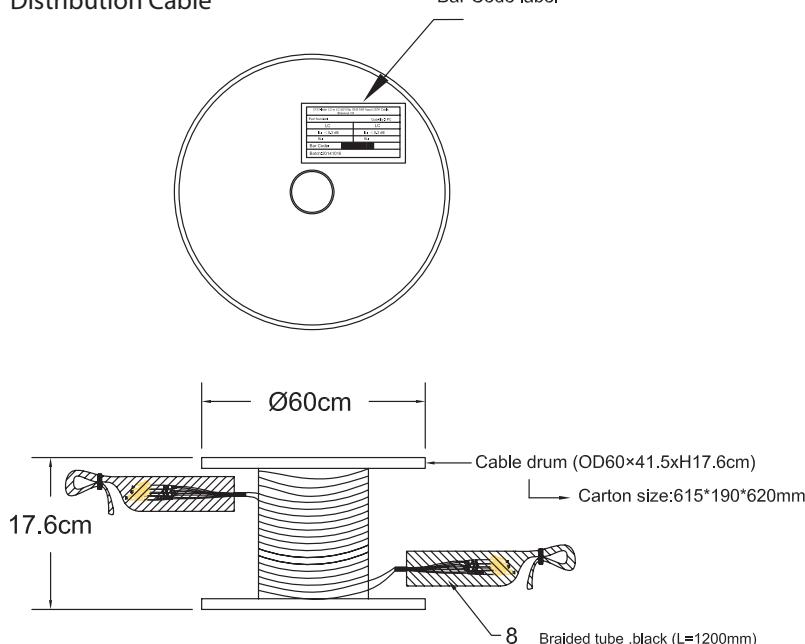
Drawing Ref	Description	Qty
1	LC (or connector as specified) Dust Cover	Core Count Specific
2	LC (or connector as specified) Simplex connector	Core Count Specific
3	LC (or connector as specified) clip, clear - allows connector polarity to be 'switched'	Core Count Specific
4	LC (or connector as specified) strain relief boot	Core Count Specific
5	LC (or connector as specified) heatshrink tube	Core Count Specific
6	A ring / B ring 'leg identifier'	Core Count Specific
7	Channel (pair of fibres identification, eg number 1-6 in 12 core cable)	Core Count Specific
8	Fan out tubing - 900 micron or 2.0mm	Core Count Specific
9	Gland / splitter assembly, black	2
10	Strain relief boot	
11	Mini Break-out cable LSOH. Core count and Performance category customer specified	Customer specified



## Packaging

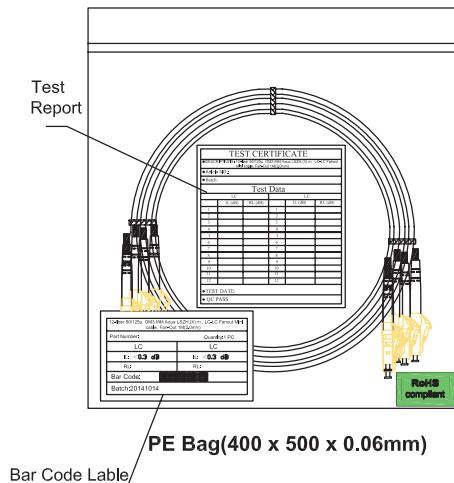
The Excelerator Pre-terminated solutions are packaged and labelled as follows:

Distribution Cable



Bar Code label

Breakout/Mini Breakout Cables



TEST CERTIFICATE					
• DESCRIPTIONS: 12-fiber 50/125µ OM3 MM Aqua LSZH,(X) m , LC-LC Fanout Mini cable, Fan-Out 1M(2.0mm)					
• Article NO.:					
• Batch:					
Test Data					
LC		LC		LC	
IL (dB)	RL (dB)	IL (dB)	RL (dB)	IL (dB)	RL (dB)
1		1			
2		2			
3		3			
4		4			
5		5			
6		6			
7		7			
8		8			
9		9			
10		10			
11		11			
12		12			
• TEST DATE:					
• QC PASS					

Test Report

12-fiber 50/125µ OM3 MM Aqua LSZH,(X) m , LC-LC Fanout Mini cable, Fan-Out 1M(2.0mm)	
Part Number:	Quantity:1 PC
LC	LC
IL: <0.3 dB	IL: <0.3 dB
RL:	RL:
Bar Code:	
Batch:20141014	

Bar Code Label (100mmX60mm)

## Pre-terminated Video

View the Excel Pre-terminated video which shows how to install a pre-terminated Distribution Cable fibre solution.

[Pre-terminated fibre video](#)

## Enquiring couldn't be simpler!

We've developed an online Excelerator configurator that helps you to choose exactly what you need by selecting the relevant criteria.

[Pre-Termination configurator tool](#)

Once you've chosen your requirements the configurator will provide you with a detailed drawing and a Bill of Materials (BOM) which can be emailed to our sales team to produce a quotation.

Alternatively we've produced an Excelerator Check List that runs through all of the information that we need to be able to provide you with a quotation.

# Excelerator Fibre Pre-terminated Checklist

**excel**  
without compromise.

Company Name:			
Contact Name:	Customer Site:		
Date of Enquiry:	Date Required:		

- |                 |                          |  |
|-----------------|--------------------------|--|
| Distribution:   | <input type="checkbox"/> | Distribution Cables are made from tight buffered fibre contained within 900 micron coloured tubes, they are intended for use, as inside panel to inside panel, rack to rack or backbone links.                               |
| Break out:      | <input type="checkbox"/> | Breakout Cables are made from individual 2mm tight buffered fibre tubes contained within an outer sheath.  |
| Mini Break out: | <input type="checkbox"/> | This is the smallest trunk cable size, and uses a special manifold/splitter to break out the fibre into either 900 micron for use inside patch panels or 2mm tubes for connection to the front of a patch panel or a switch. |

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Category: OM3, OM4, OS2, other		Length: (measured tip to tip)	
--------------------------------	--	-------------------------------	--

**Note:**

(Length < 0.5m} -0/+100mm  
 (0.5 L<5m} -0/+150mm  
 (5 L<20m} -0/+200mm  
 (L20m} +1%

**Note:**

Standard fan-out lengths for Trunk and Distribution Cables - 1000mm

Standard fan-out lengths for Break out & Mini Break out - 1000mm

(Ensure this is understood when calculating length)

Connector A, Type:	Connector B, Type
LC	<input type="checkbox"/> LC
SC	<input type="checkbox"/> SC
SC/APC	<input type="checkbox"/> SC/APC
LC/APC	<input type="checkbox"/> LC/APC
FC	<input type="checkbox"/> FC
ST	<input type="checkbox"/> ST
6 x LC Duplex Fibre Module	<input type="checkbox"/> 6 x LC Duplex Fibre Module

**Note:** (For use with Distribution Cable and Multi-Use Panel)

Cores: 4, 8, 12, 16, 24, 48, 72, Other:	
---	--

**Staggered/Non Staggered:**

**Note:**

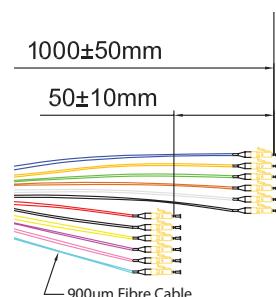
Stagger on Distribution Cable is 650mm and the connectors are grouped in bundles of 6.  
 Breakout and Mini Breakout cables are Non-Staggered as standard.

**Packaging:**

**Note:**

All Trunk and Distribution Cables will be supplied with Protection Tubes at both ends and pulling eye on one.

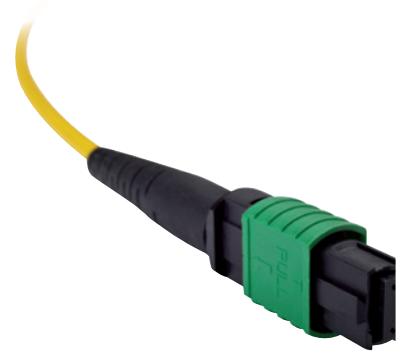
All Break out and Mini break out cables <10m will be supplied bagged and boxed above this length all assemblies will be supplied on a reel.





### Excelerator MTP® Solutions

The [Excel MTP fibre optic cabling system](#) provides a scalable, high density solution particularly suited for data centres or where space is at a premium and high availability is required. The system is suitable for OM3, OM4 and OS2 requirements, with the trunk cables offered in 12, 24, 36, 48, 72, 96 or 144 configurations. They have been designed and manufactured to support both the pre-terminated and the emerging 40/100 gigabit Ethernet fibre optic installations.



Using the US Conec MTP Elite® connector the Excel MPO (multiple-Fibre Push-On/Pull-Off) system ensures the superior performance with low loss properties.

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The MTP connector was introduced originally as a method of connecting 12 cores of fibre optic cable in a single connector. The original primary use was to offer a "plug and play" pre-terminated fibre optic solution.

Recently applications have been introduced, and are being developed, that require more cores of fibre per channel when using multimode fibre.

#### Applications – 40GbE and 100GbE

Amongst applications that will utilise the MTP connector. These are:

40GBASE SR4 – 40 Gigabit Ethernet

100GBASE SR10 – 100 Gigabit Ethernet

100GBASE SR4 – 100 Gigabit Ethernet

These applications will use multimode optical fibre, specifically OM4 category.

The Ethernet speeds described above will be obtained using parallel optical transmission. Parallel optics is based on multiple transmissions of 10 Gigabit Ethernet over fibre. This means that to support 40 Gigabit Ethernet, four transmit fibres and four receive fibres will be required. This will be achieved using the central 8 cores of the MTP.

100 Gigabit Ethernet (SR10) will use ten cores to transmit and ten to receive. This in turn will require 2 MTP links, each having the central 10 cores of the fibre being utilised. As 100 Gigabit Ethernet will use two MTP channels the connectors can be either stacked vertically or horizontally. The newer 100 Gigabit Ethernet (SR4) application will use four (Tx) and four (Rx) cores, permitting one MTP connector to support one channel.



## The Excel Excelerator MTP Range

The [Excelerator MTP®](#) portfolio has been configured to ensure that it will work with both 2 core channels and array cables. The trunk cables will be provided with pins, any future MTP® patch leads (used to connect the equipment to the patch panel) will be provided without pins.

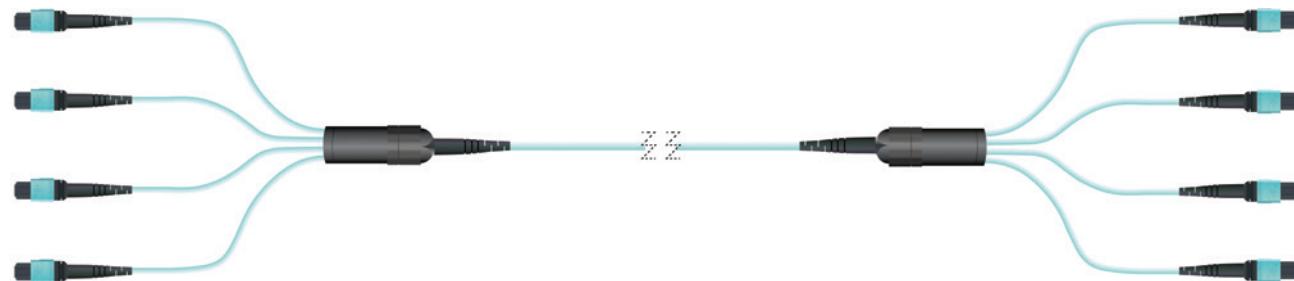
The MTP Elite® connector is manufactured with or without pins. The connection must be between one of each to ensure correct alignment of the fibre therefore the trunk cables will be provided with pins, any future MTP® patch leads (used to connect the equipment to the patch panel) will be provided without pins. The Excel MTP® portfolio follows the connecting method detailed in EN 50174-1:2009+A1:2011, TIA 568-C-3 method B and ISO14763-3 We can however, accommodate all polarity methods on request.

The [Excelerator MTP®](#) portfolio can work with both 2 core (duplex) channels and parallel array channels.

### [Excelerator MTP® Trunk Cables](#)

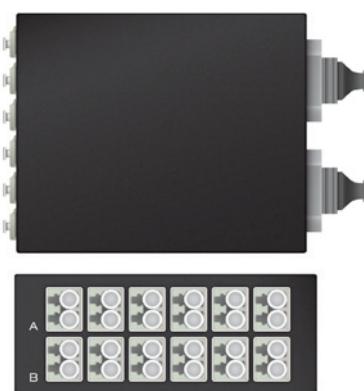
12, 24, 36, 48, 72 and 96 core assemblies are available. This corresponds to 1, 2, 3, 4, 6 or 8 MTP® connectors at each end contained within an additional outer sheath: Trunk cables are always pinned.

This length is always measured tip to tip so it is recommended to round up to the nearest metre in length and do not forget any vertical drops and "Service loops". Correctly managed service loops do not affect the performance of the fibre.



### [Excelerator MTP® Cassettes](#)

The MTP cassettes come in either 12 or 24 core LC and OM3, OM4 and OS2(APC) variations. The different Polarity method such as Method A and Method C is achieved with alternate cassettes at each end. However you don't need to worry about how this is achieved by answering some simple questions the Excel Sales Team can propose the correct solution for your needs.





### Excelerator MTP® Patch Panel Frames

There are two options for mounting the cassettes the [angled frame](#) can accept 4 and the [straight panel](#) accepts up to 5, which when populated with the 24 core LC cassette provides density of 120 fibre cores in 1U.

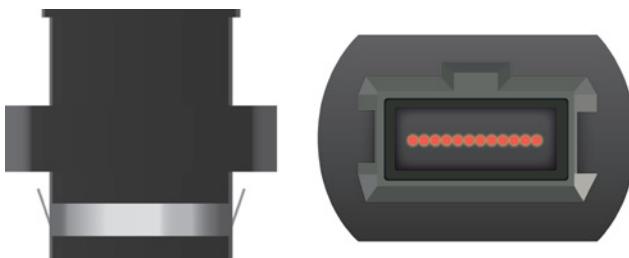


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The patch panel frames are sold unloaded. Any empty cassettes can be populated at a later date without disturbing existing services. The patch panels also allow a mix of fibre optic grades to be presented within the same patch panel.

### Excelerator MTP® Through Couplers

There are two options for mounting through couplers for use with the MTP-LC Fanout, they are the 6 port cassette replacement module or the [24 port panel](#).



### Excelerator MTP® Patch Leads

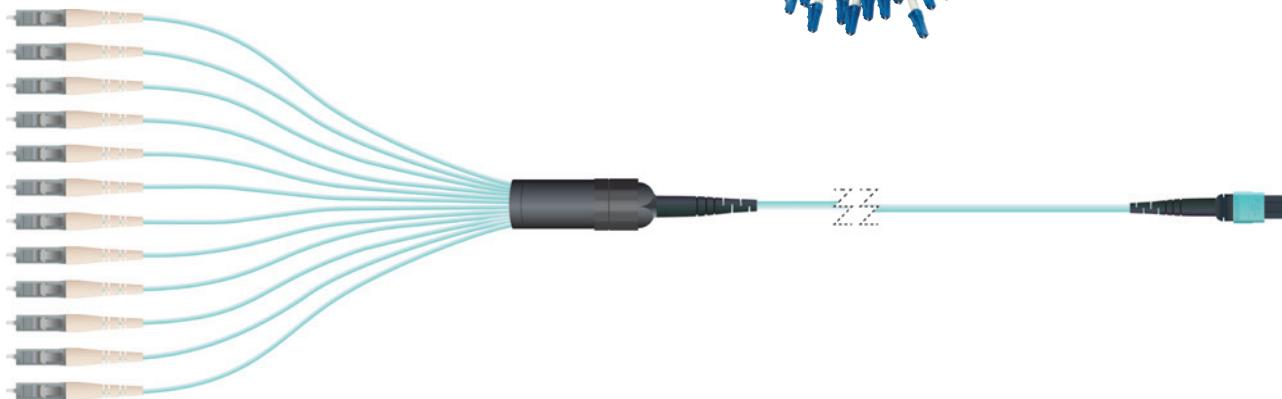
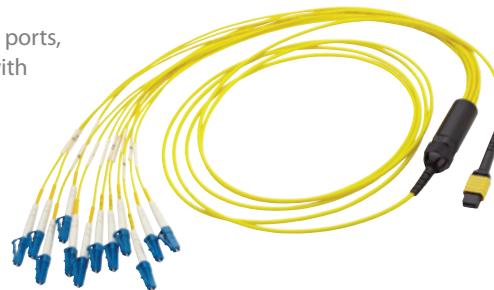
The MTP patch Leads are used for direct connection of equipment, they are available in both standard and custom lengths. Patch Leads are always unpinned.



## Excellerator MTP® – LC Fanout

These are used to connect from a through coupler panel directly into LC switch ports, they are available in OM3, OM4 and OS2(APC) variations and come complete with clips to convert the simplex LC fanout leads into duplex. The benefit of this approach is that it reduces the losses in the channel by one mated connection.

They are available in both standard and custom length however the actual length of the fanout is always 500mm.



S5

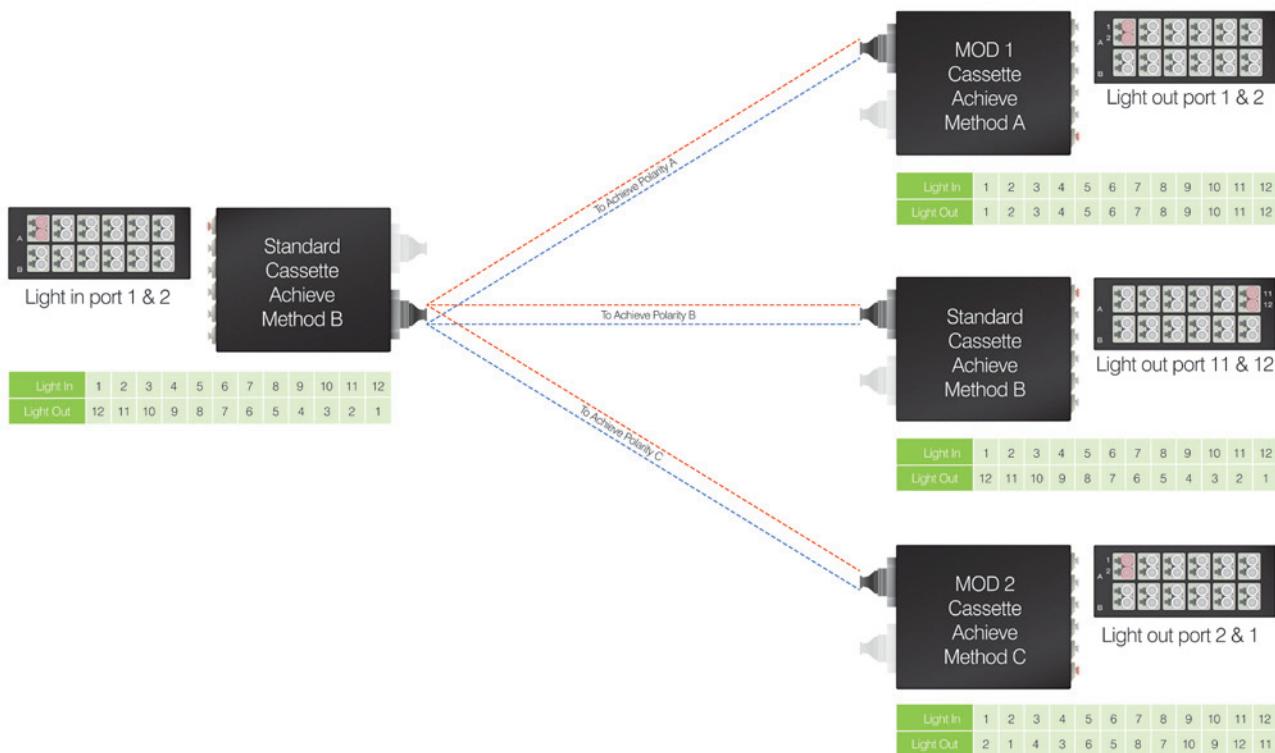
## MTP Polarity Methods

If you are unsure; if you put light in Core 1 where do you expect the light to come out?

**Answer:**

Core 1 – Method A, Core 12 – Method B, Core 2 – Method C

**NB.** You need a cassette at either end to achieve the desired polarity output.





# Excelerator MTP Pre-terminated Checklist

**excel**  
without compromise.

Company Name:			
Contact Name:		Customer Site:	
Date of Enquiry:		Date Required:	

Is it for existing site or a new install?

Do you know the Polarity you require?

Method A

Method B (EN50174-1/ISO 14763-3)

Method C

If unsure; if you put light in Core 1 where do you expect the light to come out?

**Answer:**

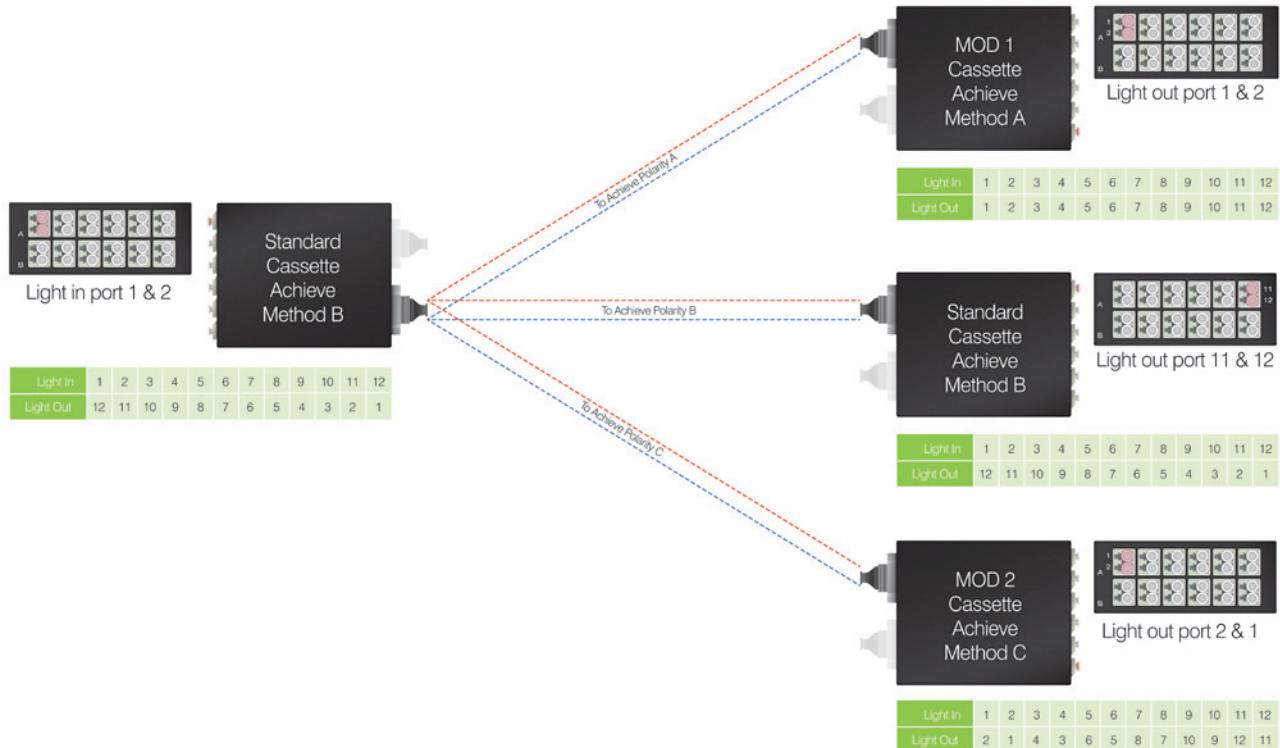
Core 1 - Method A

Core 12 - Method B

Core 2 - Method C

**NB.** You need a cassette at either end to achieve the desired polarity output.

Category: OM3, OM4, OS2(APC)			
Cassettes Required – Original 12 Core:	24 Core:	6 x LC Duplex Fibre Module:	
(For use with Multi-Use Panel)			







Qty:		Qty:		Qty:	
Category:		Category:		Category:	
Length:		Length:		Length:	

Qty:		Qty:		Qty:	
Category:		Category:		Category:	
Length:		Length:		Length:	

## MTP Fanout assemblies:

Qty:		Qty:			
Category: OM3, OM4, OS2, OS2		Category: OM3, OM4, OS2, OS2			
Connector: LC, LC/APC, SC, SC/APC		Connector: LC, LC/APC, SC, SC/APC			
Length:		Length:			

Qty:		Qty:			
Category: OM3, OM4, OS2, OS2		Category: OM3, OM4, OS2, OS2			
Connector: LC, LC/APC, SC, SC/APC		Connector: LC, LC/APC, SC, SC/APC			
Length:		Length:			

Qty:		Qty:			
Category: OM3, OM4, OS2, OS2		Category: OM3, OM4, OS2, OS2			
Connector: LC, LC/APC, SC, SC/APC		Connector: LC, LC/APC, SC, SC/APC			
Length:		Length:			

Qty:		Qty:			
Category: OM3, OM4, OS2, OS2		Category: OM3, OM4, OS2, OS2			
Connector: LC, LC/APC, SC, SC/APC		Connector: LC, LC/APC, SC, SC/APC			
Length:		Length:			

**Note:** Fanout section are 500mm

Singlemode MTP connector will be APC

# Excel Environ® Racks and Open Frames

## Section 6

### In this Section:

[Environ® Range Overview](#)

[Environ® Rack Quick Reference Chart](#)

[Environ® CR Series](#)

[Environ® ER Series](#)

[Environ® SR Series](#)

[Environ® OR Series](#)

[Environ® WR Series](#)

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## The Environ® Range

The Environ® range includes:



The **Environ® CR** standard Comms Rack range is supplied with a glass front and steel rear door. The CR range is designed with features, and functionality which make it ideal for LAN and security cabling installations and the housing of 19" mounted equipment such as switches, routers, storage and recording devices.

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The **Environ® ER** Equipment Rack provides the same set of design features as the CR series with the added benefit of a single wave design mesh front door and mesh style wardrobe rear doors providing, ventilation, strength, security, and great aesthetics. The ER range is ideal for the installation of cabling, networking, server and AV equipment.



The **Environ® SR** Server Rack range is designed to provide choice, functionality, and ease of use within high density server and equipment installations. With exceptional load bearing, split side panels, together with mesh design front and wardrobe rear door options, the SR range is ideal for data centre and enterprise equipment room installations.



The **Environ® OR** Open Rack solution has been refreshed to provide an even greater choice of vertical and horizontal cable management and is an ideal solution where there is a secure environment for the installation of high density copper and optical cabling.



The **Environ® WR** range of wall racks provide a wide choice of depths and heights. The WR series is designed for the installation of both cabling and equipment across a range of applications and are ideal for the housing of cabling, security and AV equipment.

Visit [www.excel-networking.com](http://www.excel-networking.com) to view a series of videos that show the features and benefits of the Environ® range and also run through the build from flat pack to fully assembled.

## Environ® - A Solution for Every Requirement

The Excel range of racks is extensive and we believe that we've got a quality solution to meet every installation requirement. To help you pick the product that's right for your requirement we've highlighted the key features and benefits below:



Key Features	Comms Rack	Equipment Rack	Server Rack	Open Rack	Wall Rack
U Size	15U 20U 24U 29U 33U 42U 47U	29U 42U 47U	29U 42U 47U	42U 48U 52U	6U 9U 12U 15U 18U 21U
Available Widths	600 mm 800 mm	600 mm 800 mm	600 mm 800 mm	600 mm	600 mm
Available Depths	600 mm 800 mm 1000 mm	600 mm 800 mm 1000 mm	1000 mm 1200 mm	75 mm 400 mm	390 mm 500 mm 600 mm
Load Capacity	600 kg	600 kg	1300 kg	1500 kg	63 kg - 390 60 kg - 500 60 kg - 600
Colour	Grey White Black	Grey White Black	Grey White Black	Black	Grey White Black
19" Profiles	Front & Rear	Front & Rear	Front & Rear	Front	Front & Rear
1U height markings	✓	✓	✓	✓	
19" Profiles - adjustable position	✓	✓	✓		✓
Quick release doors	✓	✓	Secure lift off doors		✓
Swing lock handle on front door	✓	✓	✓		
Multi-point locks			✓		
Front door	Glass	Wave Vented full width	Wave Vented full width		Glass
Rear door	Single steel	Double vented	Double vented		
Removeable side panels	✓	✓	✓		✓
150 mm Cable Tray			800 mm width only		
High capacity vertical cable management	800 mm width only	800 mm width only	800 mm width only	Optional Accessories	
Jacking feet & load bearing castors as standard	✓	✓	✓		
Available flat pack	✓	✓	✓	✓	✓
Available from stock	✓	✓	✓	✓	✓

## Environ® CR Series



The Key features of the [Environ® CR](#) range include:



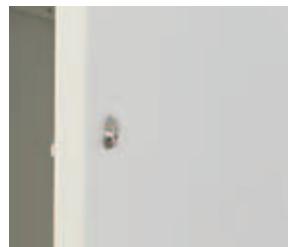
- Swing handle cam lock fitted to glass front door



- Large cut out in base for cable entry



- 19" profiles marked with U height position



- Barrel lock fitted to steel rear door



- Full height front and rear adjustable 19" profiles



- Multiple brush strip cable entry in roof and base



- Side panels are lockable and racks can be bayed with or without side panels



- High density vertical cable management  
– 800 series only



- Jacking feet and castors can be fitted simultaneously



- Vented Roof

## Environ® CR600 – 600mm Wide Comms Rack

The Environ® CR600 is a versatile range of 600 mm wide racks fitted with a glass front door. Designed to accommodate a load of up to 600 kg and available in a range of heights and depths they offer features that make them suitable for a wide range of applications in the data, security, audio visual and telecommunication arenas.

### Features

- 15U to 47U high
- 600, 800 or 1000 mm deep
- Grey White or Black colour
- 600 kg load capacity
- Can be bayed with or without side panels
- Jacking feet included
- Baying kit included
- Large cut out in base for cable entry
- Heavy duty lockable castors included
- Jacking feet and castors can be fitted simultaneously
- Multiple brush strip cable entry in roof and base
- Aesthetically pleasing framed glass front door
- Swing handle cam lock fitted to glass front door
- Barrel lock fitted to steel rear door
- Full height front and rear adjustable 19" profiles
- Galvanised steel 19" mounting profiles
- 19" profiles marked with U height position
- Supplied assembled or flat pack
- Removable side panels
- Left or right hinge door



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### Product Specification

Standard	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
Material	SPCC Cold Rolled Steel
19" Rails	2.0 mm thick
Side Panels	1.0 mm thick
Other	1.2 mm thick
Colour	Grey White - RAL 9002 Black - RAL9004
Load capacity	600 kg (Static)
Front door lock	Single point cam lock swing handle
Rear door lock	Single point barrel lock
Side panels lock	Single point barrel lock



### Environ® CR800 – 800mm Wide Comms Rack



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The Environ® CR800 is a versatile range of 800 mm wide racks fitted with a glass front door. Designed to accommodate a load of up to 600 kg and available in a range of heights and depths they offer features that make them suitable for a wide range of applications in the data, security, audio visual and telecommunication arenas.

#### Features

- 24U to 47U high
- 600, 800 or 1000 mm deep
- Grey White or Black colour
- 600 kg load capacity
- Can be bayed with or without side panels
- Jacking feet included
- Baying kit included
- Large cut out in base for cable entry
- Heavy duty lockable castors included
- Jacking feet and castors can be fitted simultaneously
- Multiple brush strip cable entry in roof and base
- Aesthetically pleasing framed glass front door
- Swing handle cam lock fitted to glass front door
- Barrel lock fitted to steel rear door
- Full height front and rear easily adjustable 19" profiles
- Galvanised steel 19" mounting profiles
- 19" profiles marked with U height position
- Supplied assembled or flat pack
- High density vertical cable management
- Removable side panels
- Left or right hinge door

#### Product Specification

Standard	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
Material	SPCC Cold Rolled Steel
19" Rails	2.0 mm thick
Side Panels	1.0 mm thick
Other	1.2 mm thick
Colour	Grey White - RAL 9002 Black - RAL9004
Load capacity	600 kg (Static)
Front door lock	Single point cam lock swing handle
Rear door lock	Single point barrel lock
Side panels lock	Single point barrel lock

## Environ® ER Series

The Key features of the [Environ® ER](#) range include:



- Wave design mesh front door



- Wardrobe style double mesh rear doors



- Swing handle 2 point lock fitted to front door



- Multiple brush strip cable entry in roof and base



- Side panels are lockable and can be bayed with or without side panels



- High density vertical cable management  
– 800 series only



- Jacking feet and castors can be fitted simultaneously



- 19" profiles marked with U height position



- Full height front and rear adjustable 19" profiles



- Vented Roof



### Environ® ER600 – 600mm Wide Equipment Rack



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The Environ® ER600 is a versatile range of 600 mm wide racks fitted with a wave design mesh front door and wardrobe style double mesh rear doors. Designed to accommodate a load of up to 600 kg and available in a range of heights and depths they offer features that make them suitable for a wide range of applications in the data, security, audio visual and telecommunication arenas.

#### Features

- Available in 29U, 42U and 47U heights
- Baying kit included
- 600, 800 or 1000 mm deep
- Can be bayed with or without side panels
- Grey White or Black colour
- 600 kg load capacity
- Jacking feet included
- Large cut out in base for cable entry
- Heavy duty lockable castors included
- Multiple brush strip cable entry in roof and base
- Wave design mesh front door
- Jacking feet and castors can be fitted simultaneously
- Swing handle 2 point lock fitted to front door
- Swing handle 3 point lock fitted to rear doors
- Wardrobe style double mesh rear doors
- 70% ventilation front and rear doors
- Full height front and rear adjustable 19" profiles
- Galvanised steel 19" mounting profiles
- Supplied assembled or flat pack
- 19" profile depth markings for easy adjustment
- 19" profiles marked with U height position
- Removable side panels
- Left or right hinge full door

#### Product Specification

Standard	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
Material	SPCC Cold Rolled Steel
19" Rails	2.0 mm thick
Side Panels	1.0 mm thick
Other	1.2 mm thick
Colour	Grey White - RAL 9002 Black - RAL9004
Load capacity	600 kg (Static)
Front door lock	2 point swing handle cam lock
Rear door lock	3 point swing handle cam lock
Side panels lock	Single point barrel lock

## Environ® ER800 – 800mm Wide Equipment Rack

The Environ® ER800 is a versatile range of 800 mm wide racks fitted with a wave design mesh front door and wardrobe style double mesh rear doors. Designed to accommodate a load of up to 600 kg and available in a range of heights and depths they offer features that make this rack suitable for a wide range of applications in the data, security, audio visual and telecommunication arenas.

### Features

- Available in 29U, 42U and 47U heights
- Wardrobe style double mesh rear doors
- Baying kit included
- 70% ventilation front and rear doors
- 600, 800 or 1000 mm deep
- Full height front and rear adjustable 19" profiles
- Can be bayed with or without side panels
- Galvanised steel 19" mounting profiles
- Grey White or Black colour
- Supplied assembled or flat pack
- 600 kg load capacity
- 19" profile depth markings for easy adjustment
- Jacking feet included
- Large cut out in base for cable entry
- Removable side panels
- Heavy duty lockable castors included
- Left or right hinge full door
- Multiple brush strip cable entry in roof and base
- Wave design mesh front door
- Swing handle 2 point lock fitted to front door
- Swing handle 3 point lock fitted to rear doors
- Jacking feet and castors can be fitted simultaneously

### Product Specification

<b>Standard</b>	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
<b>Material</b>	SPCC Cold Rolled Steel
<b>19" Rails</b>	2.0 mm thick
<b>Side Panels</b>	1.0 mm thick
<b>Other</b>	1.2 mm thick
<b>Colour</b>	Grey White - RAL 9002 Black - RAL9004
<b>Load capacity</b>	600 kg (Static)
<b>Front door lock</b>	2 point swing handle cam lock
<b>Rear door lock</b>	3 point swing handle cam lock
<b>Side panels lock</b>	Single point barrel lock



S6

## Environ® SR Series



The Key features of the [Environ® SR](#) range include:



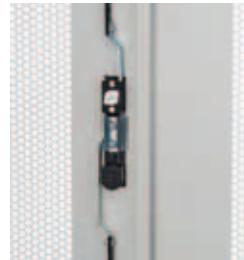
- Wave design mesh front door



- Wardrobe style double mesh rear doors



- Swing handle 2 point lock fitted to front door



- Swing handle three point lock fitted to rear doors



- Quick release hinged side panels  
- 42U and 47U only



- High density vertical cable management  
- 800 series only



- Jacking feet and castors can be fitted simultaneously



- Brush strip style cable entry in roof



- Full height front and rear adjustable 19" profiles



- Removable base panels for optimum airflow control

## Environ® SR600 – 600mm Wide Server Rack

The Environ® SR600 is a versatile range of 600 mm wide racks fitted with a wave vented front door and double vented rear doors. Designed to accommodate a load of up to 1300 kg and available in a range of heights and depths they offer features that make them suitable for a wide range of applications in the data centre and telecommunications arenas.

### Features

- Available in 29U, 42U and 47U heights
- Baying kit included
- 1000 or 1200 mm deep
- Can be bayed with or without side panels
- Grey White or Black colour
- Jacking feet included
- 1300 kg load capacity
- Removable and sliding base panels for cable entry
- Brush strip style cable entry in roof
- Heavy duty lockable castors included
- Jacking feet and castors can be fitted simultaneously
- Wave design mesh style front door
- Swing handle two point lock front door
- Wardrobe style double mesh rear doors
- Swing handle three point lock rear doors
- Full height front and rear adjustable 19" profiles
- Galvanised steel 19" mounting profiles
- Supplied assembled or flat pack
- 19" profiles marked with U height position
- 70% ventilation front and rear doors
- Quick release hinged doors
- Doors open 235° / 180°
- Removable side panels - horizontally split on 42U and 47U



S6



### Product Specification

<b>Standard</b>	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
<b>Material</b>	SPCC Cold Rolled Steel
<b>19" Rails</b>	2.0 mm thick
<b>Top bar</b>	1.5 mm thick
<b>Door, top panel and side frame</b>	1.2 mm thick
<b>Other</b>	1.0 mm thick
<b>Colour</b>	Grey White - RAL 9002 Black - RAL9004
<b>Load capacity</b>	1300 kg (Static)
<b>Front door lock</b>	2 point swing handle cam lock
<b>Rear door lock</b>	3 point swing handle cam lock
<b>Side panels lock</b>	Single point barrel lock



### Environ® SR800 – 800mm Wide Server Rack



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The Environ® SR800 is a versatile range of 800 mm wide racks fitted with a wave vented front door and double vented rear doors. Designed to accommodate a load of up to 1300 kg and available in a range of heights and depths they offer features that make them suitable for a wide range of applications in the data centre and telecommunications arenas.

#### Features

- Available in 29U, 42U and 47U heights
- Baying kit included
- 1000 or 1200 mm deep
- Can be bayed with or without side panels
- Grey White or Black colour
- Jacking feet included
- 1300 kg load capacity
- Removable and sliding base panels for cable entry
- Brush strip style cable entry in roof
- Wave design mesh style front door
- Heavy duty lockable castors included
- Jacking feet and castors can be fitted simultaneously
- Swing handle two point lock front door
- Wardrobe style double mesh rear doors
- Swing handle three point lock rear doors
- High density vertical cable management
- Full height front and rear adjustable 19" profiles
- Galvanised steel 19" mounting profiles
- Supplied assembled or flat pack
- 19" profiles marked with U height position
- 70% ventilation front and rear doors
- Quick release hinged doors
- Doors open 235° / 180°
- 150 mm cable tray included
- Removable side panels - horizontally split on 42U and 47U

#### Product Specification

Standard	ANSI/EIA-310-E - IEC 60297-2 - DIN 41494 Part 1 & 7
Material	SPCC Cold Rolled Steel
19" Rails	2.0 mm thick
Top bar	1.5 mm thick
Door, top panel and side frame	1.2 mm thick
Other	1.0 mm thick
Colour	Grey White - RAL 9002 Black - RAL9004
Load capacity	1300 kg (Static)
Front door lock	2 point swing handle cam lock
Rear door lock	3 point swing handle cam lock
Side panels lock	Single point barrel lock

## Environ® OR Series - 2 Post Open Rack

The Environ® OR series of open racks are designed for the mounting of patch panels and networking equipment in secure environments or in locations where space does not allow for the use of a standard rack. Each frame is constructed from rigid aluminium and supported by heavy duty top and base cross members which enable static load bearing of up to 1500kg. A choice of heights, upto 52U are available in a standard 2 post 75mm deep rack. For deeper options or 4 post requirements, two of the 2 post racks are installed with a set of adjustable depth members allowing total useable depth of 400mm. Each profile has U height numbering and pre threaded conductive M6 tapped holes for quick and easy equipment installation. Each rack is supplied flat pack with all required fixings and installation instructions. A wide range of high density vertical and horizontal cable management solutions are available to suit each rack.

### Features

- 2 post rigid aluminium construction
- Available in 42U, 48U and 52U heights
- 19" profiles marked with U height positions
- 1500kg static load bearing
- M6 threaded 19" profiles
- Available with adjustable depth profiles
- Simple Bolt Together Assembly
- Compatible high density cable management
- Supplied flat packed
- DIN41494 compliant
- Heavy duty top and base cross members
- 25 Year System Warranty Available

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### Product Specification

Standard specification	DIN 41494 compliant
Rack Material	Aluminium
Paint Coating	Black - RAL9005
Supply	Flat Pack
U Frames	2 pieces
Base Plates	2 pieces
Upper cross member	2 pieces
M6 self tap screws	30 pieces





### Environ® OR Series - High Density Cable Management



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The Environ® OR series of cable management solutions are designed for standard through to high density cable management within enterprise and data centre environments. The vertical designs are specifically relevant where the use of angled patch panels, or ports is preferred due to the required port density.

Options are available in a range of widths with front only, or front and rear management, each based on the same core design.

Each manager has a rear frame manufactured from powder coated welded sheet steel and is fitted with full height, ABS plastic cable management finger assemblies which have a rounded finish to prevent cable damage or stress.

Each frame has a full height hinged door manufactured from formed and powder coated aluminium to provide a strong but lightweight finish to any installations. The doors can be locked to secure cable access, and via simple fitted twist handles can hinge from left to right, or right to left. The door is fixed to the cable management frame at the top and base, enabling maximum access to installed cables, and is easily removed when required.

Within each vertical management unit 8" wide and above are cable spools and letterbox cutouts to assist management of excess cable, or patching to rear or adjacent frames.

The horizontal range can be supplied in either 2U or 3U designs. Each are assembled from a powder coated steel back or mid plate, with front only, or front and rear cable management fingers and a hinged 'lid/face' which snaps lock at the top and bottom to protect cables and provide an aesthetically pleasing finish.

#### Features

- Vertical design available in 42U, 48U and 52U heights
- Horizontal design available in 2U, 3U and 4U
- Vertical design available in range of depth and width options
- Manage in excess of 1500 Category 6 cables
- ABS cable management fingers
- Rounded cable management fingers to avoid cable damage
- Lockable aluminium double hinge doors
- Doors open left to right, or right to left
- Cable spools in vertical design from 8" wide and above
- End panels available
- Pass though cut outs in vertical design from 8" wide and above
- Quick and easy to fit to Environ® OR racks, fixings supplied
- Ideal for use with angled patch panel or ports
- Free standing or fix to Environ® OR racks
- Aesthetically pleasing design

## Environ® WR Series - Wall Mounted Racks

Environ® wall mounted racks are available in a choice of 390mm, 500mm and 600mm depths. They are designed for the installation of both cabling and equipment and are ideal for use across a range of applications including local area networking (LAN) cabling and hardware, and the housing of security, audio and visual equipment.

A full range of Excel accessories are available to complete cable or equipment installation from shelving through to ventilation and power distribution units.

### Features

- Choice of 390mm, 500mm and 600mm depths
- Fully adjustable front and rear 19" mounting profiles
- Available in 6 heights, 6U, 9U, 12U, 15U, 18U and 21U
- Removable cable entry panel in top and base providing easy access to install cables and equipment. NB. The back is not removable.
- Available in grey and black
- Aesthetically pleasing framed safety glass front door
- Available as a flat pack
- Load carrying capacity 63kg on 390mm and 60kg on 500mm and 600mm depths
- First fix mounting plate included as standard
- Quick release doors
- Lockable, quick release side panels for maximum access into rack
- Angled vented roof

### Product Specification

Material Thickness	
Rack Part	
Frame	1.20mm
Top cover and fan entry plate	1.20mm
19" mounting angles	1.50mm
Side panels	1.20mm
Front door frame	1.20mm
Front door glass	5.00mm

Product Standard Compliance	
Process/Part	Standard
Manufacturing facility	ISO 9001:2000
19" mounting angles	IEC60297-1
Overall rack dimensions	IEC60297-2
Load carrying capacity, 390mm	63kg
Load carrying capacity, 500mm and 600mm	60kg
Paint finish, grey rack	RAL 7044
Paint finish, black rack	RAL 9004
Paint finish, front door blue trim	RAL 5013
Glass door, safety specification	BS3193:1993
Surface treatment	Phosphate Coating



S6

S6

# CyberSPACE

[www.excel-networking.com](http://www.excel-networking.com)

Access industry leading educational resources such as Excel encyclopaedia, white papers, and case studies.

Our partner area enables warranty applications, brochures, end user targeted mailing pieces and the creation of personalised literature, including product specification sheets.

The image displays three screenshots of the Excel Networking website:

- Top Screenshot:** Shows the "SmallSPACE" product page with a banner, navigation menu, and a "Partner Area" sidebar containing links like "My Details", "My Warranties", "Branded Literature", "Asset Recovery", "Asset Library", "Technical Notes", and "Warranties".
- Middle Screenshot:** Shows the "Warranties" section under the "Partner Area". It includes a "Welcome Demo" sidebar and two boxes: "Add a New Warranty" (for new warranty details) and "Rejected Warranties" (for re-submission with amended details).
- Bottom Screenshot:** Shows the "Brochures" section under the "Partner Area". It includes a "Welcome Demo" sidebar and a list of brochure categories: "All Data Centre Patch Lead Management", "An Introduction to The Data Standard Catalogue", "Bios Filter", "Category A", "Everbloc DR Server Floor Standing Racks", "Everbloc DR Server Floor Standing Racks", "Everbloc DR Server Racks", "Instrumented Mounted Racks", "OpenRacks - Data Category A", "OpenRacks - Data Category B", "OpenRacks - Data PDUs", and "Basic Blanks - Data Catalogue".

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# Excel Power Distribution

## Section 7

### In this Section:

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## Power Distribution Units

**Power Distribution Units (PDUs)** are an important and often overlooked part of an infrastructure design and installation. At their simplest they deliver the power required for the equipment within the rack, more advanced units can provide management information on power consumption and local environmental conditions such as temperature and humidity. It is important to consider the PDU requirement at the rack installation stage rather than as an afterthought at the equipment installation stage. Making sufficient provision for the power will ensure the longevity and best use of the rack.

PDUs can be fitted in various different ways within the rack: front; rear; horizontal rack mount; vertical side mount. This may be dependent on –

- Available space in the rack
- Position of equipment
- Position of the power input for specific equipment

What capacity and how many PDU's should there be? For a rack that will be dedicated for equipment consideration should be made for dual power supply. In this case at least two PDUs will be required to provide the primary and secondary power supplies. This is typical for data centre and high importance communication rooms. Where racks are used to serve smaller locations and house a mixture of equipment and cabling then the requirement may be less. However, as networks and installations evolve over time the requirements change.

There are a variety of types of sockets including IEC C13 & C19 type used throughout the world. Additionally there are country specific types, such as the UK (BS1363), Schuko and NFC French styles.

Excel has Standard, Modular, Monitored and Managed PDUs to suit all requirements.

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## Efficiency Measurements

The more energy that is used in a data centre (or other facility) results in higher bills. These account for major ongoing costs in operation. Efficiency measurements are required to establish the performance of the data centre. Depending on the organisation or current trends these can be carried out in many different ways. The following two make the same comparison, just expressed in different ways.

### Power Usage Effectiveness

Power Usage Effectiveness (PUE) compares the energy used directly for the computer equipment with the total power used in the facility. The calculation is a simple formula:

$$PUE = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$

*Total Facility Energy* is a measure of all energy used including that consumed by the IT equipment. This includes, measuring the energy consumed as electricity, gas etc. *IT Equipment Energy* only relates to the energy used for the direction operation of the equipment. All energy measurements must be in the same units (or converted), for example kWh (kilowatt hours).

The resulting number does not have units. The aim is to reduce the PUE, with a PUE of 1 meaning only the IT Equipment uses energy. The typical PUE is difficult to quantify. However, the aim should always to be below 2.

### Data Centre Infrastructure Efficiency

Data Centre Infrastructure Efficiency (DCIE) is the inverse of PUE and is expressed as a percentage. Therefore the formula is:

$$DCIE = \frac{\text{IT Equipment Energy}}{\text{Total Facility Energy}}$$

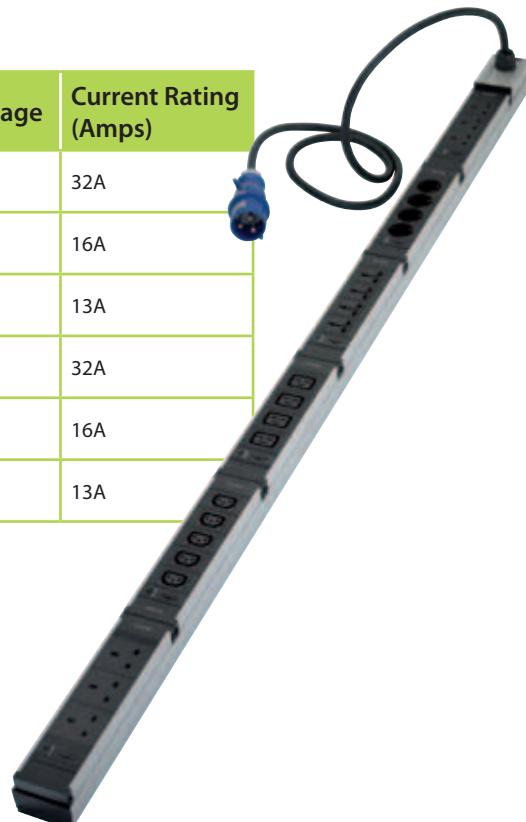
Using and recording the information that is supplied from the Excel Intelligent PDUs can help calculate the IT Equipment Energy usage, which in turn allows the PUE or DCIE to be calculated. Once the baseline figure is calculated steps can be put in place and the improvements may be measured.

## Excel Modular PDU Range

The Excel range of modular PDU's introduce flexibility and design options to suit your power requirements. A range of socket modules are available which snap into the housing quickly, easily and securely without the need for tooling.

First choose the empty housing hardware:

Part Number	No. of Modules Housed	Input Connectivity	Output Connectivity	Voltage	Current Rating (Amps)
555-050	6	(S)	Optional	250V	32A
555-051	6	(S)	Optional	250V	16A
555-052	6	(S)	Optional	250V	13A
555-053	5	(S)	Optional	250V	32A
555-054	5	(S)	Optional	250V	16A
555-055	5	(S)	Optional	250V	13A



Then pick your choice of power modules to go into your chosen housing.

You can mix and match socket styles to suit your requirements and be safe in the knowledge that you can change them at a future date with the 'snap in' connectivity.

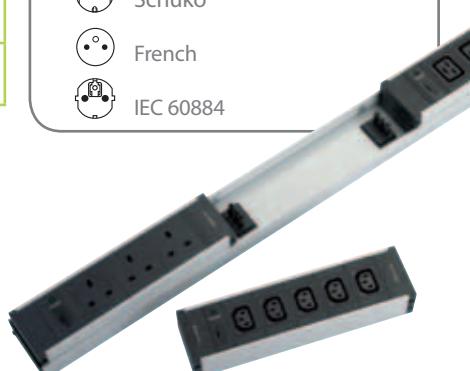
The Excel power modules may be added or removed safely without turning the power off. Installations of modular housing with empty positions is safe and makes provision for future power requirements without having to commit to the socket connectivity.

See below for the list of modules available.

Part Number	No. of Sockets	Feature	Output Connectivity	Voltage	Total Current Rating (Amps)
555-060	3	Fused	(S)	250V	16A
555-061	5	Fused	(S)	250V	10A
555-062	4	Fused	(S)	250V	16A
555-063	4	Fused	(S)	250V	10A
555-064	4	Fused	(S)	250V	16A
555-065	4	Fused	(S)	250V	16A

### CONNECTIVITY KEY

(S)	3 pin - BS1363
(S)	"Commando Style" IEC 60309
(S)	C13 - IEC60320
(S)	C19 - IEC60320
(S)	Universal - GST18
(S)	Schuko
(S)	French
(S)	IEC 60884



## Excel Standard PDUs

The Excel **Standard PDUs** are available in a variety of sizes and socket types. The horizontal PDUs have the mounting brackets at the front to allow attachment to the 19" profiles. The vertical PDUs have the mounting brackets at the rear to allow mounting to single 19" profile, side supports or flat surface. Note that vertical PDU's are sometimes referred to as Zero U, due to mounting outside of the vertical equipment mounting rails.



A range of input connectivity plugs are available to support different installation environments. The IEC 60309 "Commando style" plugs are utilised in Data Centres and other locations where the total current load for the PDU will exceed the standard domestic plug rating (UK BS1363, Schuko, French NFC. etc). It is becoming more common in rack installations to use either the C13 or C19 IEC output sockets. Within the range there are also PDUs with C14 and C20 Input Plugs so that a PDU may be connected direct to a rack mounted UPS (Uninterruptible power supply).

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Part Number	No. of Sockets	Switched	Filtered	Mounting Orientation	Input Connectivity	Output Connectivity	Voltage	Current Rating (Amps)
D13-4H-EXL	4	✓		Horizontal			250V	13A
D13-5H-EXL	5	✓		Horizontal			250V	13A
D13-6-EXL	6	✓		Vertical			250V	13A
D13-6H-EXL	6	✓		Horizontal			250V	13A
D13-8-EXL	8	✓		Vertical			250V	13A
D13-10-EXL	10	✓		Vertical			250V	13A
D13-12-EXL	12	✓		Vertical			250V	13A
D13-6HF-EXL	6	✓	✓	Horizontal			250V	13A
D13-8F-EXL	8	✓	✓	Vertical			250V	13A
D13-10F-EXL	10	✓	✓	Vertical			250V	13A
D13-12F-EXL	12	✓	✓	Vertical			250V	13A
D16-6H-EXL	6	✓		Horizontal			250V	16A
D16-8-EXL	8	✓		Vertical			250V	16A
D16-10-EXL	10	✓		Vertical			250V	16A
D16-12-EXL	12	✓		Vertical			250V	16A
D32-8-EXL	8	✓		Vertical			250V	32A
D32-10-EXL	10	✓		Vertical			250V	32A
D32-12-EXL	12	✓		Vertical			250V	32A
555-230	16	✓		Vertical		12  & 4	250V	32A
555-231	20	✓		Vertical		16  & 4	250V	32A
555-232	24	✓		Vertical		20  & 4	250V	32A
D13-6HIEC-EXL	6			Horizontal			250V	13A

Part Number	No. of Sockets	Switched	Filtered	Mounting Orientation	Input Connectivity	Output Connectivity	Voltage	Current Rating (Amps)
D13-6HIECF-EXL	6		✓	Horizontal			250V	13A
D13-8IECF-EXL	8		✓	Vertical			250V	13A
D13-10IEC-EXL	10			Vertical			250V	13A
D13-12IEC-EXL	12			Horizontal			250V	13A
555-240	6	✓		Horizontal			250V	10A
555-241	8	✓		Vertical			250V	10A
555-242	10	✓		Vertical			250V	10A
555-243	12	✓		Vertical			250V	10A
555-245	6	✓		Horizontal			250V	16A
555-246	8	✓		Vertical			250V	16A
555-247	10	✓		Vertical			250V	16A
555-248	12	✓		Vertical			250V	16A
555-250	6	✓		Horizontal			250V	10A
555-251	8	✓		Vertical			250V	10A
555-252	10	✓		Vertical			250V	10A
555-253	12	✓		Vertical			250V	10A
555-083	8			Horizontal			250V	16A
555-084	9			Horizontal			250V	16A
555-092	6	✓		Horizontal			250V	16A
555-093	8	✓		Horizontal			250V	16A
555-097	6			Horizontal			250V	16A
555-098	8			Horizontal			250V	16A

For the full range of PDU's available please visit [www.excel-networking.com](http://www.excel-networking.com)

## Excel Intelligent PDU Family



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The [Excel Intelligent PDU Family](#) offers a high specification portfolio of power distribution units that are designed to suit any environment, where monitoring or managing of information is required. Excel is able to offer a PDU with up to 48 sockets with any combination of socket type including UK, Schuko, C13, C19 etc.

We design and build everything in the UK, and have developed a wide range of products that cover the whole scale from overall monitored products to individual socket monitoring and individual socket switching.

With a turnaround of approx 10-14 days from order to manufacture and delivery, the Excel Intelligent PDU range provides total flexibility to allow you to build a solution that fits your individual requirement. From our experience there isn't an Intelligent PDU's of one size fits all' so we provide you with a simple build configuration to get exactly what you need.

Our range of products has been developed so they can work as individual masters or run as a master and slave system. We can have one master with up to 31 slaves, all from one IP address, reducing the requirement for multiple IP addresses. The Excel Intelligent PDU range also comes with free software making it a highly competitive solution allowing the user to monitor and report on up to 50 IP addresses with the software. In theory it is possible to have up to 1600 PDU's each with up to 48 outlets per PDU, all from one free software licence.

The Excel Intelligent PDU range provides billing quality accuracy to better than 1%, allowing the unit to be used in co-location centres for the monitoring and charging of power used.

Our system is designed for use in both single and 3 phase systems and to that end is designed with one monitoring board, but with a meter board at the beginning where the input power flows through, allowing them to sample the power 4000 times per second. This enables the units to measure the power at every point on the sine wave providing a very accurate result. Most Intelligent PDUs available only sample between 200 and 250 volts, so results are not as accurate, particularly with RMS voltages.

The meter board allows the unit to economically meter a 3 phase system, as it uses 3 meter boards, one per phase. If required the PDU can be split into 3 separate sections (for use in co-location facilities) and group the results for 3 separate users on the same power strip. Other possibilities are to measure both A and B feeds through one monitoring system.



# Excel Intelligent PDU Family

## The Excel Intelligent PDU Product Range

The [Excel Intelligent PDU range](#) is a highly flexible solution. All versions have a built-in Environmental centre which covers a series of functions. As standard the units have a local display this can be supplemented by an additional remote display that can be mounted on the front of a rack for easy reading.

### Excel INT1

Includes the necessary network and environmental ports plus a local RGB display. The information provided is as follows:

Local display via the RGB shows per phase:

- Kilowatts
- Voltage
- Overall amps (current)
- Cumulative Kw/hours
- True Power Factor

Overall PMS Unit shows per phase remotely:

- Kilowatts
- Frequency
- kWA
- Voltage
- Overall amps (current)
- Cumulative Kw/hours
- BTUs
- K/Joules
- Kg CO<sub>2</sub>
- True Power Factor

The unit can also provide the following optional environmental and security capabilities:

- 8 x temperature sensors (daisy chained through a single port)
- 1 x temperature and humidity sensor port
- 1 x door lock port
- 1 x key pad port
- 1 x door sensor port
- 1 x close contact port to allow connection of 3 devices
- Remote display port

### Excel INT2

As above plus monitoring at socket level.

- Amps
- kWh
- VA
- Watts

### Excel INT3

Includes both individual socket monitoring and individual socket switching

As INT2 with the following additional features:

- Per socket shows remotely:
  - Amps (current)
  - Cumulative Kw/hours
- Per socket switching

### Measurement Accuracy

The Meter board measures the complete AC waveform 4000 times a second to provide a class II billing quality measurement of RMS Volts, RMS Amps, Kilowatts, Power Factor, Frequency, and Internal PDU Temperature.

Additional measurements of Peak Volts, Peak Amps, and kVA are also available. These values are used to calculate kWh, BTU's, Kilograms of Co<sub>2</sub>, Kilojoules, and Energy Cost.





## Excel Intelligent PDU Family

### Building your Excel Intelligent PDU

Please follow these basic steps to build your Excel Intelligent PDU

#### Management Level

Choose from:

- INT1 - Local and remote overall powering
- INT2 - Local and remote overall and per socket monitoring
- INT3 - Local and remote overall and per socket monitoring and switching

#### Phase & Orientation

- 1V = Single Phase Vertical
- 3V = 3 Phase Vertical
- 1H = Single Phase Horizontal
- 3H = 3 Phase Horizontal

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#### Input & Power

- C14 = 10A
- C20 = 16A
- UK = 13A
- SCH = 16A
- Com16 = 16A Commando
- Com32 = 32A Commando
- X = Open Ended (i.e. no connector fitted, suitable for hard wiring)

#### Outlets - Quantity & Type

- UKL = UK 13A Left
- UKR = UK 13A Right
- SCH = Schuko
- C13 = 10A
- C19 = 16A
- Total number of sockets per PDU needs to be in multiples of 4 (these can be mixed i.e. 10 x C13 and 2 x C19 units)

#### Additional Outlet Options

- 2nd, 3rd or 4th outlet selection

#### Lead Length

- Add the length of lead required
- Add 'T' if required at the top of the unit and 'B' if at the bottom

NB. The standard length is 3 metres

# Excel Intelligent PDU Family

## Communications Protocol's

The [Excel Intelligent PDU](#) has embedded HTML web pages, which can be viewed as either HTTP or the more secure HTTPS. The web pages allow a user to Monitor and control the power usage of a PDU, as well as providing the interface to set up the PDU and commission it for use.

The PDU can also communicate via SNMP V1, 2, and 3, enabling the user to integrate the PDU's with their own software choice using a MIB file.

## RGB Display

As standard the PDU comes with a built in RGB Display, the display shows IP Address, kWh, and Volts, Amps, power factor and kilowatts per phase.

In the event of an alarm condition the display changes colour and flashes giving a visual representation of a problem.

An optional remote display can be fitted to the rack door or in a prominent position where the inbuilt display may be obscured at the rear of a rack.

## Socket Types



3 Pin - BS1363



BS1363 & C13 - IEC60320



C13 - IEC60320



C19 - IEC60320



Schuko

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# IntelligentPDU



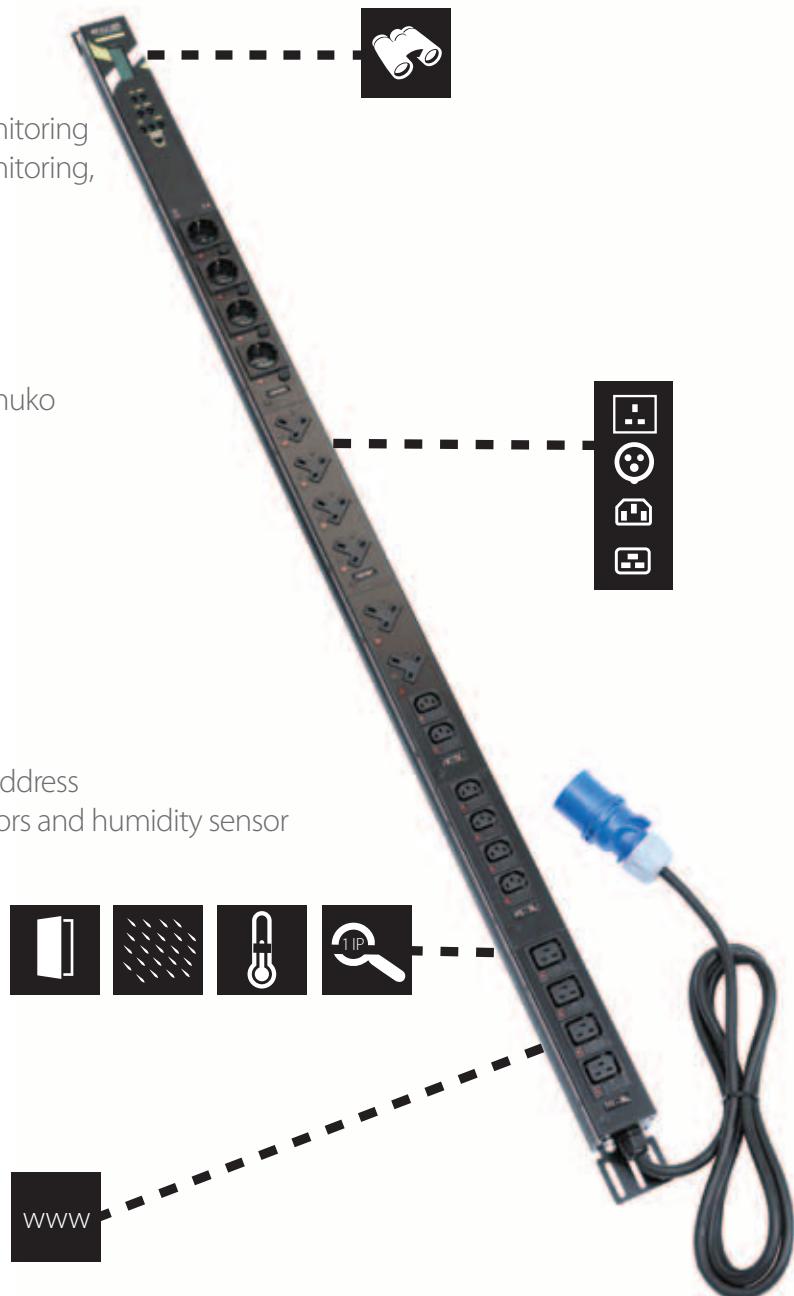
## PDUs Available

- Local & remote overall power monitoring
- Local & remote overall and per socket monitoring
- Local & remote overall and per socket monitoring, and power switching

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## Socket Types

- Any socket combination: C13, C19 and Schuko
- Locking
- Single or three phase
- 16 – 63 Amp
- Up to 48 sockets on one PDU



## Features

- UK design and manufacturer
- Short lead times
- Daisy chain up to 32 units together - 1 IP address
- Environmental ports - 8 temperature sensors and humidity sensor
- 3 volt free contacts
- Door control for up to 2 doors
- Remote LCD display
- Accuracy



## Control

- Web browser
- SNMP
- Mod-Bus
- Software (Free)
- Optional card reader port



## Excel Desktop Power Distribution Units



Excel [Desktop Power Distribution Units](#) offer a convenient addition to the work place. Available with either UK or Schuko power sockets and options for 6c apertures to accept data outlets and USB power in a stylish anodised aluminium finish, the PDUs are easily fitted to the desktop with the supplied clamps.

The Excel Desktop PDUs eliminate the need to scramble under the desk to connect up laptop and other power supplies. With the option of the 6c Apertures and the USB power points it increases the flexibility of any work area for the resident or casual occupant.

The USB outlets supply up to 2.1 amps permitting phones and tablets to be charged. An illuminated master power switch is fitted to each PDU. The power leads are supplied separately to ensure that the correct length is selected.

### Features

- Desktop mounting
- UK or Schuko Power Sockets
- USB Power Option
- Removable Power Cord
- Optional 6c Apertures
- Illuminated Master Power Switch

Part Number	UK Sockets	Schuko Sockets	USB Power	6c Apertures	Length	Height	Depth
555-270	2				166 mm	78 mm	91 mm
555-271	2			2	222 mm	78 mm	91 mm
555-272	2			4	282 mm	78 mm	91 mm
555-273	4			2	325 mm	78 mm	91 mm
555-274	4			4	386 mm	78 mm	91 mm
555-275	2		2	4	332 mm	78 mm	91 mm
555-276	4		2	4	436 mm	78 mm	91 mm
555-280		2			152 mm	78 mm	91 mm
555-281		2		2	208 mm	78 mm	91 mm
555-282		2		4	263 mm	78 mm	91 mm
555-283		4		2	296 mm	78 mm	91 mm
555-284		4		4	348.5 mm	78 mm	91 mm
555-285		2	2	4	314 mm	78 mm	91 mm
555-286		4	2	4	398 mm	78 mm	91 mm



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# MarketSPACE

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# Excel Voice Cabling Systems

## Section 8

### In this Section:

[Excel Voice Cabling System](#)

[Excel Connecting Hardware](#)

[Excel Frames](#)

[Line Jack Units – LJU](#)

[Design and Installation Considerations](#)

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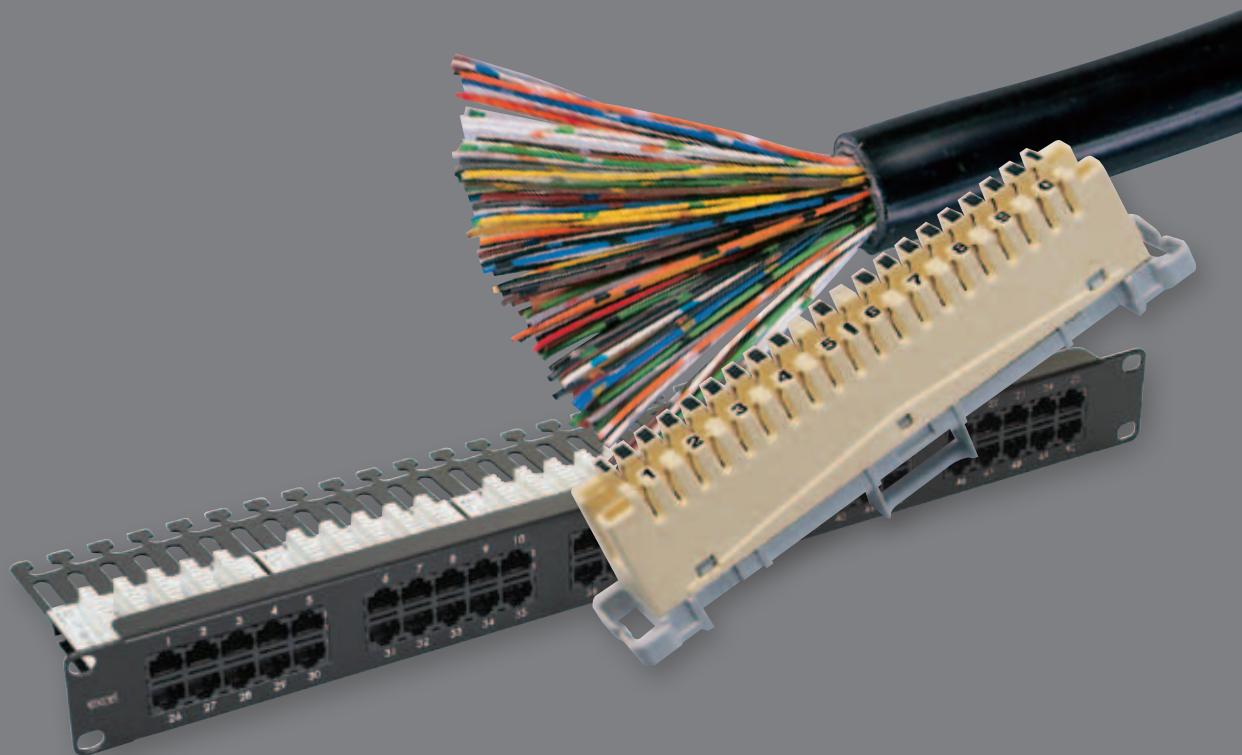
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## Excel Voice Cabling System

The [Excel range of Multipair Voice Cabling](#) is an end-to-end solution that includes both cables and connecting hardware in addition to mounting frames and accessories.

This product range owes its history to POTS (Plain Old Telephone Systems) and is based on the use of Analogue voice circuits. This means its design heritage may be traced back to BT, but it, in fact, goes back even further to the original Post Office Telecoms that BT was split from a long time ago. It is not classified in the same way as the Data Cabling Systems are.

In current times, Multipair Voice cabling systems are used primarily as Emergency Back-up systems such as Emergency Lift Phones and BT RedCare etc (or for Analogue Fax Services). Therefore the Excel Range of Multipair internal telephone cables and components are manufactured in accordance with the relevant BT types.

Some Tender Specifications call for Category 3 for Voice Cabling. By meeting the requirements of CW1308 Excel Voice cable also meets the requirements of Category 3.

### Cables

All the [cables](#) start with an individual conductor, the diameter size of which is 0.50 mm Nominal. Each conductor is insulated with PVC as per BS 6746 and the spark test is at 4.5 KVDC.



These Cores are twisted into pairs and the required number of pairs are then typically laid up in either layers for cables containing up to and including 25 pairs, or in units for items of 32 pairs and above. The pairs are colour coded for ease of identification and in larger pair count cables a coloured tape is used to wrap units of pairs to ease installation. An earth conductor of 1.38mm plain copper is included in certain larger pair count internal grade cables.

### CW Cables

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All cable sizes are based upon the number of pairs in the outer sheath and various lengths.

CW1308 comes in the following pair counts: 2,3,4,6,10,20,25,32,40,50,100,160,200,320. Cables generally have a white outer sheath, however black can be supplied in certain cables.

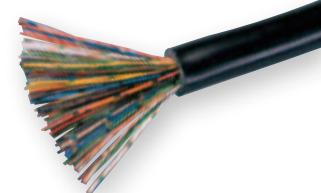
CW1308B are available in pair counts of 10,20,25,50,100,200.

CW1128 are available in pair counts of 5,10,20,50,100. This range is also available with two further 5 & 10 pair count cables with larger 0.9mm conductors. Typically for longer distance applications.

CW1128/1198 are available in 5,10 pairs.

### Cable Construction

- [\*\*CW1308\*\*](#) – Internal Grade Low Smoke and Fume Cable
  - These cables are manufactured in accordance with BT type CW1308.
- [\*\*CW1308B\*\*](#) – Internal/External Grade Low Smoke Zero Halogen Cable
  - Is constructed in a similar way to Standard CW1308 but is suitable for Internal and External use due to a UV resistant jacket. The cable's specification is further enhanced by the use of Low Smoke Zero Halogen (LSOH) Outer Sheath.
- [\*\*CW1128\*\*](#) – External Grade Cable
  - This range of cables is made up from conductors of solid plain copper insulated with cellular (foamed) polyethylene. These conductors are twisted into pairs and the required number of pairs are laid up into units which are identified by coloured tapes. The cables are petroleum jelly filled and sheathed in black polyethylene, and are manufactured in accordance with BT type CW 1128. Suitable for installation in external ducts that are liable to flooding for extended periods.
- [\*\*CW1128/1198\*\*](#) – Armoured External Grade Cable.
  - These cables are manufactured as the External cables detailed previously but have the addition of a steel wire armouring for direct burial applications. The cables are manufactured in accordance with BT type CW 1128/1198.
  - Please refer to page 169 of this section for colour code details.



## Category 3 Cable

Excel Category 3 UTP Cables are manufactured, tested and verified to the EIA/TIA 568B and ISO11801 standards for Category 3 performance and are fully compliant with the IEC60332-1 specification. Cables are metre marked to avoid waste.

### Cable Sizes

All cable sizes are based upon the number of pairs in the outer sheath and various lengths.

25 P	11.50 +/- 1.00 mm
50 P	15.00 +/- 1.00 mm
100 P	20.50 +/- 1.00 mm
200 P	28.00 +/- 1.00 mm
300 P	34.00 +/- 1.00 mm



### Cable Construction

Available in both PVC and LSOH outer sheath constructions, with Solid Annealed Copper Wire conductors with a minimum nominal diameter of 0.505 mm. Each conductor is insulated with HDPE (high density polyethylene)

## Connecting Hardware

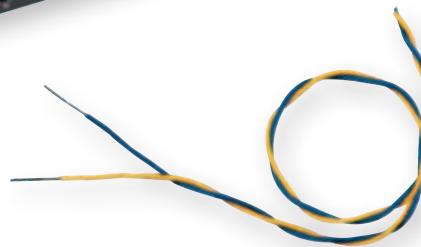
- [Excel 25, 50 or 60 Port RJ45 Patch Panels](#)

- The Excel voice patch panel is a 1U panel which provides a cost effective method of terminating and presenting Multipair Voice cables. Each panel has 25 or 50 RJ45 ports per 1U and an integral rear cable management tray. Each port is numbered and each can be wired with up to 3 pairs.



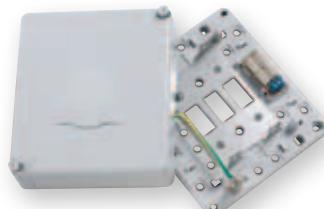
- [CW1423 – Jumper Wire](#)

- CW1423 Jumper Wire is a Single Pair cable and is insulated with an Irradiated Outer Sheath for use on Distribution Frames.



- [Excel Connection Boxes](#)

- The range of connection boxes includes the 200, 250 and 300 Series, providing connection from 2 to 10 way. Each box is manufactured from high quality plastic and suits all Terminal Strips.



## Frames

- Distribution Frames

- [Excel 500 Series Connection Box](#)

The Excel Series of Connection Boxes offers increased pair capacity while maintaining an industry standard footprint. The stainless steel backmount frame verticals support 237 Style strips giving a normal capacity of 340, 690, 1020 and 1600 pairs depending on the model. The Excel Connection Box Range allows an extra 5 way backmount to be fitted under the standard verticals increasing the capacities to a roomy 390, 780 or 1170 pairs. The door opens through 180° for ease of access. It can be removed entirely using quick release hinges and is easily reversed for left-right opening applications.

- [111B](#)

The Modular construction of the 111B means that any size of installation can be equipped using a standard building block. The 111B is compatible with older style frames, such as 105 or 108, to allow the extension of existing installations. Single verticals can be joined side by side for wall mounting or back to back to form a free standing system. If height reduction is required, the legs can be removed and the 111B mounted directly on the floor giving an overall height of just 1850mm.



- o [108a/City80](#)

Supplied as a dual distribution frame as standard, the 108a frame has the capacity for up to 1380 pairs when using 10 pair termination strips. The City 80 is an extended version and offers up to 1600 pair capacity. The flexible design allows for mounting frames on the floor with or without the supplied legs - on the wall or back to back.

- o [Sub Rack Termination Strip Carrier](#)

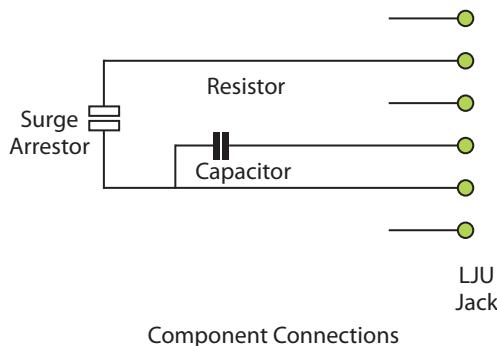
The Sub Rack Strip Carrier is used to mount Terminal Strips in 19" Cabinets. Two styles are available: the recessed version positions the terminal strips inside the 19" cabinet profile and the flat version aligns the strips with the cabinet's profiles.



## Line Jack Units – LJU

Line Jack Unit (LJU) is the term used for the voice outlet and contains a socket to accept the UK telephone plug. Often referred to as the BT Plug. The incoming line from the telephone exchange comprises of a single copper pair (2 wires). This is an analogue system which may be installed in a bus topology within the premise. A bus topology means that sockets are installed in series to provide the same connection to each socket. Depending on where used, the LJU's are available in three different versions: PSTN Master; PABX Master and Secondary. The first LJU within the premise terminates the line, this is the Public Switched Telephone Network (PSTN) Master . The PSTN Master has components inside to split out the ring voltage and also provide a level of protection to the exchange. The resistor and capacitor makes the telephone ring and the gas surge arrestor balances the incoming line if an overvoltage occurs (protection for the exchange). If the telephone line is provided by British Telecom then the PSTN Master is referred to as an NTE (Network Terminating Equipment).

### Contents of the PSTN Master



### Other Versions

The other two versions are the PABX Master and Secondary. The Private Automatic Branch Exchange (PABX) Master has the above components and configuration with the omission of the Surge Arrestor. A PABX or sometimes referred to as a Private Branch Exchange (PBX) is the telephone system used inside the business or premises. The details of the specific PABX needs to be consulted to determine whether an extension needs a PABX Master or a Secondary. The Secondary LJU has the above configuration without any of the components inside. They are used where a PABX does not need a Master for extensions or for use in extending an extension or home line.

### Series Formats

The LJUs are available in different series formats.

- [2 Series](#) – 68 x 68 mm complete with back box for overall depth of 29 mm
  - o Single Outlet
- [3 Series](#) – 86 x 86 mm to fit on a standard UK Single Gang Back Box (not included)
  - o Single Outlet
- [4 Series](#) – 86 x 86 mm to fit on a standard UK Single Gang Back Box (not included)
  - o Double Outlet

## Summary

	2 Series	3 Series	4 Series
	 68 x 68 x 29 mm including Back Box	 86 x 86 mm (Back Box not included)	 86 x 86 mm (Back Box not included)
PSTN Master	550-250 Type 2/1A	550-253 Type 3/1A	550-256 Type 4/1A
PABX Master	550-251 Type 2/2A	550-254 Type 3/2A	550-257 Type 4/2A
Secondary	550-252 Type 2/3A	550-255 Type 3/3A	550-258 Type 4/3A

## Design and Installation Considerations

As with structured cabling, correct planning and installation must be carried out in line with the established best practices of the industry. Therefore consideration of BS EN 50174 is vital.

It is important to remember that Multipair Voice cabling is an unscreened solution and therefore susceptible to external interference. It is therefore important to follow the separation guidelines set out in BS EN 50174 when installing Voice Cabling in proximity to either Power Cables or Equipment likely to cause interference such as Lift Motors or Generators etc.

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Table No. 1 Colour Coding for pairs

Pair Number	Colour of Insulation	
	a - Wire	b - Wire
1	WHITE – blue	BLUE – white
2	WHITE – orange	ORANGE – white
3	WHITE – green	GREEN – white
4	WHITE – brown	BROWN – white
5	WHITE – grey	GREY – white
6	RED – blue	BLUE – red
7	RED – orange	ORANGE – red
8	RED – green	GREEN – red
9	RED – brown	BROWN – red
10	RED – grey	GREY – red
11	BLACK – blue	BLUE – black
12	BLACK – orange	ORANGE – black
13	BLACK – green	GREEN – black
14	BLACK – brown	BROWN – black
15	BLACK – grey	GREY – black
16	YELLOW – blue	BLUE – yellow
17	YELLOW – orange	ORANGE – yellow
18	YELLOW – green	GREEN – yellow
19	YELLOW – brown	BROWN – yellow
20	YELLOW – grey	GREY – yellow

**Note:** Colour in upper case indicates base colour and colour in lower case indicates Stripe Marking colour on the core. For external cables the convention is to only use the “base” colour and keep the pairs twisted together. This is because there is a chance that when the gel is wiped off it could remove any markings.

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excel

# Packed **SPACE**

## High Performance, High Density

Excel MTP solutions are designed to support high speed next generation Ethernet applications, they also offer patch panel density of up to 120 cores in 1U of rack space. Market leading performance is assured through the use, as standard, of US Conec Elite low loss connectors.

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without compromise.

# Excel Installation Guidelines

## Section 9

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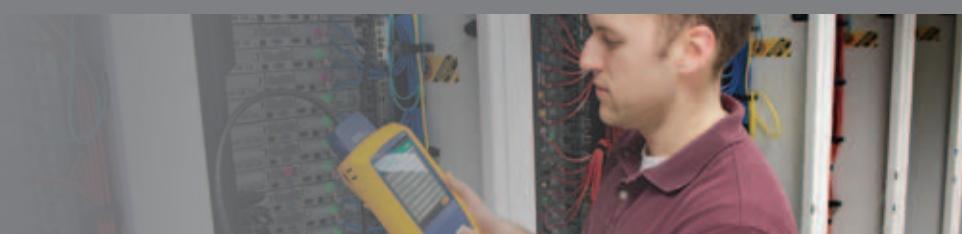
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#### Environ® OR Installation Guide

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# Generic and Copper

## Planning

Before you start, prepare to start.

- Have you got the cabling system design mapped onto the layout of the space?
- Do you have the correct materials ordered against the Bill Of Materials estimated to complete the project?
- Has the fire stop solution been approved?
- Do you need any specialist training or product support from Excel?
- Are the deliveries scheduled to match the installation plan?
- Are there any site inductions required? If so, when are these held?
- Is the area to be handed over to you for your installation? If so, in what condition? Will you be required to run a 'Permit to Work' scheme for you and other trades?
- Is there a clean, dry, secure storage area allocated for your materials?
- Are there any special precautions to observe for site Health and Safety?
- Are the method statements and COSH statements for the installation, termination and testing approved?
- Do you have a change control process and reporting scheme?
- Do you need to notify the site with the names or identification for your staff?
- Is the labelling method, scheme, style, colour agreed and approved by the client?
- Is the test equipment serviceable and to specification?
- Is there a headroom performance requirement from the tested cabling?
- Have you agreed how to deal with a star pass, (ie. marginal results)
- Do you have access to power outlets for testers, laptops etc?

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## On site

- Is the containment installed in the correct place and to the right specification?
- Are you holding daily briefings for the site operatives?
- Is there any temporary fire stopping required during the installation phase?
- Is there any difference between the reality of the site and the plans?
- Are there any access restrictions or other trades working in the same areas at the same time?
- Is the earthing and electrical system installed?
- Is there restriction on the use of mobile phones or walkie-talkies?



## Site Environment Classification

The environments where cabling is to be installed are classified to cover the different conditions under which the cabling is required to operate. Conditions which may affect the cabling performance are used to determine the applicable environmental classification. Use the environmental classification to select the components. The same classification is used to determine the appropriate containment and installation techniques.

The local environment along the channel is classified for each M, I, C, or E group, and the classification of an environment is determined by the most demanding parameter within the M, I, C or E group. With regard to temperature, the local environment is considered to be the operating temperature of the cabling.

The considerations for:

- Mechanical rating include shock/bump, vibration, crush, impact, bending, flexing and torsion
- Ingress rating include particulate ingress, immersion
- Climatic and Chemical rating include humidity, rate of change of temperature, solar radiation, damaging chemical concentration
- Electromagnetic rating include electrostatic discharge, conducted radio frequency, magnetic field

All twisted pair copper cabling supplied by Excel for normal indoor use is designed and classified to perform in a Class 1 environment ( $M_1, I_1, C_1, E_1$ ). Most indoor office and data centre environments fall within the Class 1 environment ( $M_1, I_1, C_1, E_1$ ).

If you have a specification requirement which is beyond Class 1 use you must consult with Excel technical support for guidance on containment and product selection.

## Excel 'How To' Video Clips

Our series of 'How To' video clips demonstrate the recommended and most efficient methods of installation of various products from across the Excel range. This information can be of particular use for engineers or designers, new to Excel, or to products such as screened Category 6<sub>A</sub>. The clips can be viewed via [YouTube](#), or by visiting

[www.excel-networking.com](#).

We will be adding to the series over time, so please check the Excel website for the latest updates.



## Containment and Cable Routing

### Power and Data Separation

Local and national safety regulations may require different separation or segregation distances. Separation and segregation for safety must take precedence over all other requirements. To reduce the risk of noise disturbing the data flowing in copper twisted pair cables, Excel recommends following the requirements set out in the latest issue of EN50174; these are summarised below. The more stringent requirement (greater distance) shall take precedence.

Essentially there are two ways of mitigating the effects of noise disturbing the transmission of data in a copper twisted pair cable; one way is to separate by distance the twisted pair cabling from the noise source, using air to attenuate any noise; the other way is to provide a barrier between the noise source and the twisted pair cabling using a grounded barrier to attenuate the noise.

The factors to consider are:

- Environment
- Type of containment
- Performance of cable type
- Application being supported
- Construction of power cable
- Scale of power source
- Proximity to the power cable



## Excel Installation Guidelines

When all of this is calculated you get a separation recommendation.

- Environment:** All twisted pair copper cabling supplied by Excel for normal indoor use is designed and classified to perform in a Class 1 environment M<sub>1</sub>, I<sub>1</sub>, C<sub>1</sub>, E<sub>1</sub>.
- Containment:** No barrier or no metallic barrier (typically wall trunking or open ladder), open metallic (typically basket but not ladder), perforated metallic (typically slotted tray) and solid metallic (typically 1.5mm wall steel conduit).
- Cable Style:** The performance of the cable and connector set is provided by the manufacturer. The applications to be supported will be the determination factor that provides the Classification for the cabling system chosen.
- Power Cable:** An assumption is made that power cables will provide a high degree of self cancellation for any noise carried if they are constructed with a live, neutral and earth bound together in a common sheath. If individual tails are used (separate unbound conductors) then power cable is to be treated as a noise hazard.
- Power Scale:** How many power cables are present or likely to be installed? Classification for power cabling is based on the qualification of a single phase 230 Volt, 20 Amp circuit. Three phase power is to be treated as three times a single phase. For circuits which are more than 20A treat as multiples of 20A. Lower voltage AC or DC power cables must be treated on their current rating, e.g. a 100A 50V DC cable is equivalent to 5 of 20A cables.

$$A = S \times P$$

**A** (Final Separation Distance) = **S** (Basic Separation Distance) x **P** (Power Cabling Factor)

## S - Basic Separation Distance

		Cable Management System			
Segregation Classification	Cable Performance	None (or Non-metallic)	Open metallic containment	Perforated metallic containment	Solid metallic containment
d	Class F <sub>A</sub>	10 mm	8 mm	5 mm	0 mm
c	Class D or E or E <sub>A</sub> F/UTP	50 mm	38 mm	25 mm	0 mm
b	Class D or E or E <sub>A</sub> U/UTP	100 mm	75 mm	50 mm	0 mm
a	Coaxial	300 mm	225 mm	150 mm	0 mm

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Notes	Plastic containment	Equivalent to weld mesh 50 mm x 100 mm and steel tray of less than 1 mm thickness (and trunking without lid). Cables to be installed at least 10 mm below top of barrier.	Equivalent to steel tray of 1 mm thickness (and trunking without lid). Cables to be installed at least 10 mm below top of barrier.	Equivalent to steel conduit 1.5mm wall thickness. Steel conduit less than 1.5mm thickness will require greater separation.
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## P - Power Cabling Factor

Quantity of Circuits	P – Power cabling factor
1 to 3	0.2
4 to 6	0.4
7 to 9	0.6
10 to 12	0.8
13 to 15	1.0
16 to 30	2.0
31 to 45	3.0
46 to 60	4.0
61 to 75	5.0
> 75	6.0

### Zero Segregation - Conditional Relaxation of Requirement

Where the requirements in specific EMI conditions do not apply, no segregation distance is required between power and data where:

Power - Single Phase, Total power ≤ 32A, Power conductors contained in overall sheath or twisted, taped, bundled together

Data Cable - Segregation Classification is "b", "c" or "d" in an E<sub>1</sub> environment classification of EN 50173

### Separation requirements for specific EMI sources

Source of disturbance	Minimum separation	Note
Fluorescent lamps	130mm	a
Neon lamps	130mm	a
Mercury vapour lamps	130mm	a
High-intensity discharge lamps	130mm	a
Arc welders	800mm	a
Frequency induction heating	1000mm	a
Hospital equipment		b
Radio transmitter		b
Television transmitter		b
Radar		b

### NOTE

- a The minimum separations may be reduced provided that appropriate cable management systems are used or product suppliers guarantees are provided
- b Where product suppliers guarantees do not exist, analysis shall be performed regarding possible disturbances e.g. frequency range, harmonics, transients, bursts, transmitted power, etc.

## Overhead and Under Floor Containment Fill Ratio

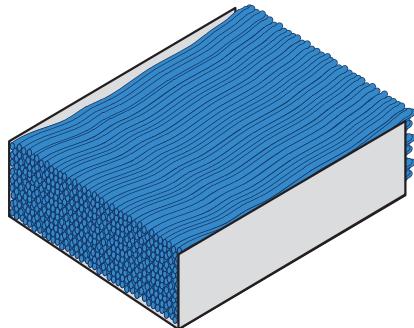
Cable trays, basket, ladder racking and other containment should be filled on day one:

- To accommodate a day one minimum calculated spare fill of 20%
- Up to a maximum of 150mm (6 in) cable depth for solid floor containment.

The spare capacity requirement is to allow room for future expansion, and to facilitate additions and removal of cables once the building becomes operational

NOTE: A calculated fill ratio of 50% will physically fill the entire containment due to spaces between cables, and random placement.

Picture shows a cable tray that is full of cable which equals a 50% fill ratio



Example - What is the minimum width of a 75mm deep cable tray supporting 1000 cables, each with a diameter of 5.5mm?

$$\text{Area of one cable} = \frac{(\text{cable diameter})^2 \times \pi}{4}$$

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$$\text{Area of one cable} = \frac{(5.5)^2 \times 3.14}{4} = 23.75\text{mm}^2$$

$$\text{Area of 1000 cables} = \frac{(5.5)^2 \times 3.14 \times 1000}{4} = 23746\text{mm}^2$$

Multiply this occupied area by 1.2 to give 20% over size for day two expansion

$$\text{Usable Area or Area required within cable tray (50% fill)} = \frac{\text{cable tray width} \times \text{cable tray depth}}{2}$$

$$1000 \text{ cables} = (23746\text{mm}^2) \times 1.2 = \frac{\text{cable tray width} \times 75\text{mm}}{2}$$

$$\text{Minimum width of cable tray} = 759.9\text{mm}$$

# Excel Cable - Containment Size Calculations

Containment sizes may be calculated based on the: dimensions of the containment, diameter of the cable and fill ratios.

Different styles of containment use different formulae to calculate the maximum number of cables that may be housed. These formulae offer an estimate of the quantities. However, the actual quantity of cables that may be contained will be influenced by other factors such as routing, access, etc. Never plan to fill containment to the maximum during the initial installation as quantities are likely to change as additions are required.

Excel offers a spreadsheet that is available for download from the Technical Note section of the Excel website's [Partner Area](#). excel-containment-sizing.xlsx

(all dimensions in mm)

Tray Dimensions		Number of Cables																				
		100-912 Cat 7A Plus S/FTP (1200 MHz)		100-910 Cat 7A S/FTP (1000 MHz)		100-189 Cat 6A U/UTP		100-198 Cat 6 A F/FTP "S" Foil		100-191 Cat 6 A U/FTP "S" Foil		100-071 Cat 6 U/UTP		100-076 Cat 6 F/UTP		100-066 Cat 5e U/UTP		100-217 Cat 5e F/UTP				
Width	300 mm	Diameter of Cable	8.5	7.8	8.3	6.9	6.7	6.2	7.2	5.2	6.4	Area of Cable	56.7	47.8	54.1	37.4	35.3	30.2	40.7	21.2	32.2	
Height	50 mm	Area of Cable											Number of Cables	106	126	111	160	170	199	147	283	187
Spare Capacity	25 %	Number of Cables											Area of Containment									
Area of Containment	15000 mm <sup>2</sup>	Area of Containment											Usable area									
Usable area	12000 mm <sup>2</sup>	Usable area																				
<b>S9</b>																						

Cross-sectional area of an individual cable is calculated –

$$\text{Area of cable} = \frac{\pi d^2}{4} \quad (\text{where } d = \text{diameter of the cable})$$

## Tray Calculation

This tray calculation is based on the information in EN 50174-2:2009 + A1:2011

$$\text{Maximum number of cables} = \frac{wh}{2 \times \text{Area of cable}}$$

(where w = width and h = height of the tray)

(in the above calculation the area of a cable is doubled to allow for the fact that a cable is circular and also will not fit perfectly in containment).

These formulae may be combined into one

$$\text{Maximum number of cables} = \frac{2wh}{\pi d^2}$$

Note – the maximum stack height of cables is 150 mm

The number of cables should then be reduced to allow for future installations.



## Excel Installation Guidelines

### Basket Tray or Ladder

As basket tray and ladder is non-continuous containment the maximum stack height needs to be reduced. This calculation is based on the information in EN 50174-2:2009 + A1:2011

$$\text{Maximum stack height} = \frac{150}{1 + 0.0007 s}$$

(where "s" is the span distance)

### Conduit

The formulae for the maximum number of cables within conduit is based on a calculation that has been modified from the BICSI Telecommunications Distribution Methods Manual (TDMM).

The formula assumes straight runs with no bends and smooth walls.

$$\text{Maximum number of cables} = 0.4 \frac{c^2}{d^2} - 1$$

(where "c" is the inside diameter of the conduit and "d" is the diameter of the cable)

The number of cables should then be reduced to allow for future installations.

## Heating Effects

Energy losses from within cabling will be translated into generation of heat. There are many factors which accumulate to create this effect. The installer needs to be aware that the temperature rise in the cabling at these points can be in the order of 10°C or higher when all of these factors come together. The temperature rise created is greatest where:

- the cabling is managed into large bundles
- and/or there are a large number of simultaneous users
- and/or cabling is run into constricted spaces such as at wall penetrations
- and/or the cabling is required to support higher energy applications / PoE applications.
- The energy loss due to heating effects is different for Screened and Unscreened cable.

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All the performance criteria for the 100m Channel as outlined in EN 50173-2 is based upon it operating at an ambient temperature of 20°C and for every degree over this level this distance will be reduced. The following formula provided in the above standard gives the rate of reduction for unshielded cables, in short for temperature increases up to 20°C above the ambient the Channel should be reduced by 0.4% and for temperatures increased over 40°C above the ambient there is an additional 0.6% that has to be added.

### Unshielded

$$L_{t>20^\circ C} = L / (1 + (T-20) \times 0.004)$$

$$L_{t>40^\circ C} = L / (1 + (T-20) \times 0.004 + (T-40) \times 0.006)$$

This could potentially have a dramatic effect to the performance of installed cabling as recent research shows that the level of heating can be significant in some cases 30-40°C above the ambient.

Screened Cabling performs much better, as the research has proved it does not heat up as much as an unshielded cable and when it does the de-rating formula is much simpler as it is based upon 0.2%.

### Shielded

$$L_{t>20^\circ C} = L / (1 + (T-20) \times 0.002)$$

L = Length T = Temperature

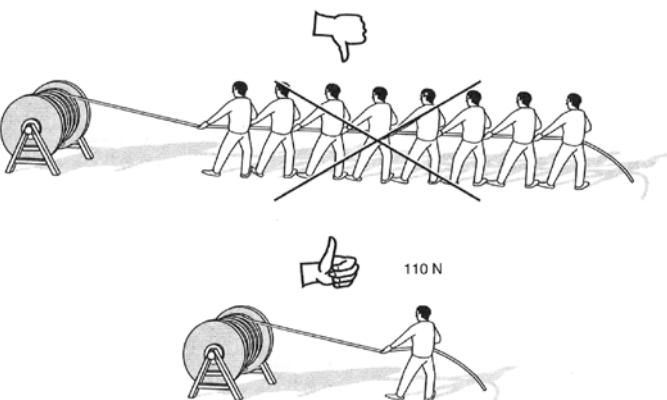
These heating effects can be mitigated by:

- reducing the bundle size
- loosening the bundle ties at points of constriction
- distributing the high energy use across different cable bundles
- It is also possible to Loose Lay the cables on to cable matting or cable tray without bundles entirely, more details of this approach can be found in Tech Note TN08 which is located within the 'Partner Area' of [www.excel-networking.com](http://www.excel-networking.com)

## Cable Installation

From the cabling system design and floor plans, make a cable pulling schedule. Map the pulling schedule onto the floor plans.

- Identify the labels and cable ID so that temporary labelling can be applied.
- It may be faster, cheaper and more accurate to print two sets of the final cable labels, using one set for installation purposes and then replacing them after testing is completed. This will avoid unsightly 'Pen Marks' on the cable.
- Ensure that for each group of finished labels they are aligned and attached so they are readable from the same direction.
- If the installation is a mixture of copper and fibre optic cabling install the copper cabling first.
- Plan the occupation of cabling in the containment and along the route so that crossovers are eliminated and entry points into and exits from the containment are not congested.
- In any cable run where the cable is to be pulled the run should contain no more than two 90° bends. If more than two 90° bends are required or the sum of all angles is greater than 180° then there must be more pull points along the cable run where the cable is able to be managed in and out of the containment.
- Respect the installation bend radius of the cable. Never exceed the recommended maximum pulling load of the cables.
- Determine the pulling in points which will cause damage to the cable, through sharp edges or bends tighter than the installation bend radius.
- Apply any protection to the containment where damage to the cable sheath may occur. Consider using cable installation aids.
- Bundle size should be kept to a minimum.
- Maximum bundle size is 24 for 4 pair twisted copper cables.
- Smaller bundles make better use of limited containment space.
- With mixed length cables in a cable run always pull in the longest length cables first.
- Secure the stack of cable boxes or reels using a pulling frame or cable stands to hold the packaging in place.
- Pulling force must be respected. Maximum pull force for a single, or bundle of cables, is 110 N (25 lbf).
- Avoid any cable kinks and maintain proper bend radius control during cabling pulling. If any kinks should occur, kinked cable should be removed and replaced.
- For safety, only use cable jacks and pulling frames which are designed for and fit for purpose.
- Always control the rate at which cables are pulled off the drum.
- Take great care over the management of cable drum.



## X Excel Installation Guidelines

- Hook and eye cable fixings are preferred.
- If nylon type zip ties are used, ensure excess is cut flush, to avoid the creation of sharp and dangerous edges.
- Do not over tighten.
- No deformation, marking or compression of cable jacket is allowed.
- For further clarification on the use of cable ties also see tech Note TN12 in the Partner Area of [www.excel-networking.com](http://www.excel-networking.com)
- Acclimatise the cables to the location where they are to be installed, minimum 2 hours.
- Refer to the specification sheet for the installation and operating temperature ranges for the cables being installed.
- The recommended installation temperature range is 0° – 60°C (32° – 140° F). Avoid pathways exposed to extreme thermal cycling.
- Remember that for some outdoor cabling there may be a minimum installation temperature.
- Do not install copper cabling or optical fibre cabling with a metallic strength member outdoors when there is a thunder or lightening storm about.
- Only use approved lubricants and pulling gels for the cable type being installed.
- For external installations seal the ends of all cables with a water tight product before installation.

When installing cable at high level the additional requirements are as follows:

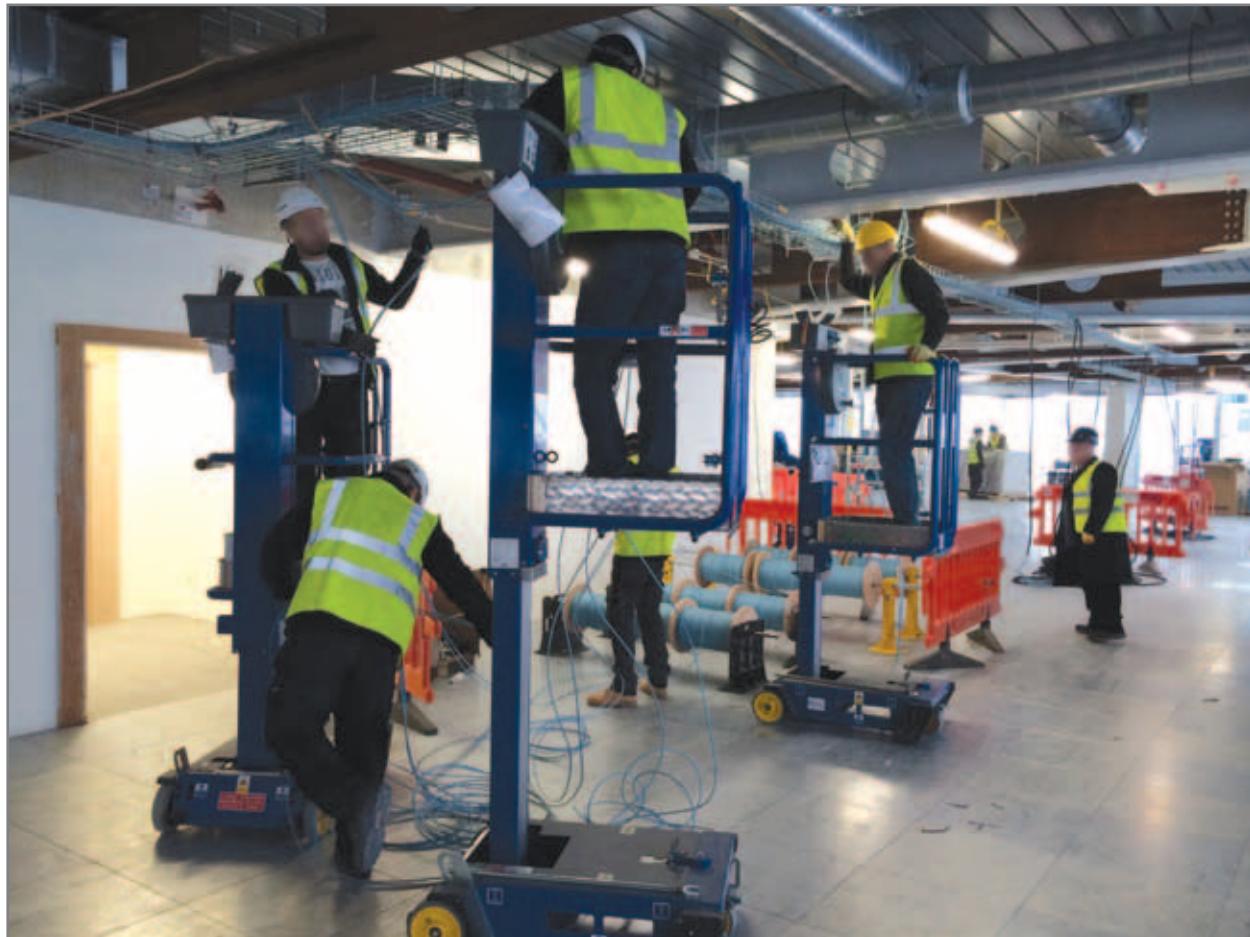
- Protect the edges of the basket or tray before starting to install the cable to ensure no damage is caused.
- Ensure that the edges of the tray or basket have a bend radius that exceeds the installation Bend Radius of the cable concerned, this may be achieved by artificially increasing the dimension by the use of temporary packing material
- If bundles of cable are being routed from tray at high level to enter a cabinet from the top, some form of 'waterfall' must be used to ensure the bend radius of the cable is not compromised. This can be simply and cost effectively achieved by the use of a section of split flexible plastic conduit installed along the edge involved. The following image gives an example.

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- When installing cable at high level ensure that sufficient engineers are available to carry out the work, it is recommended that cables are 'passed' from one engineer to the next rather than trying to drag them over the tray.

The following image will give an example of this practice.



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This table lists the most common part codes for the Excel cable designs. The diameters provided are correct for all part codes to which this design is applied, for example coloured versions of Category 6 U/UTP.

Part Number	Description	Diameter	During Installation – Bend Radius	Installed – Bend Radius
<a href="#">100-065</a>	Excel Category 5e Unscreened Twisted Pair (U/UTP) Cable - PVC	5.2 mm	42mm	21 mm
<a href="#">100-066</a>	Excel Category 5e Unscreened Twisted Pair (U/UTP) Cable - LSOH	5.2 mm	42mm	21 mm
<a href="#">100-216</a>	Excel Category 5e Screened Twisted Pair (F/UTP) Cable - LSOH	6.4 mm	51mm	26 mm
<a href="#">100-070</a>	Excel Category 6 Unscreened Twisted Pair (U/UTP) Cable - PVC	6.2 mm	50 mm	25 mm
<a href="#">100-071</a>	Excel Category 6 Unscreened Twisted Pair (U/UTP) Cable - LSOH	6.2 mm	50 mm	25 mm
<a href="#">100-076</a>	Excel Category 6 Screened Twisted Pair (F/UTP) Cable - LSOH	7.6 mm	61 mm	30 mm
<a href="#">100-189</a>	Excel Category 6 <sub>A</sub> Unscreened Twisted Pair (U/UTP) Cable – LSOH	8.3 mm	67mm	34mm
<a href="#">100-191</a>	Excel Category 6 <sub>A</sub> Screened Twisted Pair (U/FTP) 'S-Foil' Cable – LSOH	6.7mm	54mm	27mm
<a href="#">100-196</a>	Excel Category 6 <sub>A</sub> Screened Twisted Pair (F/FTP) 'S-Foil' Cable – LSOH	6.9mm	56mm	28mm

## Earthing, Grounding and Bonding

Unless you are a qualified and competent electrical person leave the connection of the earthing wire onto the electrical system to the electrical trade.

The following information is for guidance purposes, Grounding and bonding of all systems should be carried out in accordance with EN50174-2, EN50310 standards.

The best type of earthing conductor used to provide a signal earth connection is a flat braided strap. Flat is best because it offers a greater surface area and braided straps because impedance is affected by length and braid offers many different routes and therefore lengths of conductor for the unwanted signals to flow along. If you use a solid core conductor to provide an earth strap you can improve this by adding a second, different length, earth conductor to reduce the possibility of an impedance issue resisting the passage of the unwanted signals.

Do not coil an earthing conductor around a screwdriver to make it look neat and tidy, you are forming a coil which can restrict the transmission of signals.

It is best practice to connect the earth stud in a cabinet onto a separate earthing bar located in the cabinet. It is recommended that the bar is provided with four or more attachment points for equipment earths to be connected onto. This is because if all of the equipment earths are run back to the earth stud then for safety reasons the electrical supply must be disconnected every time a new piece of equipment is added or removed from the cabinet.

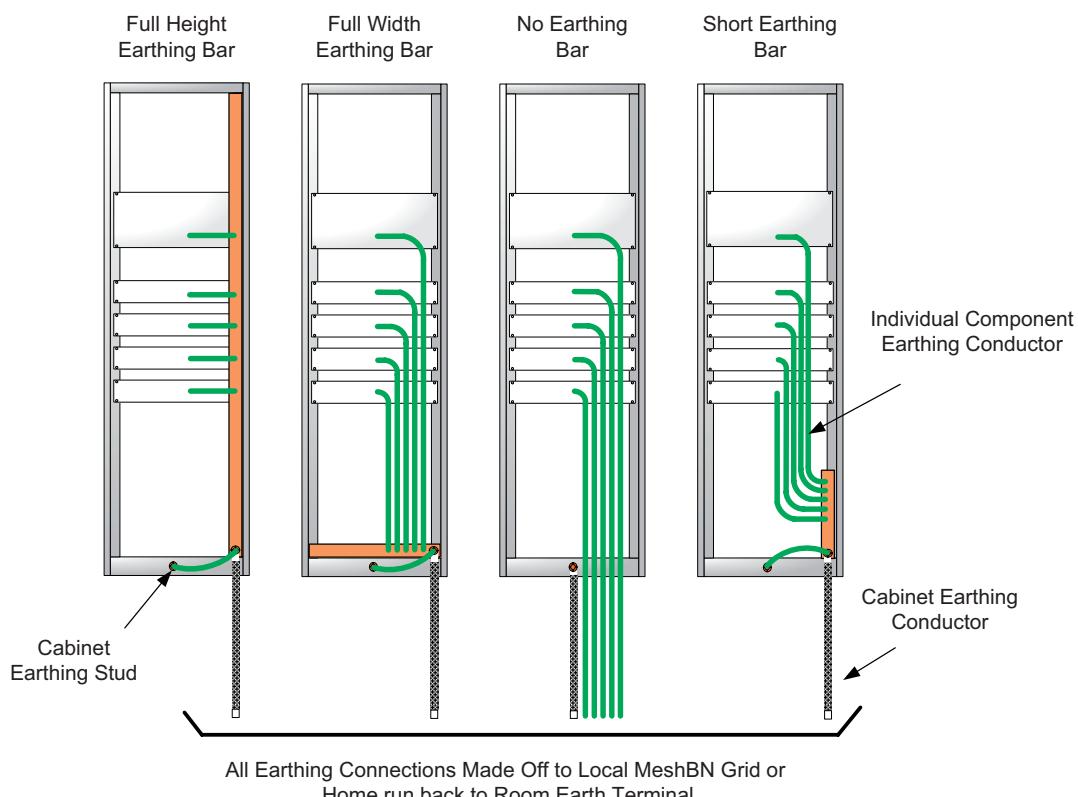
When installing a piece of equipment which requires a signal earth, always install the equipment, then attach the earth connection, then connect up the power.

ESD (Electrostatic Discharge) can kill equipment. When installing equipment into a cabinet or frame always use an ESD strap connected between you and the cabinet.

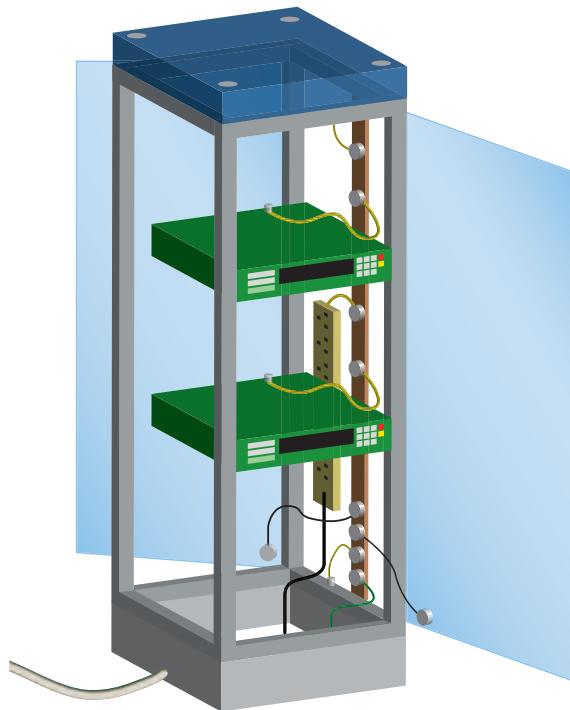
Each earthing conductor must be grounded onto a clean, purposeful earthing point. Use an approved cleaning method and bonding gel to protect the joint from oxidisation.

Do not daisy chain earthing conductors; the only exception to this is where there is a run of metallic cable containment when each length must be grounded onto the next.

### Example of Cabinet Earthing



## Example of Rack Earthing



The best practices for communications rooms and data centres recommend provision of an equipotential earthing grid or MESH-BN (a bonding network in which all associated equipment frames, racks and cabinets and usually the DC power return conductor, are bonded together as well as at multiple points to the Common Bonding Network).

This grid is used to earth all of the metallic components (frames, racks, floor tiles and pedestals, cable containment, etc) providing:

- a reliable signal reference
- adequate immunity from electromagnetic interference carried by the earthing network

Each rack and frame must be provided with an earthing conductor made back to either the MESH-BN or home run back to the main communications grounding bar within the room. For some installations this may be the electrical earthing bar in the main power distribution board.

Within the UK the specification for the rack earth connection is covered by:

BS6701:2010 Telecommunications equipment and telecommunications cabling specification for installation, operation and maintenance.

### 5-2.2.4 Earthing of racks, frames and cabinets.

Not less than:

- $4\text{mm}^2$  for a rack  $\leq 21\text{U}$
- $16\text{mm}^2$  for a rack  $> 21\text{U}$

(please refer to the standard for further details)

## Racks and Frames

- Install the racks and frames in the pre assigned positions.
- Check alignment of any containment with the cable entrances (for power and data) to the rack.
- Apply temporary labels to identify the location.
- Secure the racks and frames to the solid floor and/or wall to provide stability when loaded with equipment and cabling.
- Install any baying or joining components.
- Attach the earthing kit to all rack and frame components.
- Connect the main earthing conductor.
- Does the site require blanking panels for airflow management in the racks and/or frames?

The layout for the inside of each rack should be determined in the overall site design. As with a lot of new designs there are great pressures on the space available within the racks and frames. As a general rule for laying out a rack, begin at the top with the patch panels starting with optical fibre panels then copper panels. The top most position in a block of patch panels should be reserved for a horizontal wire manager, then there should be no more than two patch panels of 1U height followed by another (or closing) horizontal wire manager. On high density frames the front fingers of the vertical wire manager provide the support for patch cords so there is not the same level of requirements for horizontal wire managers. Horizontal raceways will be required to facilitate shortest routing between patch panel outlets.

- When installing panels and wire managers use all of the securing and fixing holes provided.

NB. It is essential that all cable bundles entering a rack, either from the top or the bottom, are securely attached to cable tray within the rack and under no circumstances should they be solely supported by the rear management of the Patch Panel.

## Patch Panels

Termination procedures at the patch panel:

- It is acceptable for the cables to be dressed as either, 24 cables from one side or split as 12 from each.
- Maintain acceptable bend radius levels
- Do not kink cables
- Do not overtighten the cable ties to deform the cable in any way.
- Where a rear management bar is provided each cable should be individually secured by way of a cable tie, 'bunching' or grouping of cables is deemed to be a poor installation practice.
- For Category 6 and above, best practice dictates all cables shall be individually terminated and secured to the management bars provided. This has the two benefits of improved performance and ease of re-termination if a wire map error is discovered during testing without the need to disturb any adjacent outlets on the same panel.

To enhance wire management in the back of the panel, it is recommended that a strain relief bar is mounted to the rack. Along the strain relief bar use hook and eye cable ties for additional cable management.

Termination procedures for the punch down patch panel:

- Follow installation instruction sheet
- Outer cable jacket should be trimmed to be as close as possible to point of termination
- Last twist should be no further than 13 mm (0.5 inches) from the point of termination.



## Wall Boxes and Desk Outlets

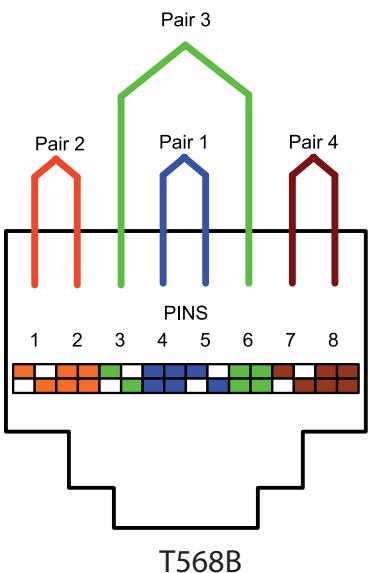
For a duplex, twin outlet presentation, choose a back box that complies with the minimum bend radius of the cable.

If metal GOP boxes or metal face plates are used, ensure that there is a grounding facility / earthing lug and a suitably sized earth wire connection, with sufficient cable to earth the box and lid.



## Colour code

The colour code or punch down followed by Excel for all of their cabling system components is the T568B format.



## Suggested Minimum Back Box Depth

### Bevelled Euro Faceplate

	Face Plate	<a href="#">100-712 Single &amp; 100-716 Double Gang Bevelled</a>					
		Shutter	<a href="#">100-014</a>	<a href="#">100-020</a>	<a href="#">100-175</a>	Nil	
Jack	Direction of Incoming Cable	Euromod 25 x 50mm Flat Keystone Shutter - White	Category 6 <sub>A</sub> Angled Shutter for Keystone Jack 50x25mm, White	Euromod 25 x 50mm Angled Keystone Shutter - White			
	<a href="#">100-181</a> Cat 6 <sub>A</sub> Low Profile	Top	52 mm	25 mm	30 mm		
		Bottom	52 mm				
		Side	52 mm				
	<a href="#">100-182</a> Cat 6 <sub>A</sub> Unscreened	Top	62 mm	30 mm	35 mm		
		Bottom	62 mm				
		Side	62 mm				
	<a href="#">100-300</a> Cat 6 Unscreened Module	Top					
		Bottom					
		Side					
	<a href="#">100-366</a> Cat 6 Unscreened Low Profile	Top					
		Bottom					
		Side					
	<a href="#">100-011</a> Cat 6 Keystone IDC	Top	30 mm	19 mm	19 mm		
		Bottom	30 mm				
		Side	30 mm				
	<a href="#">100-211</a> Cat 6 Toolless Jack	Top	33 mm	25 mm	29 mm		
		Bottom	33 mm				
		Side	33 mm				
	<a href="#">100-210</a> Cat 6 Screened Toolless Jack	Top	63 mm	30 mm	35 mm		
		Bottom	63 mm				
		Side	63 mm				
	<a href="#">100-760</a> Cat 5e Unscreened Low Profile	Top					
		Bottom					
		Side					
	<a href="#">100-010</a> Cat 5e Keystone IDC	Top	29 mm	19 mm	23 mm		
		Bottom	29 mm				
		Side	29 mm				
	<a href="#">100-203</a> Cat 5e Toolless Jack	Top	32 mm	25 mm	29 mm		
		Bottom	32 mm				
		Side	32 mm				
	<a href="#">100-906</a> Cat 5e Screened Toolless Jack	Top	63 mm	30 mm	35 mm		
		Bottom	63 mm				
		Side	63 mm				

## Suggested Minimum Back Box Depth

Flat Euro Faceplate

	Face Plate	<a href="#">100-714 Single &amp; 100-718 Double Gang Flat</a>		
	Shutter	<a href="#">100-014</a>	<a href="#">100-020</a>	<a href="#">100-175</a>
Jack	Direction of Incoming Cable	Euromod 25 x 50mm Flat Keystone Shutter - White	Category 6 <sub>A</sub> Angled Shutter for Keystone Jack 50x25mm, White	Euromod 25 x 50mm Angled Keystone Shutter - White
 <b>CAT6A</b>	100-181 Cat 6 <sub>A</sub> Low Profile	Top Bottom Side	58 mm 58 mm 58 mm	31 mm 36 mm 36 mm
	100-182 Cat 6 <sub>A</sub> Unscreened	Top Bottom Side	68 mm 68 mm 68 mm	36 mm 41 mm 41 mm
	100-300 Cat 6 Unscreened Module	Top Bottom Side		28 mm 28 mm 28 mm
 <b>CAT6</b>	100-366 Cat 6 Unscreened Low Profile	Top Bottom Side		11 mm 21 mm 11 mm
	100-011 Cat 6 Keystone IDC	Top Bottom Side	36 mm 36 mm 36 mm	25 mm 25 mm 25 mm
	100-211 Cat 6 Toolless Jack	Top Bottom Side	39 mm 39 mm 39 mm	31 mm 35 mm 35 mm
 <b>CAT5e</b>	100-210 Cat 6 Screened Toolless Jack	Top Bottom Side	69 mm 69 mm 69 mm	36 mm 41 mm 41 mm
	100-760 Cat 5e Unscreened Low Profile	Top Bottom Side		11 mm 20 mm 11 mm
	100-010 Cat 5e Keystone IDC	Top Bottom Side	35 mm 35 mm 35 mm	35 mm 29 mm 29 mm
	100-203 Cat 5e Toolless Jack	Top Bottom Side	38 mm 38 mm 38 mm	31 mm 35 mm 35 mm
	100-906 Cat 5e Screened Toolless Jack	Top Bottom Side	69 mm 69 mm 69 mm	36 mm 41 mm 41 mm

## Suggested Minimum Back Box Depth

### 6c Faceplates

	Face Plate	<a href="#">100-670 Single &amp; 100-671 Double Gang 6c Faceplate</a>		
	Shutter	<a href="#">100-018</a>	<a href="#">100-022</a>	Nil
	<b>Jack</b>	Direction of Incoming Cable	6c Flat Keystone Shutter	6c Angled Keystone Shutter
	<a href="#">100-181</a> Cat 6 <sub>A</sub> Low Profile	Top Bottom Side	50 mm 50 mm 50 mm	30 mm
	<a href="#">100-182</a> Cat 6 <sub>A</sub> Unscreened	Top Bottom Side	60 mm 60 mm 60 mm	30 mm
	<a href="#">100-301</a> Cat 6 Unscreened 6c	Top Bottom Side		21 mm 21 mm 21 mm
	<a href="#">100-011</a> Cat 6 Keystone IDC	Top Bottom Side	27 mm 27 mm 27 mm	22 mm
	<a href="#">100-211</a> Cat 6 Toolless Jack	Top Bottom Side	60 mm 60 mm 60 mm	30 mm
	<a href="#">100-210</a> Cat 6 Screened Toolless Jack	Top Bottom Side	60 mm 60 mm 60 mm	30 mm
	<a href="#">100-758</a> Cat 5e Unscreened Low Profile	Top Bottom Side		20 mm 20 mm 20 mm
	<a href="#">100-010</a> Cat 5e Keystone IDC	Top Bottom Side	26 mm 26 mm 26 mm	22 mm
	<a href="#">100-203</a> Cat 5e Toolless Jack	Top Bottom Side	29 mm 29 mm 29 mm	22 mm
	<a href="#">100-906</a> Cat 5e Screened Toolless Jack	Top Bottom Side	60 mm 60 mm 60 mm	30 mm

## Suggested Minimum Back Box Depth

Office

	Face Plate	<a href="#">100-270 Single &amp; 100-271 Double Gang Office</a>		Floor Box Plate
		Shutter	<a href="#">100-280</a>	
CAT6A	Jack	Direction of Incoming Cable	Office Angled Keystone Shutter	
	<a href="#">100-181</a> Cat 6 <sub>A</sub> Low Profile	Top	22 mm	
		Bottom		
		Side		
	<a href="#">100-182</a> Cat 6 <sub>A</sub> Unscreened	Top	35 mm	
		Bottom		
		Side		
	<a href="#">100-276</a> Office Cat 6 Low Profile	Top		10 mm
		Bottom		20 mm
		Side		10 mm
CAT6	<a href="#">100-011</a> Cat 6 Keystone IDC	Top	23 mm	
		Bottom		
		Side		
	<a href="#">100-211</a> Cat 6 Toolless Jack	Top	32 mm	
		Bottom		
		Side		
	<a href="#">100-210</a> Cat 6 Screened Toolless Jack	Top	45 mm	
		Bottom		
		Side		
CAT5e	<a href="#">100-297</a> Cat 6 Low Profile 6c	Top		18 mm
		Bottom		20 mm
		Side		
	<a href="#">100-275</a> Office Cat 5e Low Profile	Top		10 mm
		Bottom		19 mm
		Side		10 mm
	<a href="#">100-010</a> Cat 5e Keystone IDC	Top	23 mm	
		Bottom		
		Side		
	<a href="#">100-203</a> Cat 5e Toolless Jack	Top	32 mm	
		Bottom		
		Side		
	<a href="#">100-906</a> Cat 5e Screened Toolless Jack	Top	45 mm	
		Bottom		
		Side		
	<a href="#">100-757</a> Cat 5e Low Profile 6c	Top		18 mm
		Bottom		20 mm
		Side		

## Labels and Administration

Excel recommends using the Sharpmark labelling solutions and templates. All Excel panels, outlets and faceplates are supported with predefined label layouts and formats.

An administration system is required by the network owner to organise and control connections and operation of their network and the associated support infrastructure. A full and detailed labelling scheme should be agreed before the start of the installation. As a minimum this will require labels and identifiers being applied to cables, outlets, panels, racks and frames. For larger or more complex installations a more comprehensive administration and labelling scheme is required. Best practices include labelling of items such as:

- Bonds – functional earth
- Cabinets, racks and frames
- Cables - both ends
- Closures
- Pathways
- Spaces
- Termination points including joints
- Cords/jumpers - both ends



Professional Labelling for Communications and Industry

### Part Number Information

Description	Part Number
Sharpmark Labelling Software	221-000
38 x 12.7mm adhesive wrap-around cable label (10/1050)	<a href="#">221-001</a>
38 x 12.7mm adhesive wrap-around cable label (50/5250)	<a href="#">221-002</a>
38 x 12.7mm adhesive wrap-around cable label (100/10500)	<a href="#">221-003</a>
38 x 25.4mm adhesive wrap-around cable label (21/1029)	<a href="#">221-004</a>
38 x 25.4mm adhesive wrap-around cable label (105/5145)	<a href="#">221-005</a>
38 x 25.4mm adhesive wrap-around cable label (210/10290)	<a href="#">221-006</a>
57 x 25.4mm adhesive wrap-around cable label (30/1050)	<a href="#">221-007</a>
57 x 25.4mm adhesive wrap-around cable label (150/5250)	<a href="#">221-008</a>
8 x 16mm adhesive outlet label (10/3850)	<a href="#">221-010</a>
12 x 20mm adhesive outlet label (10/2070)	<a href="#">221-012</a>
12 x 20mm adhesive outlet label (50/10350)	<a href="#">221-013</a>
10 x 15mm adhesive outlet label (50/9500)	<a href="#">221-017</a>
6 x 21mm adhesive outlet label (10/1890)	<a href="#">221-018</a>
6 x 30 adhesive outlet label (10/1350)	<a href="#">221-019</a>
5 x 15mm adhesive outlet label (10/2080)	<a href="#">221-022</a>

## Operation & Maintenance

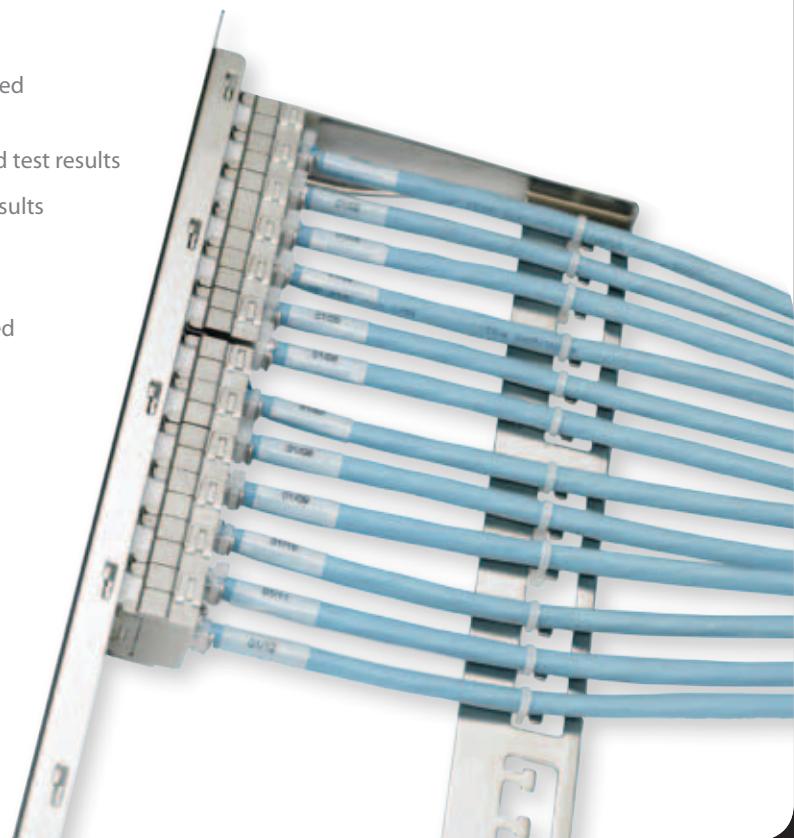
The Operation and Maintenance manual or documentation handed over to the client at the end of the job is a record of what has been provided with information about the products, how they have been implemented and the testing records.

Please note there may also be local codes and regulations, that outline how this documentation should be compiled.

An O&M package should include:

- As built drawings showing:
  - date of installation completion
  - site identity / location identity
  - location of outlets
  - identity of outlets
  - location of cabinet and frames
  - identity of cabinet and frames
    - If required with occupancy and capacity of cabinet and frames
  - pathways used
    - If required identity of pathways
    - If required with occupancy and capacity of pathways
  - fire stopping
    - If required identity of fire stop with occupancy and capacity
  - Grounding / earthing points
    - If required identity of grounding / earthing and connections
- Details of the product set used throughout the installation including:
  - product part numbers
  - product specification sheets. (don't forget to use branded specification sheets - refer to the website section 15 to see how to add your company logo and details)
  - label format and typeface
  - Bill Of Materials
- Summary test result sheets for all outlets and tested components
  - CD (or other electronic medium) of the detailed test results
  - Copy of the Fluke Linkware used to view the results
- Details of the test equipment used to certify the performance of the cabling system
- Calibration certificates for the test equipment used
- Details of the test methods used
- Warranty certificates from Excel
- Details of any routine or periodic maintenance requirements including cleaning methods and materials
- Contact details for the installer

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# Testing

Excel recommends Fluke Networks, this section is written around the use of this range of test equipment.

## Twisted Pair Copper

This section describes and sets out the requirements for Class D (Cat 5e), Class E (Cat 6) and Class E<sub>A</sub> (Cat6<sub>A</sub>) balanced twisted pair copper Permanent Link testing and Channel testing for the Excel warranty.

The preferred test equipment is a Fluke DSX 5000. There is a list of acceptable alternatives in the Warranty Section of the Partner Area at [www.excel-networking.com](http://www.excel-networking.com)



### Permanent Link Testing

The test set must be fitted with a set of:

- Fluke Permanent Link Adapter PLA004

### Channel Testing

The test set must be fitted with a set of Fluke Channel test heads.

## IMPORTANT:

- Permanent Link Adapters must be 'serviced' every 5,000 tests.
- Channel Test heads last for a maximum of 2,000 tests, and cannot be serviced, they should be discarded and new ones purchased. N.B. This number is based on the amount of matings, i.e. how often a Patch Lead is plugged into them. When testing a channel you MUST leave that Patch Lead behind or that channel test is no longer valid.
- The test set must be within 12 months of calibration.
- Tests must be run with Graphs Stored enabled and HDTDR / HDTDX recorded for all \*PASS/FAIL.
- Calibration of the Permanent Link Adapters shall be carried out in accordance with the recommendations of Fluke using a DTXCAL or DSPCAL as appropriate and on replacement of a Personality Module.
- All Channel Test Heads, Personality Modules or Personality Module tips must be frequently inspected for damage or undue wear.
- At least one set of Fluke calibration tools DSPCAL, DTXCAL must be kept on site at all times during the project installation and testing phases. NOTE: this may give you an improvement in XTALK and RL results.
- Power frequency must be set to 50Hz.
- Limits database and software must be as per the product set under test and Excel warranty requirement.
- The test limits for Excel are CENELEC EN50173 series including all latest amendments, modified by the copper cable type under test (Class D, Class E, etc). If there is any doubt for installed cabling regarding which component performance specification to be used, confirmation should be sought from the client or Project Manager and referred back to Excel for approval under their warranty scheme.
- Installers should budget and schedule for replacement of Channel Test Heads, PLA2 tips and Personality Modules. The replacement rate may be lower than recommended or required depending on wear and condition of the test equipment on site.

## Tester Log Sheet

A tester and test set component usage log sheet must be kept with each test set and maintained by the operator of the test set. The tester log must record the components within the test set including:

- test set ID (serial numbers from all major components)
- test cord ID
- test head serial numbers (PLA and Channel Head)
- calibration status (date of calibration for each component)
- component usage (number of tests executed)
- operator ID (name and company)

Replacement of ALL Copper Reference Test Cords is mandatory when they have completed 100 tests or earlier if damage is present on the test cord connectors.

## At The Start of Each Day

- Check that the batteries are fully charged
- Check all results from the previous day have been off loaded onto a laptop
- Perform a visual check on the condition of the tester components for wear or damage
- Fill out the tester log sheet and confirm all the tester components and leads are within their usage limits
- Plug the designated main end Channel Head or PLA into the main end of the tester
- Plug the designated remote end Channel Head or PLA into the remote end tester
- Enter operator name site and starting cable ID to be tested

NOTE: Every 6 Months (immediately after calibration and then +6 months) run DSPCAL or DTXCAL set up on the PLA heads

## For Each Project

- Enter the NVP for the cable obtained from the product specification sheet
- All Excel Cables are stored under 'Manufacturers' within the DTX setup tab
- Enter the performance level specification for the Channel or Permanent Link to be tested CENELEC EN50173 Class D, Class E, etc.

## Recommendations

- Perform a basic wire map test with a Mod Tap (wire map), or similar, before using the Fluke tester to fault find
- Have a laptop computer on site with the latest version of Fluke Linkware installed
- Identify Main and Remote on the Channel adapters and PLA with a permanent ink pen or label ID system

Excel requires a copy of the test results in Fluke software (flw) or the alternative testers native format. Excel will not accept .pdf files under any circumstances.

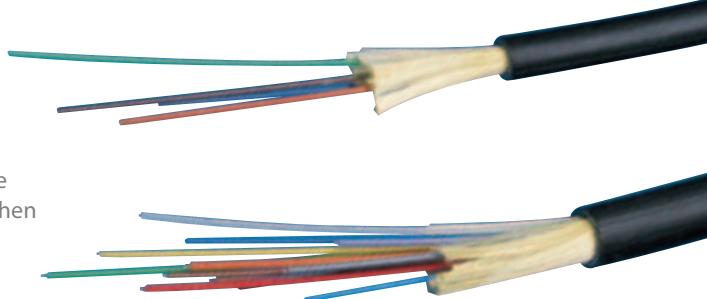
Each report will be stored by Excel.

The Installer will be provided with a copy of the Channel Warranty documentation Excel will endeavour to process Warranty Application within 5 working days if the process contained in Section 13 is followed.

# Fibre Specific

## Overview

Optical fibres require special care during installation to ensure reliable operation. Installation guidelines regarding minimum bend radius, tensile loads, twisting, squeezing, or pinching of cable must be followed. Cable connectors should be protected from contamination and scratching at all times. Violation of any of these parameters causes increased attenuation or permanent damage to the cable. The following are a few general comments to consider when installing fibre optic cables.



### Do not exceed maximum cable lengths

Make sure you check the installation instructions of the module for the appropriate cable lengths to ensure proper operation. You may experience additional attenuation loss when using bulkhead connectors to join cables even when the total length is less than the maximum allowed. Care should be used in maintaining total attenuation budget when joining cables with bulkhead connectors.

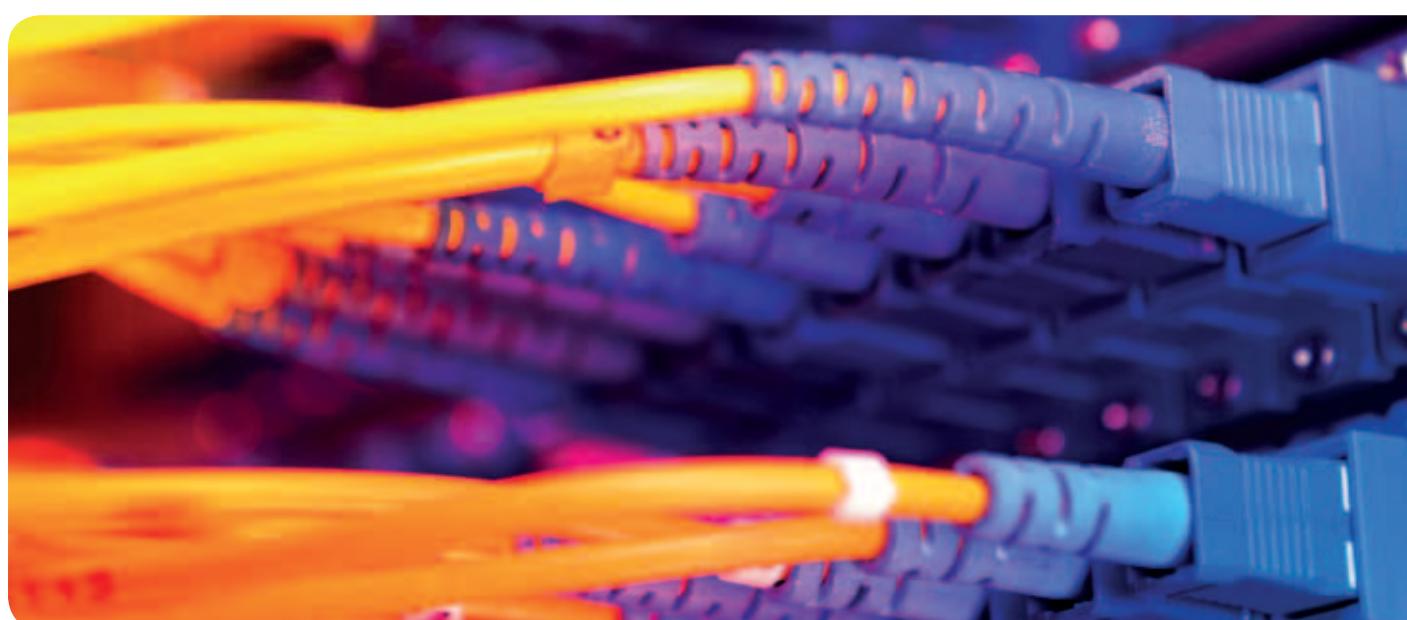
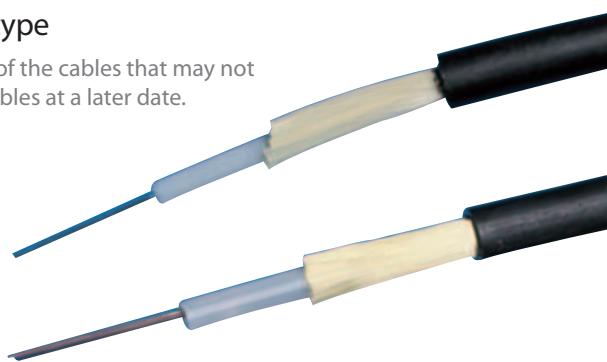
### Do not compromise minimum bend radius for a given cable type

Exceeding the bend radius of the cable can cause unseen damage to the fibres of the cables that may not manifest itself for a period of time. This can lead to an expensive re-pulling of cables at a later date.

### Avoid twisting cable

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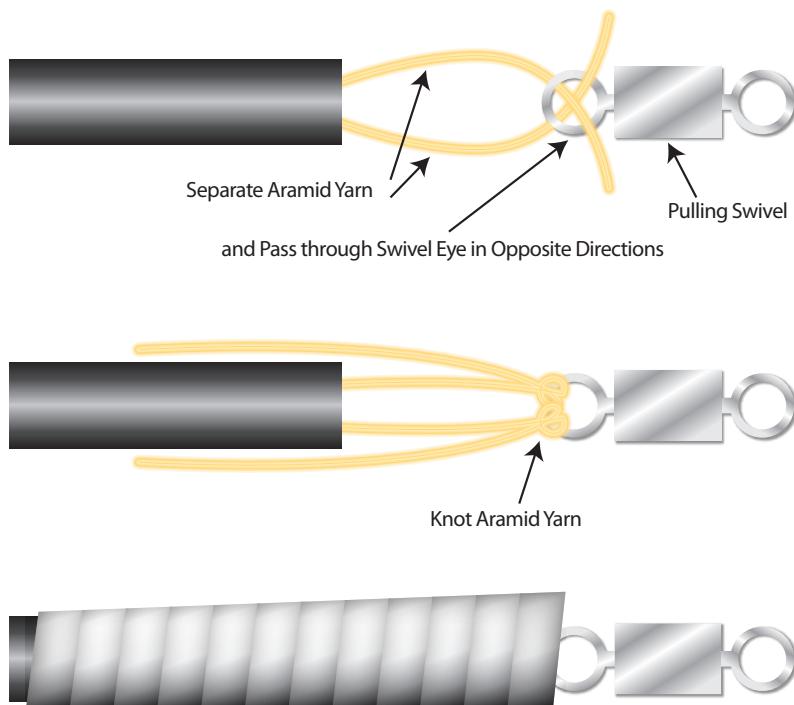
Use proper pulling techniques when installing the cables. Putting twists in the cable greatly increases the chances of breaking the fibres.



## Fibre Optic Cable Pulling Techniques

Installation methods for both wire cables and optical fibre cables are similar. Just remember these rules:

- Never pull on the connector. The connector/cable interface is not designed for pulling.
- Use a pulling grip designed for pre-connected fibre optic cables. Grips with a fixed pull ring should use a swivel to attach the pull rope.
- Monitor tension. Do not exceed the maximum tensile load.
  - On runs from 40m to 100m, use proper lubricants and make sure they are compatible with the cable jacket.
  - On runs over 100m, use proper lubricants and pull from the middle out to both ends.
  - If possible, use an automated puller with tension control or at least a breakaway-pulling eye.
- Always use a straight pull. Use cable guides to maintain the recommended bend radius. Do not exceed the cable bend radius. Exceeding the bend radius harms the fibres. It may not be immediate, it may even take a few years but eventually by exceeding the recommended bend radius of the cable you reduce the useful life of the cable
- Use a swivel-pulling eye, to prevent additional twisting of the cable during installation.



## Routing Fibre Optic Cables

Take care to properly route cables through cabinets and right angle bends within cable tray.

- **Install cables in containment without loops.** Avoid placing fibre optic cables in containment and conduits with copper cables to avoid excessive loading or twisting.
- **Protect cables from excessive or frequent bending.** Cables do not have a flex rating. Special care must be taken to protect the cable and to avoid exceeding the bend radius of the cable.

## Installation Checklist

Use the following installation checklist to ensure proper handling.

Installation Procedure	Complete	Comments
Maximum cable length not exceeded		
Bending radius not exceeded		
Maximum tensile load not exceeded		
Correct pulling techniques used		
Cable not squeezed or jacket creased		
Cable installed without loops in containment		
Cable protected from sharp edges		
Fibre cable installed in separate containment or route to copper cable		
Communications Spaces thoroughly cleaned prior to termination of fibre cables, (direct or splicing).		
Fibre connector end face cleanliness maintained		
Fibre connector dust caps in place		
Correct labelling of both fibre cables and panels		

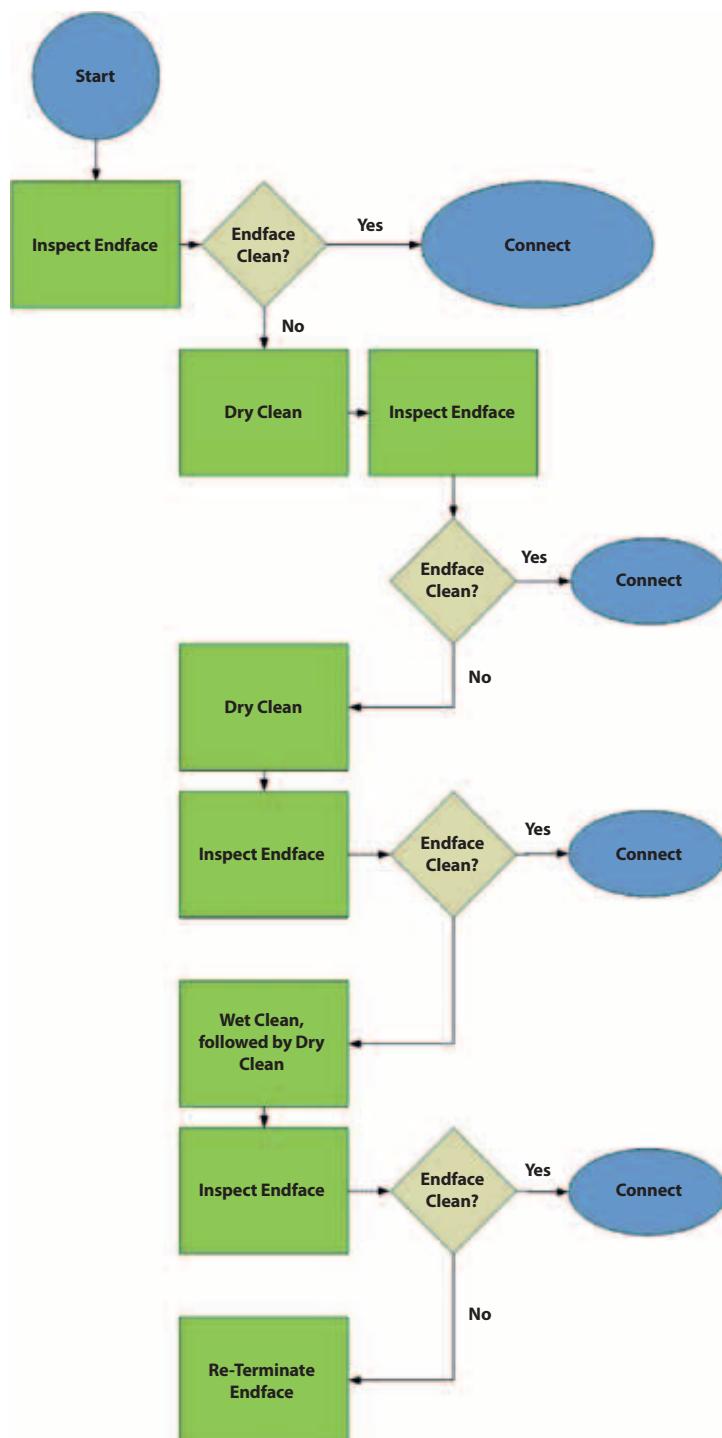
# Cleaning Techniques for Fibre Optic Cables

Any contamination in the fibre connection can cause failure of the component or failure of the whole system. Even microscopic dust particles can cause a variety of problems for optical connections. In a survey carried out by Fluke Networks they claim that 85% of the failing links can be attributed to 'end-face contamination'.

Proper cleaning of the fibre optic cable ends and transceivers is essential to minimize system attenuation.

Dirty fibre optic connectors cross contaminate their mating transceivers. Conversely a dirty transceiver contaminates its mating fibre optic connector. There are a variety of ways to clean fibre optic components. Pre-packaged wipes, swabs and, canned air are suitable. Whatever the choice, it is important to follow the correct procedure/instructions. Failure to do so could lead to even more contamination being introduced.

The following is a flow chart outlining the suggested Excel process for cleaning fibre connectors.





### Conclusion

Cleaning fibre is an essential process of any installation and there are a number of key elements to ensure success.

They are:

- Never touch the end-face of the fibre connectors – natural body oil can be a major cause of contamination
- Always keep a protective cap on unplugged fibre connectors – protection from both damage and contamination
- Do not clean bulkhead connectors without a way of inspecting them – how else will you know whether the cleaning is successful?
- Always store unused protective caps in a sealed container - they can also be a major source of contamination if not stored in a clean environment.
- Never re-use any tissue, swab or cleaning cassette reel
- Never touch any portion of tissue or swab where alcohol was applied – you could be introducing both dirt and body oil
- Never use a wet cleaning method without a way of dry cleaning immediately afterwards - the wet process can leave a harmful residue that is hard to remove when it dries

Finally, be warned:

Ensure all the fibre connectors you intend to clean are disconnected. And **NEVER** look into a fibre with either a fibre microscope or the naked eye when the lasers are on.

## Termination Options

There are a number of methods for the termination of fibre connectors each one has its own merits and benefits, in ease of termination, cost and convenience. One factor that remains consistent across all of them is the importance of cleanliness.

Multimode connectors are usually installed in the field on the cables after pulling this may include direct termination or splicing of pre-termination of factory-made "pig-tails". While single-mode connectors are usually installed by splicing a factory-made "pigtail" onto the fibre this is due to the tolerances on single-mode terminations being much tighter and the polishing processes more critical and you may not be able to get losses lower than 1 dB with field termination.

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Pre-terminated cables can be pulled with connectors already on them if, you clearly understand the potential issues: Firstly, the length must be precise, too long and you may have to store the extra cable length. Secondly, the connectors must be protected. Excel Networking offers protective sleeves to cover the connectors, but you must still be careful in pulling cables. In fact you may consider terminating one end and pulling the un-terminated end to not risk the connectors.

There is a growing movement to install pre-terminated systems especially with MPO/MTP 12 multi-fibre connectors.

### Direct termination – Epoxy, Hot Melt, Anaerobic Adhesive, Crimp & Polish

A note on adhesives: Most connectors use epoxies or other adhesives to hold the fibre in the connector. Use only the specified epoxy, as the fibre to ferrule bond is critical for low loss and long term reliability.

#### Epoxy/Polish

Most connectors are the simple "epoxy/polish" type where the fibre is glued into the connector with epoxy and the end polished with special polishing film. These provide the most reliable connection, lowest losses (less than 0.5 dB) and lowest costs, especially if you are doing a lot of connectors. The epoxy can be allowed to set overnight or cured in an inexpensive oven. A "heat gun" should never be used to try to cure the epoxy faster as the uneven heat may not cure all the epoxy.

#### "Hot Melt"

This is a 3M trade name for a connector that already has the epoxy (heat set glue) inside the connector. You strip the cable, insert it in the connector, crimp it, and put it in a special oven. In a few minutes, the glue is melted, so you remove the connector, let it cool and it is ready to polish. Fast and easy, low loss, but not as cheap as the epoxy type, it is seen as suitable for relatively small quantities of connectors.

#### Anaerobic Adhesives

These connectors use a quick setting adhesive to replace the epoxy. They work well if your technique is good, but often they do not have the wide temperature range of epoxies, so only use them indoors.

## Crimp/Polish

Rather than glue the fibre in the connector, these connectors use a crimp on the fibre to hold it in. Expect to trade higher losses for the faster termination speed. These connectors are more costly than epoxy polish types. A good choice only if you install small quantities and the customer will accept them.

## Hints for field terminating connectors

- Have the right tools for the job and ensure they are in good condition.
- Is your Test Equipment and Leads in perfect condition?
- Ensure you have the means to inspect the end-faces.
- Dust and dirt are your enemies work in the cleanest possible location.
- Use lint-free wipes to clean every connector before connecting or testing it.
- Don't work under heating vents, they distribute dirty air.
- Don't over-polish, too much polishing is just as bad as too little. Polish too much and you create a concave fibre surface, increasing the loss.
- Change polishing film regularly. Polishing builds up residue and dirt on the film that can cause problems.
- Put covers on connectors and patch panels when not in use.
- Inspect and test, then document.

## Splicing – Mechanical or Fusion

There are two types of splices, fusion and mechanical, and the choice is based on quantity, expected lifecycle and location.

### Fusion Splices

These are made by "welding" the two fibres together usually by an electric arc. Obviously, it is not advisable in an explosive atmosphere. A good fusion splicer is usually fully automatic which gives maximum assistance and ensures good splices time after time.

This is the preferred option for field termination of Excel Fibre Systems due to the accuracy and consistency of Fusion Splicing of Excel warranted pre-terminated pigtailed.

For full details on the correct procedures for Fusion Splicing please visit the following link.

<http://www.fujikura.co.uk/products/videos/>

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### Mechanical Splices

These are alignment devices that hold the ends of two fibres together with some index matching gel or glue between them there are a number of types of mechanical splices however they should only be used for temporary repairs and not long term installations covered by the Excel 25 year warranty.

## Pre-terminated

The Excel pre-terminated fibre optic portfolio is available in OM1, OM2, OM3 and OM4 multimode and OS1 and OS2 single-mode categories of system. The choice of cable type allows for the assembly to match the environment that it will be installed.

Standard fibre termination is a costly exercise requiring highly skilled engineers and specialist equipment to complete an installation. With the Excel fibre pre-terminated solution it provides a fully tested fibre loom that can be installed by non-specialist personnel, vastly reducing the installation time onsite.

### IMPORTANT NOTE:

Using pre-terminated assemblies is no excuse for a lack of cleanliness within the Communication Room the fibre connectors are still susceptible to air borne contamination, the rules regarding inspection and cleaning prior to plugging a connector into a device or patch panel outlined earlier remains the same.

## Field Testing Overview

In order to test the performance of a Fibre system several key measurements need to be carried out, these can include some or all of the following:

- End-to-end optical link loss
- Rate of attenuation per unit length
- Attenuation contribution of splices, connectors and couplers
- Length of the fibre or distance to an event
- Linearity of fibre loss per unit length
- Reflectance or optical return loss (ORL)
- Chromatic dispersion (CD)
- Polarisation Mode Dispersion (PMD)
- Attenuation Profile (AP)

Other measurements such as bandwidth may also be performed.

Some measurements require access to both ends of the fibre, such as Tier 1 optical loss testing, others require access to just one, such as Tier 2 testing with an OTDR.

Field Testing of Fibre cables falls into three group: installation, maintenance and fault finding/rectification.

The following provides a summary of each of these topics, the exact details of which depends upon the system design and the contractual requirements as outlined in the Systems Specification as detailed by the Client or their representatives.

### Installation Testing

#### Pre-Installation Tests

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Prior to installation, perform fibre inspections to ensure that the cables received conform to the right specifications of the project (Category, Length and Attenuation) Also ensure that all connectors, pigtailed and couplers, meet the requirements along with the end-face condition (particularly if pre-term assemblies have been supplied) have not been damaged in transit.

#### Installation and Commissioning Tests

During installation ensure that the area involved with the termination of the fibre is kept clean at all times and prevent the introduction of dust and debris, as this will have a major impact on the quality of system that will be handed over.

Perform tests to determine the quality of cable splices and terminations including, end-face condition, attenuation, location and reflectance. Also carry out testing to ensure the installed system is suitable for the intended application. All these tests should be recorded and provided both to the customer as well as Excel Networking as part of the warranty application.

### Maintenance Tests

Maintenance testing involves periodic evaluation of the fibre cabling system to ensure that no degradation of the cable, splices or connections has occurred. The first stage of this should always be inspection of the end-face to ensure that no contamination has been introduced during the operation of the system. Other tests include cable attenuation along with attenuation and reflectance of splices and terminations.

It is the responsibility of the Client or their representatives to define the regularity of this testing.

### Fault Finding and Rectification

During fault finding and rectification perform testing to first identify the cause of the fault (transceiver, cable, connector, patch cord) as well as the location of the fault.

Once rectification has been successfully completed carry out testing of the repaired system following the guidelines covered in 'Installation and Commissioning Tests'.

# Combined Testing Methodology

## Testing Set-up

This element is designed to provide the installer with valuable information on how to set up the Fluke DSX 5000 correctly to provide Excel with the required information to assist us in processing the warranty applications smoothly and without undue delay. (The process differs only very similar across other testers)

It is an easy to follow step-by-step guide for the less experienced whilst providing a useful reminder for those that have been testing for many years.

### Copper Testing

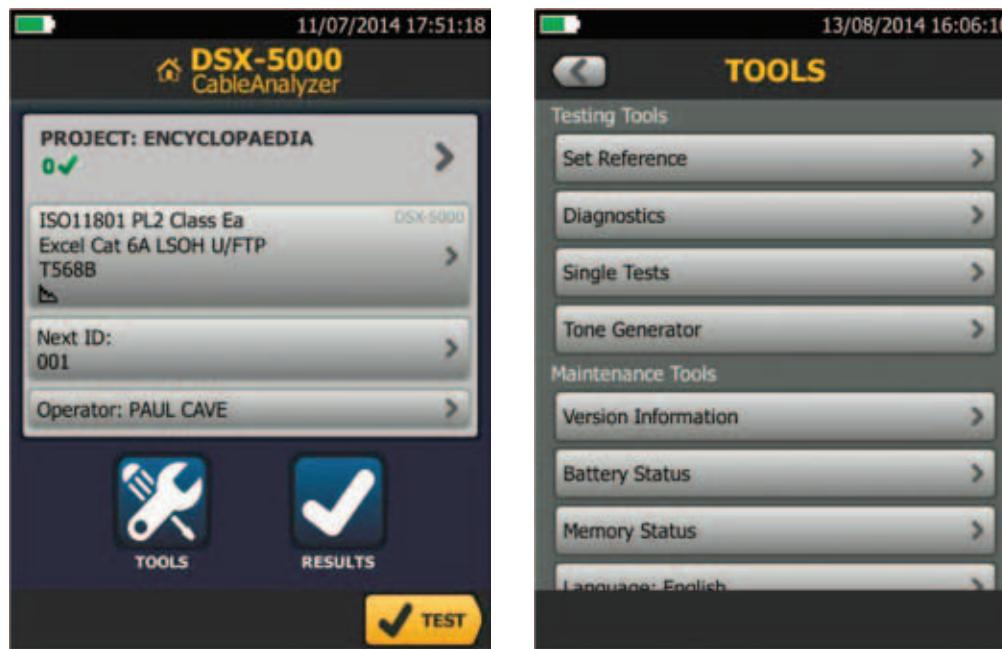
This will be broken down into a number of sub-topics, Permanent Link, Channel, Harness Links/Consolidation Cables and Patch Leads. A full description of what each one of these constitutes can be found in the preceding diagrams.

However the first step is to check that your tester is fit for purpose, it has the right software and test limits loaded and has been calibrated correctly, this is a very simple process with the new Fluke DSX 5000 and shows when the device was last calibrated and the software revision. It is very simple to check on the Fluke Networks website at [Flukenetworks.com](http://Flukenetworks.com) and download the latest version.

NB. As a Touch Screen interface you select by tapping on the icon involved.

On power up you will get the Home Screen (on the left) which shows how the device was set up for the last test. Tap the Tools icon to bring up that page.

NB. If you ever want to return to the Home Screen at any point you can press the HOME button on the front of the Main Unit.



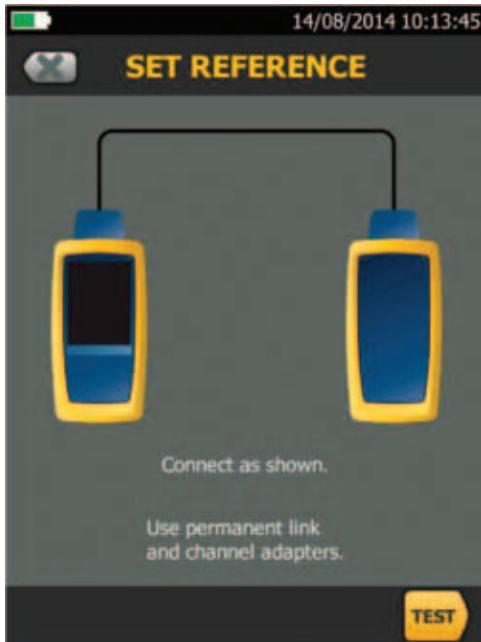
Go into Tools once there select Version Information, within here you will be able to check both the Main Unit and the module that is fitted, whether that be Copper or Fibre.



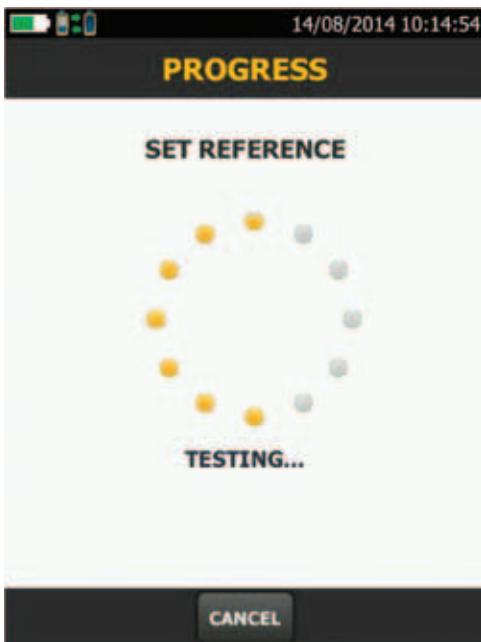
Within Tools you can also set up units of measure, language, date & time etc.

Following this you must reference the Main and Remote Units, again it is a very simple task, attach the PLA004 Permanent Link Adaptor to the Main and the Channel Adaptor to the remote. Plug them together.

Again within the Tools page select Set Reference you will then be guided through the simple process by the on screen instructions.



When ready, select the Test icon the unit will then run through the process, which only takes a few seconds and is recommended prior to starting every days testing.

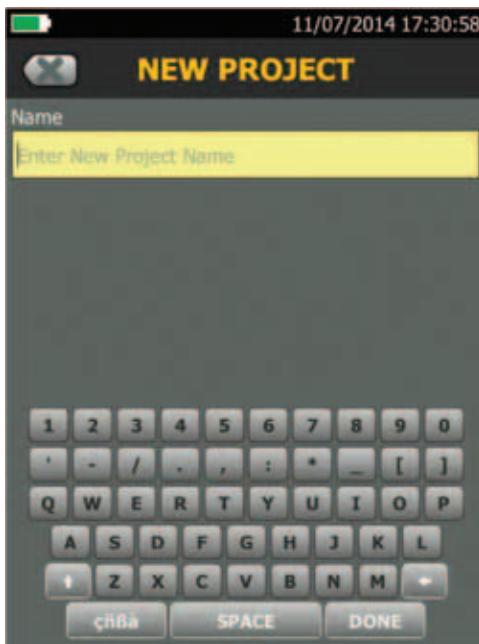


The next task is to set up the PROJECT INFORMATION. Once more this has been simplified and is even quicker to complete. From the Home Screen select PROJECT, within this screen you will be able to see each of the topics that require input.



This screen not only allows for projects to be directly set up on the device itself as well as transferring pre-configured projects that have been set up within Fluke Linkware. However for this document we will concentrate setting the project up within the DSX 5000 directly.

From this screen select CHANGE PROJECT, you will then be prompted to either select an existing one or create a new one select CREATE NEW



Repeat the process for OPERATOR, which allows for the selection from a list of previous users or the creation of a new one.

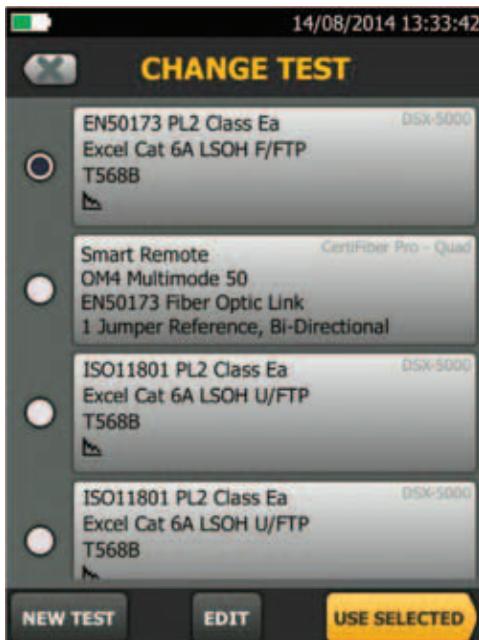
## Permanent Link

We now have to set up the specific test criteria needed for the project.

Once more this is very simple, as the unit senses whether the module attached is either Copper or Fibre and automatically selects a list of relevant tests. The Home Screen will show the last test carried out.

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Select TEST which will bring up the details of the test and then you can either, select one from the list displayed, edit one from the list or create a new one. For this exercise select NEW TEST.

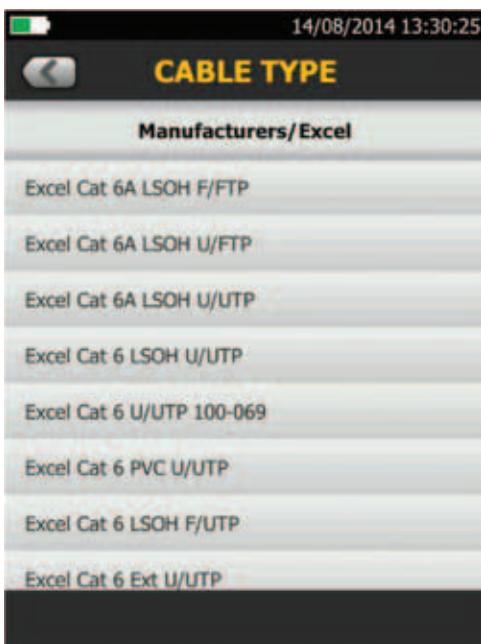


This will then bring up a new set of options.



Again this initially brings up the previous test criteria for you to edit and amend

Select CABLE TYPE, This will initially bring up a list of previously used cable types, if the one that you want is not listed select more and then the Manufacturers tab and then scroll down to EXCEL as Fluke Networks and many other equipment manufacturers list the details of Excel cables within their testers.

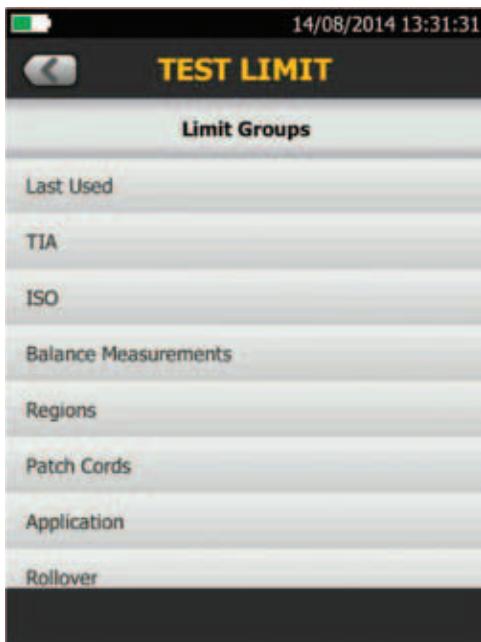


Select the type required, which inserts the relevant NVP etc and automatically takes you back to the previous screen. Follow the same process for selecting the required test limit.

However there is one slight anomaly in this process, by selecting TEST LIMIT it brings up a list of previously used tests, if the one required is not on the list, select MORE, which brings up the following screen, you will notice that it does not include EN (Cenelec).



## Excel Installation Guidelines



You must first select REGIONS and then from within that screen EN, this will then bring up all the relevant Cenelec standards to be selected from.



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For Warranty Application Purposes, EXCEL prefers that Cenelec test limits are used.

Also note at the higher Classes there is both PL2 and PL3 listed, ensure you select the correct one. PL3 is to be used whenever a Consolidation Point is part of the design.

The TEST SETUP Screen also allows contains two other important items that require selection they are:

STORE PLOT which must be selected as ON and HDTDR/HDTDX which must be set to FAIL/PASS\*

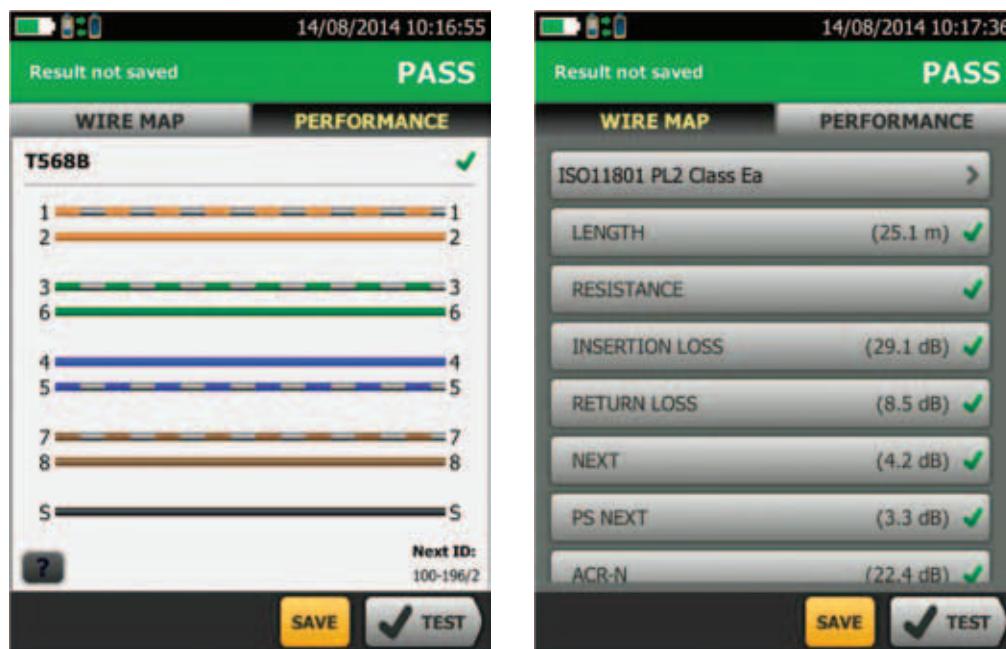
You are now almost ready to start testing but first of all you must select SAVE to store the information you have just created.

One final additional feature of the DSX 5000 is; within the Home Screen, you have the ability to set up the ID field for those links you intend to test, this can be done when setting up the project or at this stage simply by selecting NEXT ID: which brings up the next one in the range that was previously used. Select CHANGE CABLE Ids and then you can either edit the existing range or create a New ID Set within this last item you can even create a start and first point of the range.

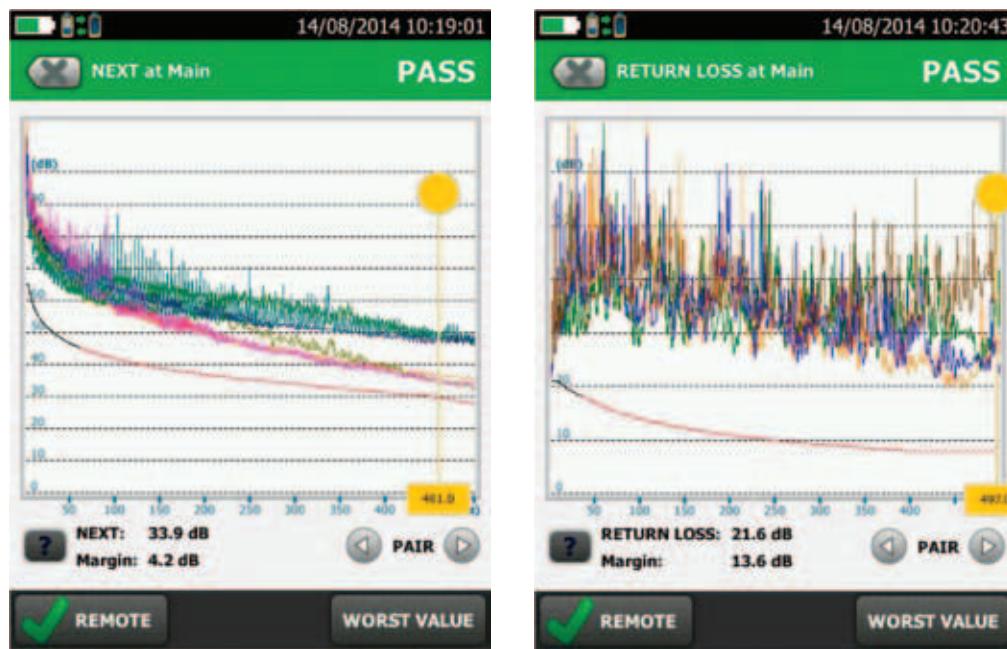
Once you select DONE, it will take you back to the test you have set up

Attach the two PLA004 leads and testing can now commence testing.

Either by pressing the White Button on the front or selecting TEST from the Home screen. It is a remarkably quick process. And the first screen you should see is the PASS screen, which has two tabs the first being WIRE MAP the second being the PERFORMANCE



To see an individual result just select the parameter and it will bring up the next screen.



You then have the option to view either from the Main or Remote end as well as seeing Worst Values, you can scroll each of the Pairs along with being able to drag and drop the cursor to specific frequencies, even zooming in a similar way as you do on any Smartphone.

## Channel

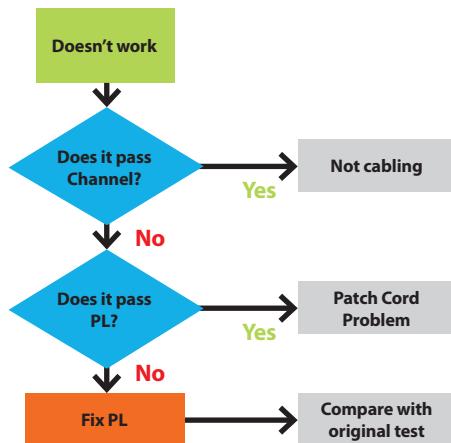
Channel Testing is not to be used for Warranty Applications, these guidelines are designed for troubleshooting purposes only. Testing the channel is very simple and straightforward.

Replace the Permanent Link Heads and replace them with the Channel Heads, and following the guidance previously given in this section, select a new set of patch leads to be used as reference cords, they should also be a minimum of 2m in length.

NOTE: these Reference Cord/Patch Leads should be replaced with new ones after every 100 tests.

From the Home Screen select the relevant Channel test in the same manner as described previously and select TEST.

The following is a workflow diagram for troubleshooting.



## Harness Links/Consolidation Cables

This is also sometimes called a Single Connector Permanent Link test. This is a link with an RJ45 Plug at the outlet.

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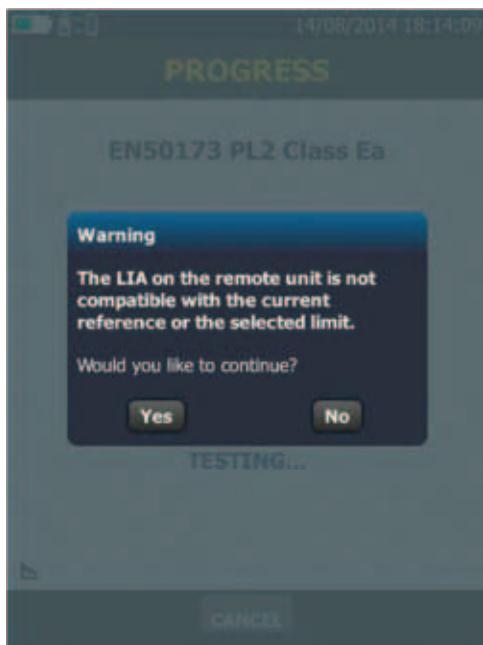
Cabling standards such as EN50173 defined two definitions for link testing, Channel and Permanent Link. In the case of the above link, it does not fit either model.



\* Remote channel adapter & RJ45 plug are excluded from the measurement using Digital Signal Processing

The above solution is a compromise between what the standards define and the desire to provide accurate test results for both Harness Links and Consolidation Cables. In this test scenario, no user patch cords are involved. Therefore it is more closely associated with a permanent link test. This is the process recommended by Fluke Networks.

When you set the DSX 5000 to a Permanent Link standard and then press the Test button you will be greeted by the following screen which correctly warns that the use of the Channel Head is not compatible with a Permanent Link test.



Select YES.

The effect of the remote channel adapter is removed in the above measurement. The channel adapter will normally add a significant amount of NEXT to the measurement unless it is cancelled out. The DSX 5000 uses Digital Signal Processing to cancel out the NEXT in the adapter in accordance with The Standards. Return loss in the mated connection is also minimized, as the adapters contain RL calibration coefficients representing a nominal RJ45 plug.

Therefore it must be noted that the TRUE value of the RJ45 plug is ignored by this test and to ensure optimum performance the Solid Core Patch Cords that are used to construct these Links/Cables are tested as such within the Factory.

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## Patch Leads

The purpose of certification testing is to ensure that a link, channel, or component meets industry performance standards. Installers certify permanent links and the network owners install patch cords at a later date to complete the channel.

Patch cord certification brings together a compliant permanent link and patch cord to make a standards compliant channel. Patch cord certification can be performed in the factory or the field with the right Test Equipment and Adapters.

As with permanent links and channels, the test equipment used for certification must be set to the correct test limit and the relevant category Patch Cord Test Heads are used.

The Fluke Networks has a range of Patch Cord Test Head Sets available, Cat5e, Cat6 and Cat6<sub>A</sub>. They all come in a version that can test both Screened and Unscreened cables. Also note unlike the Permanent Link and Channel Adaptors, they are Specific Main and Remote Heads, check you have them the correct way around as the DSX will warn of an incorrect set up.

From the Home Screen select a new Test Limit as has been described in this document, this time select Patch Cords, this will then bring up all the Categories.



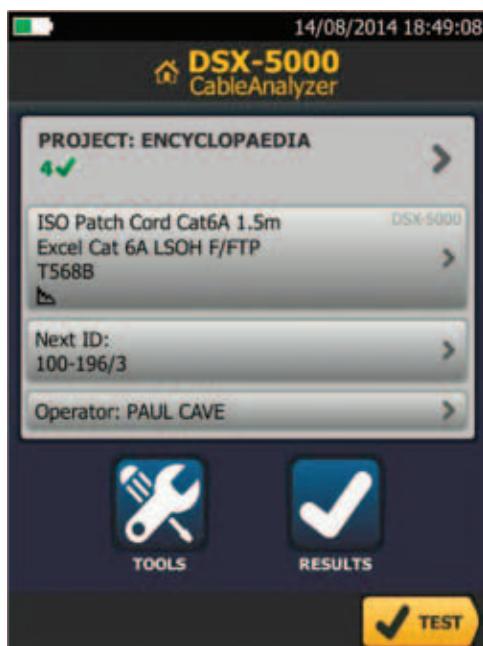
● Image features Category 6 Patch Cord Adapters



## Excel Installation Guidelines



Select the required length and then SAVE, and select from the list and you can start testing.



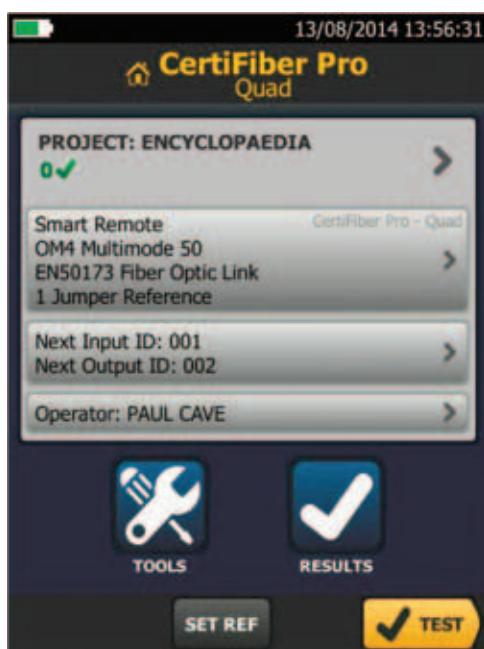
## Fibre Testing – (Tier 1)

Excel requires Fibre testing to be carried out using a Power Source and Light Meter, sometimes referred to as Fibre Loss Testing, this should be completed using the One Jumper Reference Method, the following section will guide you through what is required and how to set up a Fluke DSX 5000 fitted with Certifber Quad Fibre Modules for Multimode testing, if you testing Singlemode or using any one of the other authorised testers please refer to the Test Equipment Instruction Manuals.

We suggest that you carry out the complete set up prior, to attaching the launch leads and referencing the two units. A lot of people shy away from fibre because they think it is difficult, however from the following you will actually see how simple and easy it really is.

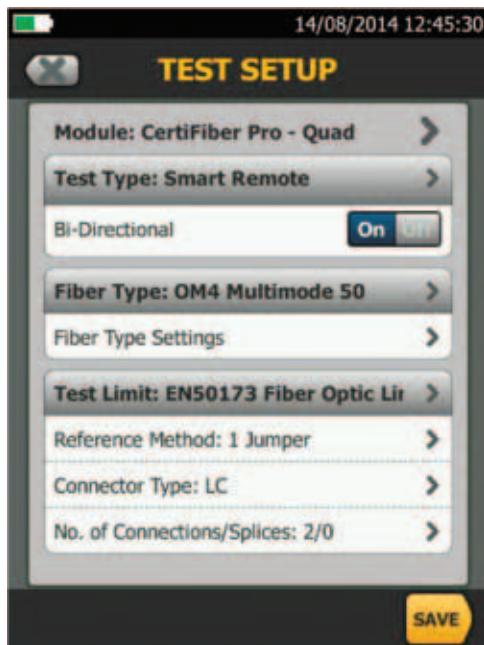
Carry out of setting up the PROJECT INFORMATION as outlined in the Copper Section

However as soon as you attached the Certifber Modules the DSX 5000 is intelligent enough to recognise this and starts part of the process for you as at the top of the Home Screen it shows the modules fitted.



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Select TEST LIMIT and you will have a number of options, once more we want to select the EN50173 Standards, if it isn't in the LAST USED list use the same process as previously described.

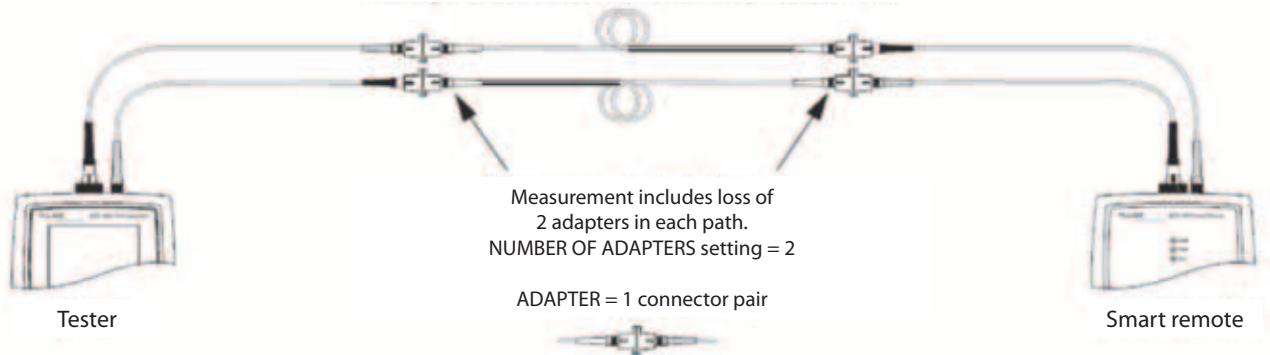


## X Excel Installation Guidelines

You will then have to change some of the other settings, ensure that Test type is SMART REMOTE and Bi-Directional is ON. Fibre Type is correct

The next stage is one of the most important during the set up phase, enter incorrect information at this stage and you WILL get incorrect results, you are setting up the 'Loss Budget' for the link you are about to test, get this wrong and successful passes will be reported as failures.

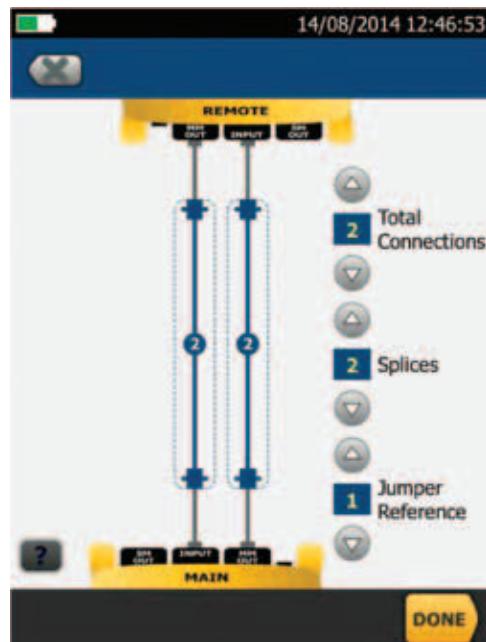
Example of Smart Remote mode test connections



You must therefore enter the correct number of Adaptors in your link as well as the correct number of Splices, (within Patch Panels etc.)

Underneath the Test Limit on the TEST SETUP Screen, there are 3 settings: Reference Method should always be 1 Jumper.

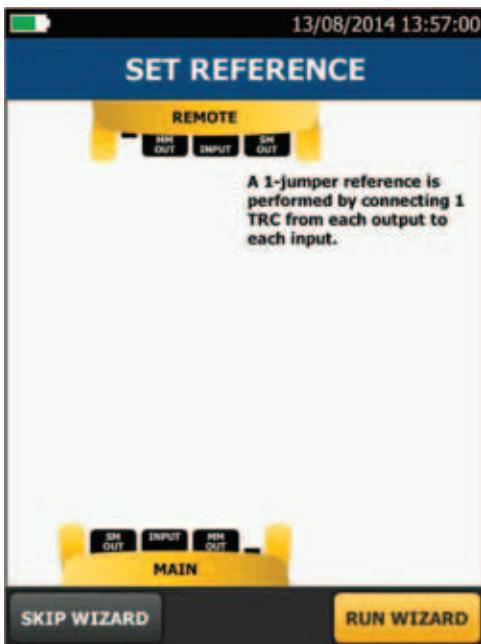
The next is the Connector Type the last one covers the number of Connections/Splices, select this and it will bring up the next screen.



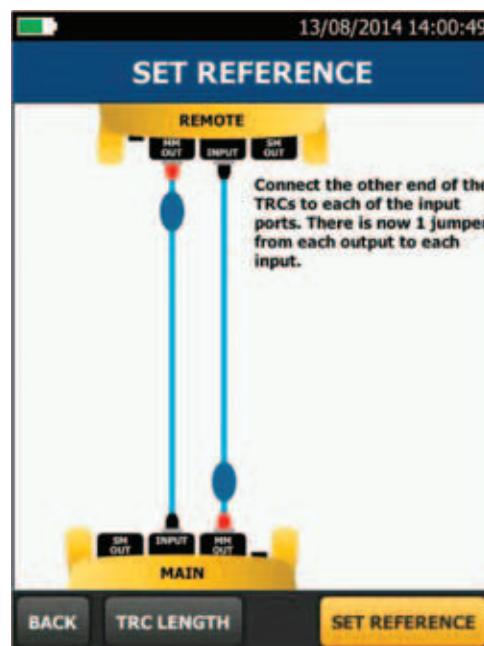
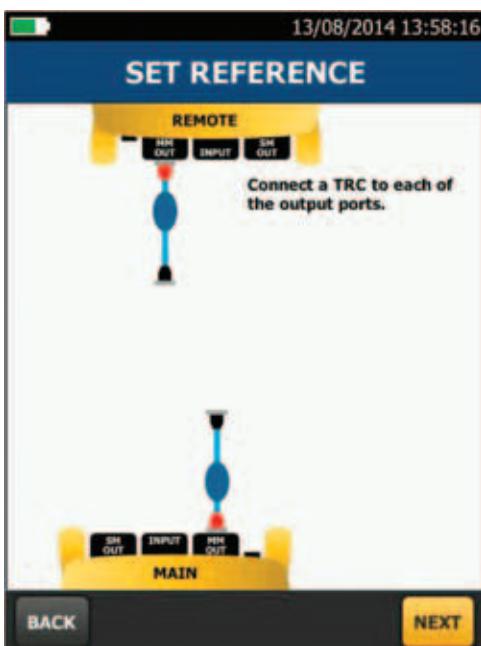
Once you have selected the right number for each item select DONE and you will be taken back to the TEST SETUP screen.

The final part of the setting up the test is to Reference the Fibre Test Leads. Select HOME, when the Home Screen appears; Select the additional icon SET REF.

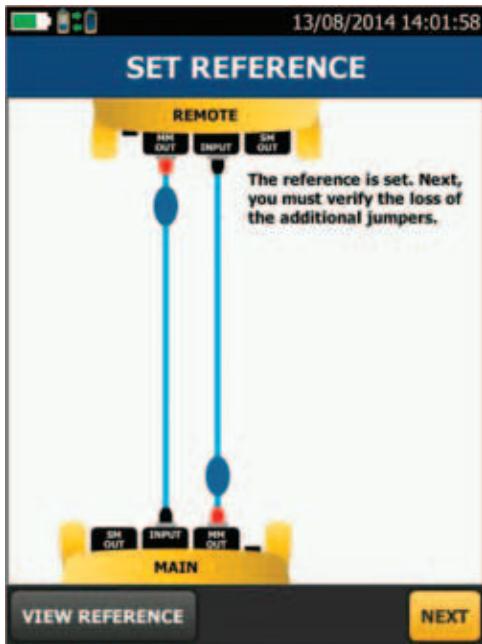
This brings up the SET REFERENCE Screen, which provides two options.



To ensure that you complete this important phase correctly select RUN WIZARD, this will take you through all the steps required.

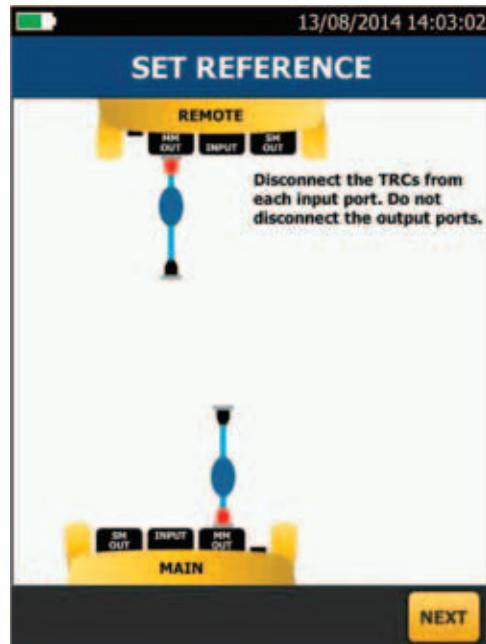


Once the units are connected Select SET REFERENCE



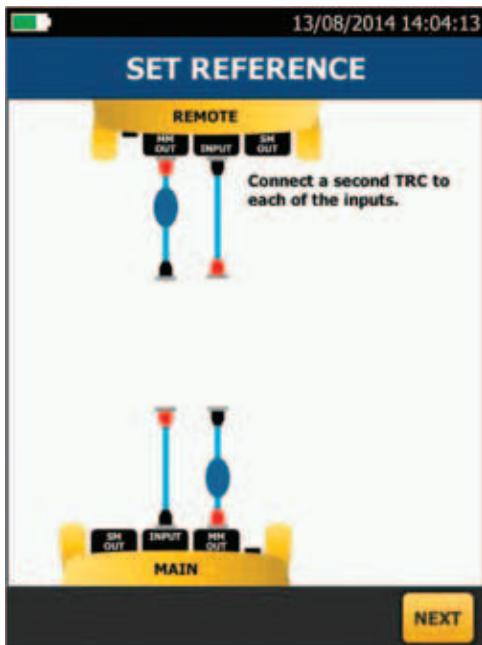
**VIEW REFERENCE**

**NEXT**

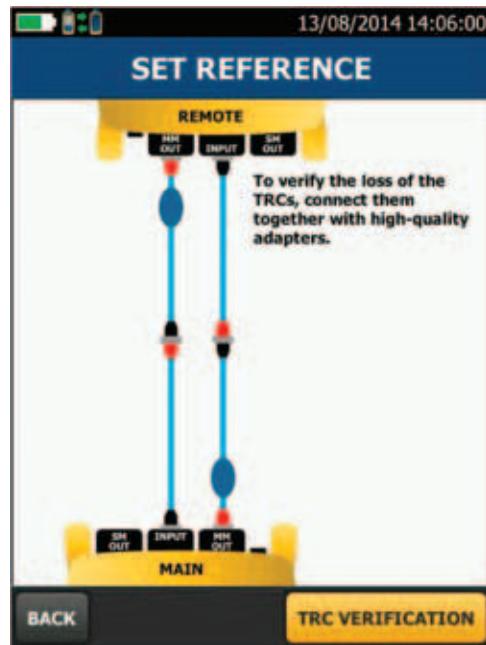


**NEXT**

After each step select NEXT



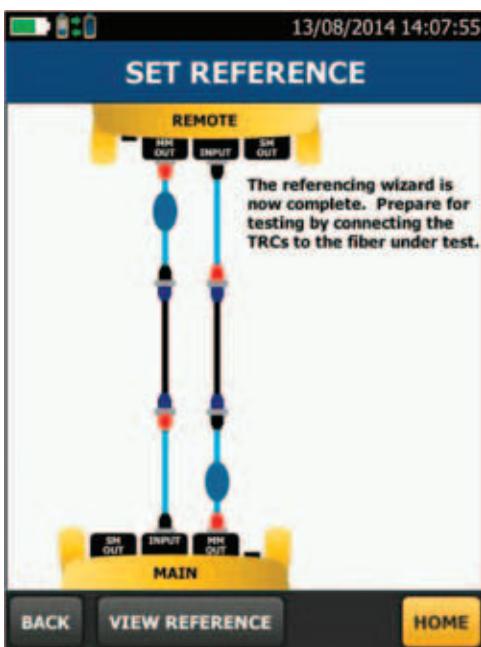
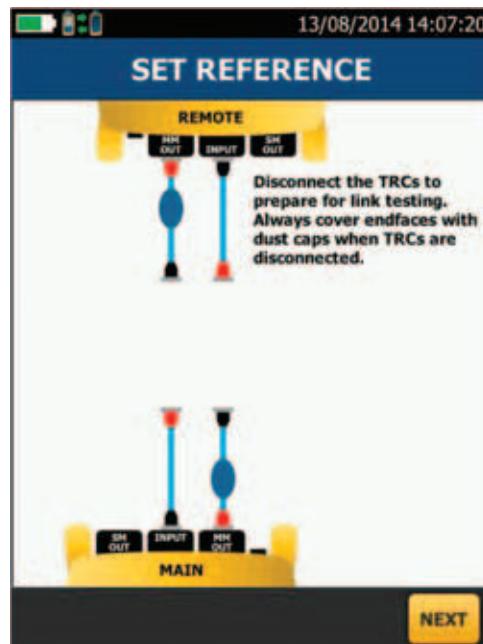
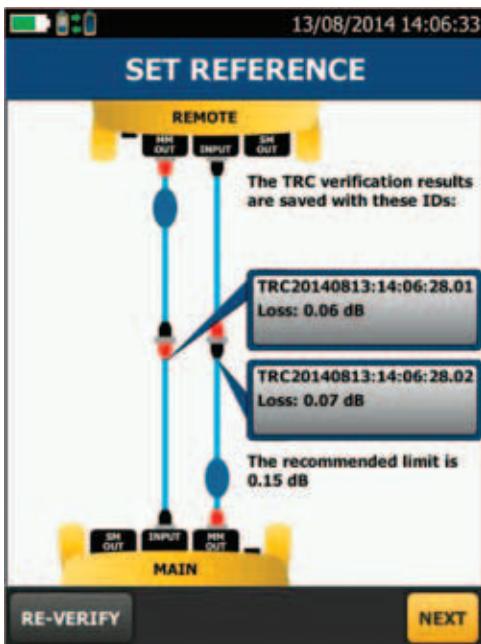
**NEXT**



**TRC VERIFICATION**

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Select TRC VERIFICATION, this brings up the values of the leads that have been Referenced Out.



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By selecting HOME it takes you back to the Home Screen, once there quickly verify the details and you are then ready to start testing.

You are now ready to start testing the fibre links. The process for setting up to Singlemode Links is almost identical.

If there are any doubts on how to set up your tester for a specific project it is recommended that you call Excel Technical Support, prior to commencing to avoid any confusion and delays with warranty applications at a later stage.



## Permanent Link Description

A Permanent Link is defined as the cabling between two outlets (or three outlets if a Consolidation Point (CP) or Local Distribution Point (LDP) is used) but excludes any patch cords.

A Permanent Link, is the fixed cabling, to which equipment and work area cords are added to complete the channel (see diagram below). Physically the Permanent Link includes cable and outlets (possibly presented in a patch panel). Where a CP or LDP is required in the Permanent Link the CP or LDP to Outlet cord and the outlet are to be included in the Permanent Link measurement and testing. There are limits imposed within the standards for key electrical parameters such as insertion loss, XTALK, RL, ELFEXT, etc. The horizontal PL must take into consideration all elements necessary to configure the operational channel, which has a limit of 100m (305ft).

### Channel Description

A channel is defined as the “up to 100m” connection between two active components.

Physically the channel includes horizontal cable outlets (possibly a patch panel), Interconnect (fan out cables) and any cross connect (patch cords), equipment or work area patch cords. There are limits imposed for key electrical parameters such as Attenuation, XTALK, RL, ELFEXT, etc, the channel is not limited to a maximum of 4 connectors or junctions. However should a channel configuration require more than 4 connectors then approval must be given, at design stage, by Excel for their warranty support.

Testing of a channel can take two forms:

- Confidence test where the patch cords are removed or replaced following the test
- Full test where the final configuration is tested and left in place

A channel test serves to validate either conformity with the generic cabling standards or application support.

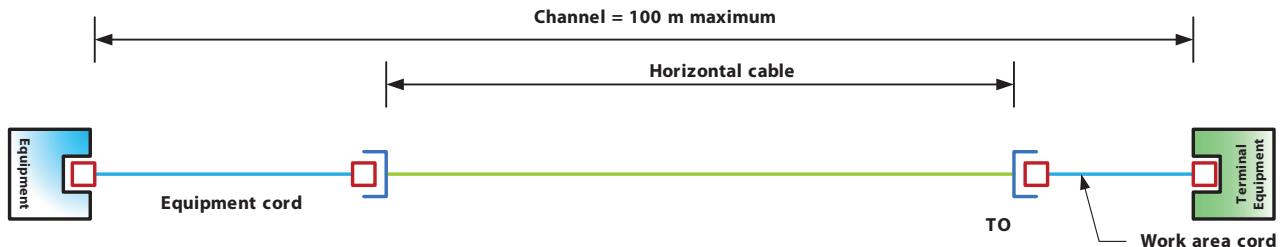
The term “Reference Cord” is defined here as a new Excel patch cord that will only be used for up to 100 tests. After 100 tests the Reference Cord must be destroyed and replaced with another new Excel Reference Cord.

Before a Channel test is performed all components in the Permanent Link must have been configured and validated for component compliance.

Marginal or star passes on all other criteria are to be treated as failures.

## Typical Permanent Link & Channel Connectivity Models

### a) Interconnect – TO model



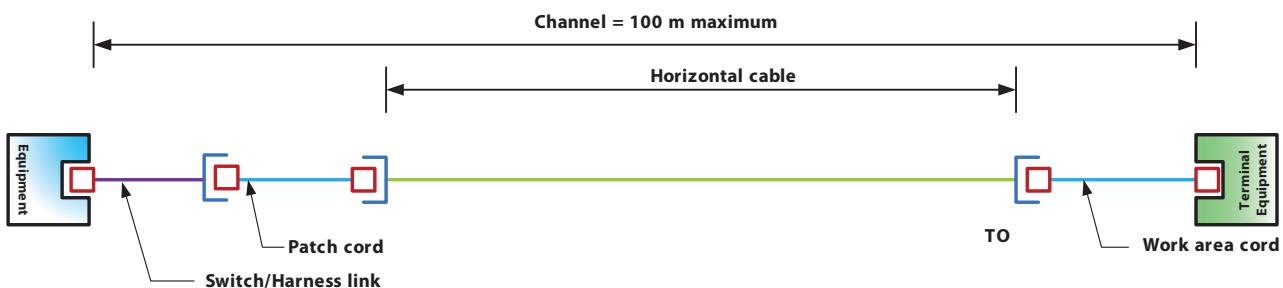
#### Mandatory tests:



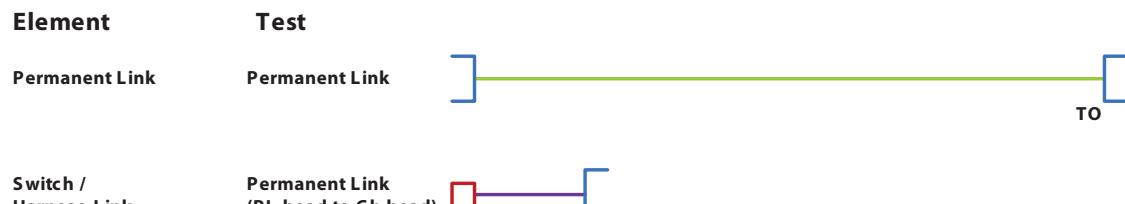
#### Optional tests:



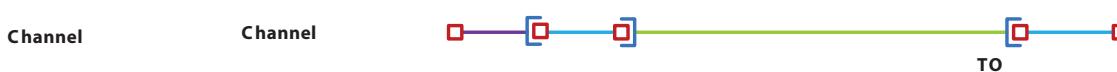
### b) Crossconnect – TO model



#### Mandatory tests:

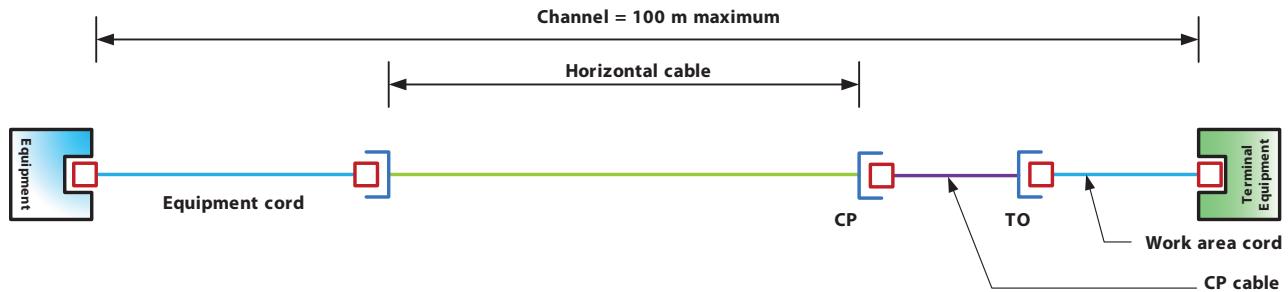


#### Optional tests:





## c) Interconnect - CP - TO model



### Mandatory tests:

#### Element      Test

CP Link

Permanent Link



CP Cable

Permanent Link (PL head to Ch head)



### Optional tests:

CP Link - TO

Permanent Link



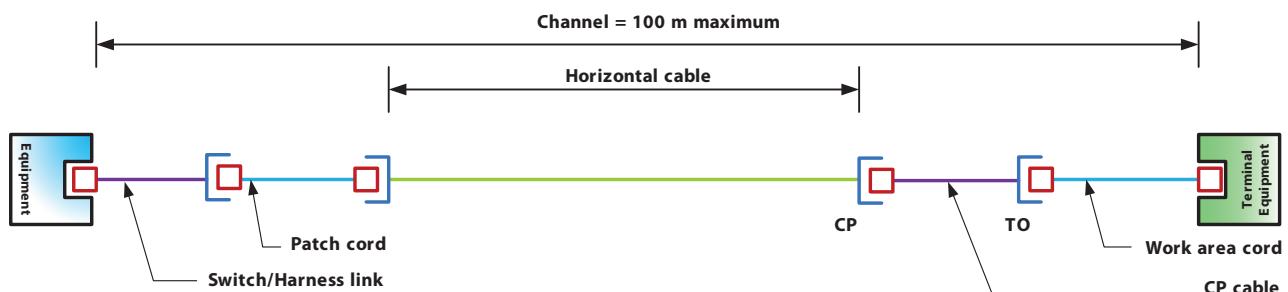
Channel

Channel



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## d) Crossconnect - CP - TO model



### Mandatory tests:

#### Element      Test

CP Link

Permanent Link



CP Cable

Permanent Link (PL head to Ch head)



Switch / Harness Link

Permanent Link (PL head to Ch head)



### Optional tests:

CP Link - TO

Permanent Link



Channel

Channel



# Excel Environ® OR Installation Guide

## Features

- Managing cable from the rear of the patch panels
- Assembly Instructions
- Installation
- How to make a 4 Post Rack
- Baying with Vertical Cable Manager
- Environ® OR Inventory
- Fitting 19" Patch Panels / Equipment
- Tools required
- Patch Cord Management

## Introduction

This installation guidelines document covers assembly instructions for the [Environ® OR 2 Post Racks](#), Baying with [Vertical Cable Management](#), creating a 4 Post Rack and cabling suggestions.

## Environ® OR Inventory

OR

- 2 off Vertical Sections
- 2 off Base Angles
- 2 off Top Angles
- Fixings

## Vertical Cable Manager

- Vertical Cable Manager - assembled
- Fixings

## Tools Required

The following tools are required:

- 2 qty spanners (13 mm)
- Philips Screw Driver



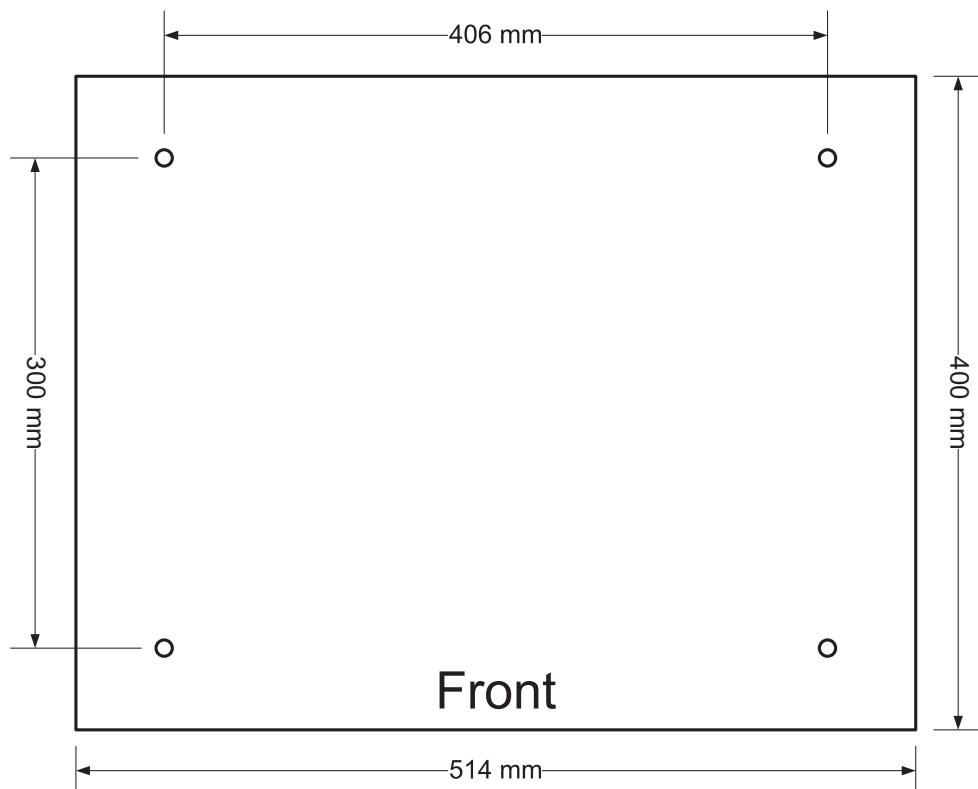


## Assembly Instructions - OR

- Lay the two vertical sections on a flat service
- Fit the two Base Angles with the nut and bolt fixings - "finger tight"
- Fit the two Top Angles with the nut and bolt fixings - "finger tight"
- Adjust inner distance between vertical sections to be  $450 \pm 0.5$  mm
- Check diagonal distances are the same
- Tighten nut and bolts

## Installation

Select suitable fixings appropriate for the floor. The OR has four 10 mm holes in the base angles. Below shows the spacing of the fixings.



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## Baying Vertical Cable Management

The [Vertical Cable Management](#) can be attached to each side of the OR 2 Post Frame. The Vertical Cable Management can be shared with the next OR 2 Post Frame or joined to another Vertical Cable Manager. The Vertical Cable Manager is fixed to the OR 2 Post Rack or adjacent Vertical Cable Manager in the following way:

- Place the Vertical Cable Manager next to the OR 2 Post Rack
- Remove both doors by rotating the handles in the direction of the arrows
- Use the supplied M8 x 15 mm Bolts and M8 Nuts to fix the Vertical Cable Manager to the OR 2 Post Rack
- Replace the doors

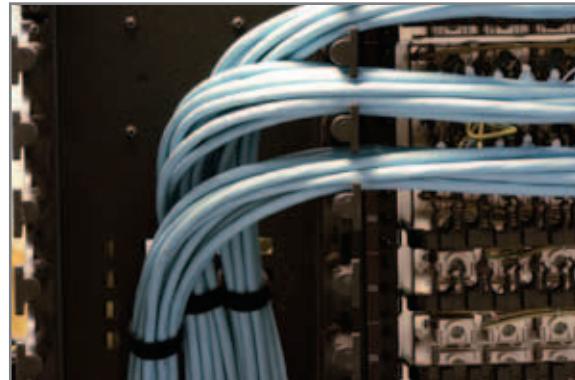
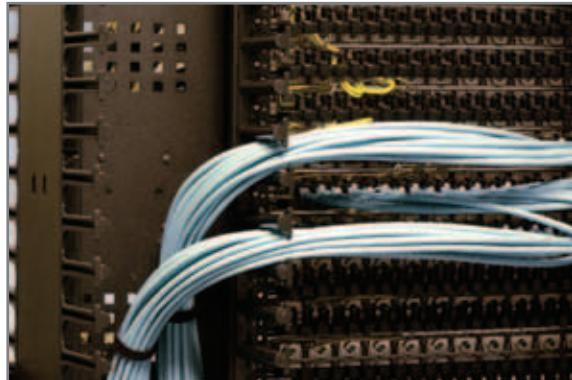
## Fitting 19" Patch Panels / Equipment

Patch Panels and equipment may be fitted to the OR 2 Post Rack using standard M6 Screws (supplied with the patch panels). The OR 2 Post Rack has M6 tapped holes in the front and rear faces of the profile. They match all three hole positions for each "U".

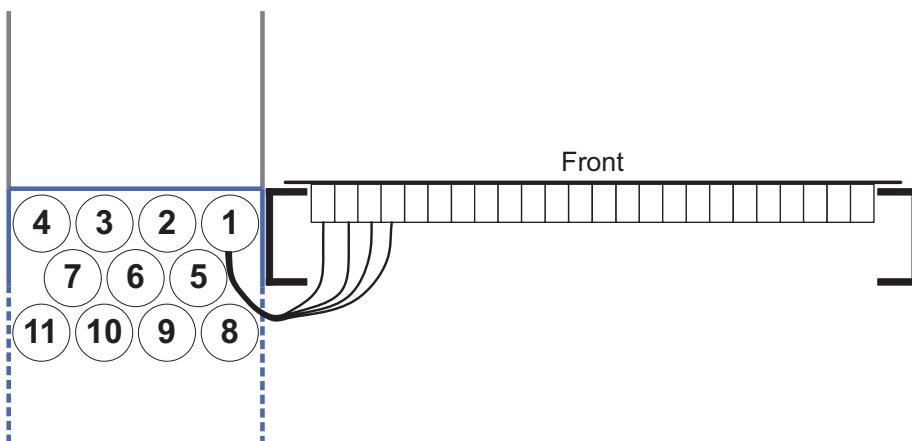
## Managing cable from the rear of the patch panels

The rear section of the Vertical Cable Manager is designed to accommodate the cable terminated on the patch panels. The plastic fingers of the Vertical Cable Manager supports the cable without damage. The suggested methods are:

- Bundle cables from the rear of the patch panel. Either all to one side or split half left and half right.



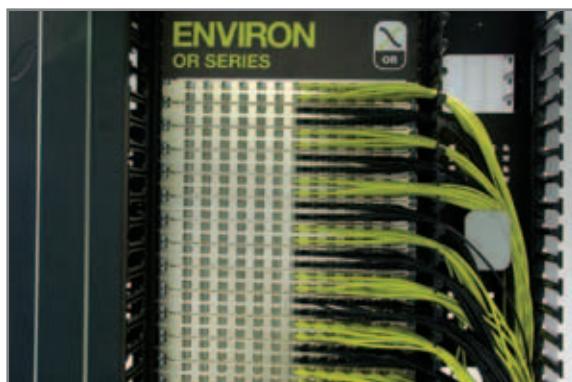
- The bundles are fixed in place within the Vertical Cable Manager. The Hook & Loop cable tie type is best to ensure no damage to the cable.
- It is suggested that if the incoming cables rise from below the upper most panel is installed first and if the cables descend from above then the lower most panel is installed first.
- The bundles then may be attached in the following order in the left and right Vertical Cable Managers



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## Patch Cord Management

The front section of the Vertical Cable Manager supports the patch cables with the plastic fingers. Plastic spools are included in 200 mm and wider Vertical Cable Managers. These are suitable for use with copper or fibre cords and may be easily removed if not required.

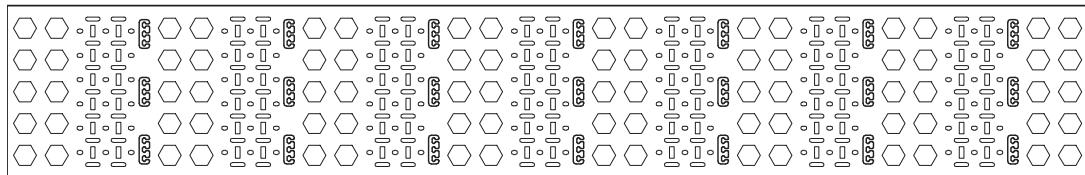


# X Excel Installation Guidelines

## How Configure a 4 Post Rack

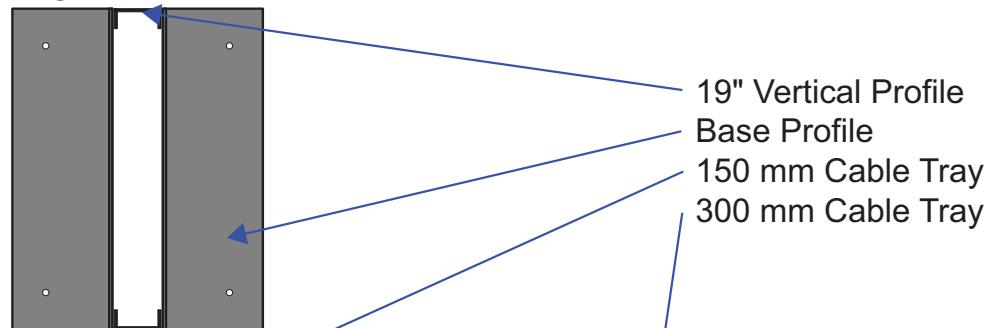
Two racks can be fitted to together to create a 4 post rack using the Excel Enhanced Cable Trays. Either 150 or 300 mm cable trays may be used. List of items required.

- 2 qty Environ® 2 Post Rack
- 1 qty Excel Enhanced Cable Tray (2 Pack) - size to match 2 Post Rack height

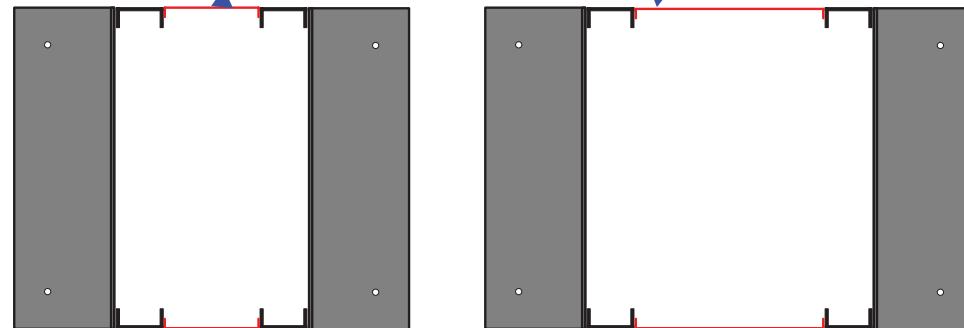


- Assemble the two OR 2 Post Racks without the inner Base Angles
- Join the Excel Enhanced Cable Tray to the inner rack mount profiles of the 2 Post Racks using the supplied M6 Screws

### Single 2 Post Rack



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2 Racks with 150 mm Cable Tray

2 Racks with 300 mm Cable Tray

# Excel Pre-Sales Support

## Section 10

### In this Section:

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## Winning Business with Excel

Excel has a team of experienced specialists who are on hand to assist with dealing with complex bids and supporting partners throughout EMEA at every step of the way, to increase their chances of winning major tenders and projects with the Excel product range.

The majority of these services are provided free of charge at any stage of a project, but it is recommended that early involvement, where relevant, would make the best use of the expertise to ensure that the most suitable Excel solution for the project is selected.

The Excel team has experience of the complete supply chain; their extensive knowledge of project management in an installer environment allows them to offer a service which is second to none.

### Excel's dedicated projects team offers the following benefits:

- Overall project responsibility – single point of contact to look after all requirements
- Set up of a dedicated account for a project and overseeing the implementation of the project terms and conditions
- Product samples/demonstrations
- Support with literature, presentations, technical specification sheets and case studies
- Manage the availability of stock for the project, ensuring that all deadlines are met
- Establish the project logistics to ensure all eventualities are catered for

### They also provide advice on:

- System design
- Installation practices
- Cabling Standards
- Technical Compliance
- Certification Testing Requirements
- Warranty Requirements

### Other services available include:

- Pre-Terminated Copper and Fibre Optic Cabling Systems - Saving installation time
- Pre & Post Sales Support
- Onsite Support Services
- Finance Options Available

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## Excel Business Development Managers

Excel's field based Business Development Managers are on hand to visit consultants and end users to discuss the benefits of the Excel Structured Cabling System. They can provide onsite presentations and meeting support in bid reviews, pre-sales or post sales meetings.

They can be contacted by emailing [projects@excel-networking.com](mailto:projects@excel-networking.com)

## Specification Documentation

To assist Consultants and Excel Partners with specifying Excel and winning tenders with the Excel product range, Excel has developed a series of documents . These documents are the ideal basis for putting together either an Excel Specification request for a Category 6<sub>A</sub>, 6 or 5e system or for answering a Tender with the Excel product range.

Copies of the Excel Tender Response document and Category 6<sub>A</sub> document are included in this chapter, the Category 6, 5e and Data Centre SCS documents can be downloaded from the website.

All documents are available electronically from [www.excel-networking.com](http://www.excel-networking.com) so that you can cut and paste the information.

# Excel Corporate Presentation

To assist Excel partners in positioning the Excel solution with potential clients, consultants and main contractors, we have produced a comprehensive corporate presentation that is available in Powerpoint or as an interactive PDF for use on the iPad.

The presentation is structured so that you can take your audience to the appropriate slides that suit their requirements, rather than having them sit through a lengthy presentation which covers information that isn't relevant to them.

Along the bottom of each slide is a menu by clicking on each heading you will be presented with a number of slides to cover that chapter. You can then go through all of these or just pick out the ones that cover the key points that you want to get across

Please see a selection of the slides below.

The presentation is available to Excel Partners to download from the Partner Area at [www.excel-networking.com](http://www.excel-networking.com)

**Global reach**

Number of countries sold into and growing

70

Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Malta, Mexico, Netherlands, Norway, Poland, Portugal, Russia, Saudi Arabia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Venezuela, Vietnam, and more.

**Award winning solution**

excel

Cabling Supplier of the Year

Manufacturer of the Year

**Customers & case studies**

excel

Reference Sites

Transport, Banking & Finance, Central Government, Utilities, Chemical, Commercial, Construction, Education, Emergency Services, Enterprise, Hospitality, Higher Education, Health, Local Government

**Component vs channel testing**

excel

Manufacturer → Component testing (Products tested individually) → Channel testing (Products tested as a channel)

**Excel warranty cover**

excel

25 Year Warranty.

**Marketing support - Excel website**

excel

Multi-lingual, News, Product catalogues, Download area, Videos

Downloads section: Specifications Sheets, Third Party Verification, Excel Products Guide, Excel Encyclopedia, White Papers, Technical Notes, Excel Training Partner Program, Excel Labels, Excel Corporate Overview Brochure, Excel Product and System Brochures, Excel Warranty Brochures

About section: Case studies, Excel Ethical Values, Third Party Verification, Excel Warranty Programme, Excel Partner Programmes

**Excel system offering**

excel

Category 3 UTP, Category 5 UTP and F/UTP, Category 5e UTP and F/UTP, Category 6 U/UTP and F/UTP, Category 7 U/UTP and F/UTP

Voice Internal Grade Cabling, External Grade Cabling

F/UTP Internal/External Grade Cables, Patch Cords and Adapters, SC, ST, LC, Connectors and Adapters, Patch Panels, MTP, MPO, Blank Plate

Racks: Environ CR Cabinet Racks, Environ ER (Equipment) and SR (Server) Racks, Environ Wall Mount Racks, Accessories

PDUs: Standard, Modular and Intelligent

Fiber: OM3/OM4 Cables, OM3/OM4 Patch Cables, OM3/OM4 Wall Mount Racks, Accessories

# Excel Tender Response Document - Overview

This document is aimed at helping Excel Partners to bid and win more projects with Excel.

It can also be used in conjunction with the compliance statement template that is available to download from the Excel website.

Each section has been designed around responding to the SCS specification template included within the Encyclopaedia, however it is easily adapted to respond to any specification document that an Excel Partner may receive.

The document looks at the different elements of the tender and will require input from the Excel Partner to produce a final tender response. It is a generic document based upon Category 6/Class E, however it can be adapted to either Category 5e or Category 6<sub>A</sub> with some basic input from an experienced Excel Partner.

## Document Control & Management Overview

This section covers the document authority and history. The Excel Partner will need to insert their details in the review control panel and provide details where required.

### Section 1 - Introduction

This section covers some basic definitions that are used throughout the document.

### Section 2 - Scope & Overview of Works

This section demonstrates the Excel Partners understanding of the forthcoming project and requires them to add in the relevant details in relation to the SCS specification.

### Section 3 - Structured Cabling Specification

This covers the specified solution that the Excel Partner will be installing and will include detail on each specific element of the proposed design and solution.

### Section 4 - Installation

Here the Excel Partner needs to expand on the basic information provided to demonstrate how the project will be installed and what specific installation skills and procedures they will deliver to the client.

### Section 5 - Testing

This section covers the testing regime as outlined in the Excel Installation Guide and as per the requirements of the Excel Warranty Programme. It has been based on the European and British Standards in the first instance and then the ISO standards.

### Section 6 - Documentation

This section defines what documentation will be delivered to the client and should incorporate test results, drawings etc.

### Section 7 - Training

This section outlines what training will be given to the client in relation to the installation of the Excel Cabling System.

### Section 8 - Warranty

The Excel Cabling System provides a 25 year warranty when installed by an Excel Partner, should it be required. This section outlines the benefits of the warranty and exactly what elements are covered.

## Appendices

This should include the following:

- Terms & Conditions
- Excel Partner Certificate
- Relevant experience of Key Staff
- Costing Spreadsheet
- Excel Warranty Brochure
- Health and Safety Policy + Certification
- Environmental Policy + Certification
- Quality Management Policy + Certification

(Insert Image)

(Insert Logo)

# Structured Cabling Tender Response for (Insert Project Name)

Presented by;

(Name & Company)

OUR QUOTE REF: (\*\*\*\*\*)

DATE: (\*\*\*\*\*)

## Document Control

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### Version Control

Version Number	Status	Author	Date
Draft			
ISSUED R01			

### Reviewed By

Name	Title	Date
	Business Development Manager	
	Project Manager	

## CONFIDENTIALITY

The proposal forming part of this response is confidential information and is proprietary to the Excel Partner (EP). This information is supplied without liability for errors or omissions. No part of this document can be reproduced, used or disclosed in any way, without the prior written consent of the (EP). The copyright and foregoing restriction of reproductions, use and disclosure extend to all media in which this information may be embodied.



## (EP) CONTACT

Any questions regarding this proposal should be directed to:

Insert Job Title :

Contact	Telephone	Mobile	Email

## VALIDITY

Our pricing is fixed in all respects until (Insert Date) as requested.

An order can be placed against this tender response for three months after issue date of (Insert Date).

## TERMS AND CONDITIONS

A copy of Standard Terms and Conditions of Sale for Contracts, is supplied with this tender response as

### **Appendix A - (EP) – standard Terms and Conditions**

We confirm that should our bid be chosen we would like to discuss the contract documentation with you to arrive at a mutually agreeable contract.

## DECLARATION

We hereby confirm that we have reviewed and complied with the requirements of the Structured Cabling System Specification as issued by The Client and we confirm that the above information is correct and that we have no objection to any of our previous employers/suppliers being contacted in conjunction with our trade standing credit worthiness.

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## VALIDITY

## TERMS AND CONDITIONS

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#### (EP) Experience

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2.2.2 Reference Contacts

2.2.3 Compliance Statements

2.2.4 Status with Excel

2.2.5 Integrator Accreditation

2.2.6 Supply status from Excel

2.2.7 Employment Status

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## 7. TRAINING

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### 8.1. System Component

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# Management Overview

## INTRODUCTION

Excel Partner (EP) understands the purpose of the project is to provide (The Client) with a structured cabling system. (EP) understands that the program of works for this project is between the following dates:

(EP) understands from the technical specification provided that the outline requirements for the structured cabling system are as follows:

- Category 6 UTP horizontal cabling
- Category 6 backbone cabling
- OM3 fibre optic backbone cabling
- CER inter-cabinet backbone cabling copper and fibre
- Equipment Cabinets

## (EP) COMMITMENT TO (THE CLIENT)

(EP) views this project as a highly prestigious and strategic project. It is understood that the manufacturer's commitment to this project will be crucial to ensure the successful completion of the installation meeting the requirements of quality, timescales and budget. If successful, (EP) has already gained the commitment of our suggested manufacturer to working collaboratively with them in achieving the major project objectives on behalf of (The Client)

## (EP) EXPERIENCE

(EP) have been installing structured cabling for \*\*years. Consequently we have completed hundreds of project installations and have many satisfied customers for our structured cabling works as well as several ongoing cabling contracts for Installs, Moves, Adds and Changes (IMAC's).

A snapshot of some of (EP) Network Services customers is given below:

- *List your customer examples here*
- 
- 
- 

The strengths of the (EP) Network Services offering are our:

- Relationship with leading Manufacturer
- Skills and experience in delivering projects and support services across a wide range of industries
- Experienced team of engineers and managers
- Financial stability

These strengths ensure that we will provide to (The Client):

- Project delivery to the agreed SLAs and commercial terms
- Accurate technical and financial information in a timely manner.
- Consistent high quality project execution compliant with health and safety standards
- Efficient utilisation of resources.
- Ongoing process development and improvement
- Good communication between (The Client) their representatives and (EP).

In summary, (EP) has the proven financial stability, the skilled resources, the manufacturer relationships, the infrastructure and a long-term commitment to quality service provision that will deliver a successful project.

We trust this response demonstrates to (The Client) that we have carefully considered our service provision, prices and implementation and that our proposal is both highly credible and cost effective. We look forward to the opportunity to discuss our response with (The Client) and their representatives and to delivering the IT infrastructure for (The Client) to the mutual benefit of both organisations.

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## 1. INTRODUCTION

This document is a full Structured Cabling Specification for all Copper and Fibre Systems required to support all Voice, Data, Audiovisual and all I.T. Services.

### 1.1 DOCUMENT HISTORY & DEFINITIONS

EXCEL	-	Product Brand name of the Structured Cabling System
EP	-	Excel Partner - Authorised and trained installer of EXCEL
SCS	-	Structured Cabling System
SCI	-	Structured Cabling Integrator
TO	-	Telecommunications Outlet
TR	-	Telecommunications Room
MER	-	Main Equipment Room
SER	-	Secondary Equipment Room
UPS	-	Uninterruptible Power Supply
PDU	-	Power Distribution Unit.

## 2. GENERAL

### 2.1 SCOPE OF WORKS

We understand (The Client) is seeking to appoint an SCI, to design, supply install and commission a structured cabling system, consisting of both copper and fibre elements, together with the supply and installation of equipment cabinets and patching frames.

The SCI will have limited design input, e.g. the exact layout of patch frames and under floor coordination.

### 2.2 RESPONSE INCLUSIONS

#### 2.2.1 Company Reports

Please see **Appendix B -(EP) - Audited Accounts**

#### 2.2.2 Reference Contacts

(EP)Response:

#### 2.2.3 Compliance Statements

(EP)Response:

You will note that our response is fully compliant in all respects.

#### 2.2.4 Status with Excel

(EP) are a certified Excel Partner.

#### 2.2.5 Integrator Accreditation

**Appendix C -(EP) – Copy of Excel Partner Certificate**

#### 2.2.6 Supply status from Excel

(EP)Response:

#### 2.2.7 Employment Status

(EP)Response:

All the 'Key' members of the project will be (EP) full time staff.

Please see

#### **Appendix D - CVs of Proposed Key Staff**

**Project Manager – \*\*\***

**Project Supervisor- \*\*\***

**Cabling Design Consultant – \*\*\***

**Cabling Test Supervisor – \*\*\***

All Management personnel involved in these works are directly employed members of (EP) staff.

(EP) do not subcontract or use agency labour to carry out any elements of the structured cabling system. (EP) use contract labour from a pool of specialist installation companies that (EP) work with and audit on a project-by-project basis.

### **2.3 SITE SURVEY**

Site survey carried out on \*\*/\*\*/\*\*\* at time.

Two staff members attended (Design Consultant and Business Development Manager).

From the site survey we duly noted a number of points that will be raised in other parts of our response.

### **2.4 OVERVIEW OF THE WORKS**

Include an overview of the project, the following may be cut straight from the tender specification documents.

#### **2.4.1 Raised Floor**

**The following is an example of what may be reported in this section, it is a section of where you may raise your concerns and observations.**

**(EP) Sample Response:**

During the site survey a number of anomalies were noted. Firstly and the most notable is the fact that the maximum floor void to the underside of the floor tile is only 115mm. and in some points as little as 110mm as illustrated by the following image.

With the use of 13mm Cable matting, it will only leave a maximum of 100mm free whilst this is the maximum recommended height of a bundle of Category 6 cabling, this is not a major problem; however there will be areas where it will be inevitable that the SCS will have to cross power cabling. This fact will mean that the Cable Route will become wider than described within the drawings provided.

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## 2.5 STRUCTURED CABLING INTEGRATOR'S (SCI) DESIGN ELEMENT

Throughout the contract period, the (EP) will be responsible for the following design elements.

### 2.5.1 Cable topology and routing

Production of working drawings for a structured cabling system, which meets the Client's requirements, will be provided.

### 2.5.2 Cable System Standards

The performance of the Horizontal structured system being provided will meet ISO 11801, ISO 60603-7-5, ISO 61156-5, EN 50173-1, 2011 standards operating at frequencies up to 250Mhz, supporting Voice, Data & Video applications at data rates of up to 1Gbit/s to full 100m channel requirements.

The Horizontal Category 6 compliant system is also backwards compatible with ISO 11801:2002, ISO 61156-5, EN 50173-1:2002,

The cabling solution will also have a valid 4 connector independent third party certification.

### 2.5.3 On Floor Co-ordination

The EP will be responsible for all on-site co-ordination with other contractors and includes, but is not limited to: cable routing, containment, bridging, floor tile lifting, the mounting of associated equipment, etc.

(EP) adopts a flexible and non-confrontational approach to working with other trades. We have found that adopting an open and consistent dialogue with all other parties working on any project has ensured that it is completed in a timely manner.

### 2.5.4 Samples & Mock-ups

Samples and/or mock-ups will be supplied for all elements of the Structured Cabling System that are not part of the chosen manufacturer's product set. The required samples will be provided upon request, these may include:

- GOPs (metal box, Kopex and anchor plate)
- Faceplates
- Patch Frames
- Racks
- Patch Panels
- Labels

## 3. STRUCTURED CABLING SPECIFICATION

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### 3.1 SOLUTION SPECIFICATION

#### 3.1.1 Design

The system proposed will be an Excel Category 6 UTP solution covered by a 25 warranty comprising of the following elements

#### 3.1.2 Copper Cable

To minimise the risk to staff and the building itself in the event of a fire, a Low Smoke Zero Halogen (LSZH) solution is required for this installation. The part number for this element will be 100-071

Both ends of all 4-pair cables will be terminated in an RJ45 socket outlet as specified by the solution manufacturer.

#### 3.1.3 Fibre Cable

Fibre elements of the structured cabling system will be constructed from multi mode fibre. The multi-mode fibre has been specified as OM3 50/125 mm (2000 Mhz/km) tight buffered. Furthermore, the multi-mode fibre is designed to support 10 Gigabit Ethernet at 300 metres and 10,000 metres respectively in accordance with 802.3ae at both of the following wavelengths, 850 nm SR and 1300 nm.

### 3.2 SCS EQUIPMENT AND SERVER RACKS

#### 3.2.1 Equipment Racks (ER)

Within the MER and SER, ER racks will be installed to accommodate various services. We will be responsible for the supply, delivery, unpacking, assembly, baying, earth bonding, securing and adjustment of shelves and fixing of power strips etc. These racks will be supplied as part of this tender in the quantities detailed within the cost spreadsheet.

The following rack makes/models will be provided for general and server use:

- Excel 42U ER Racks

● Excel 42U SR Server Racks

ER rack dimensions and quantities are specified in the cost spreadsheet.

All racks will be equipped as follows:

When patch panels are installed within a rack, horizontal management panels will be installed at a rate of 1 per 48 ports

19" rack mountings front and rear

Two 300mm cable trays

One four-unit fan tray (ER Racks only)

The racks will be bayed together and require side panels in-between.

The racks will be labelled at front and back with engraved identity plates as specified within the cable labelling section ((The Client) numbering scheme to be advised).

The racks will be supplied with a 6mm earth bonding stud. (EP) will be responsible for all internal earth bonding of the ER racks; the electrical contractor will be responsible for providing a safety earth to the rack bonding point.

Within the MER/SER there is a requirement for the installation of copper cabling from the patching frames to the ER racks.

### 3.2.2 Equipment Rack (ER) Category 6 Copper Cable

Within the MER/SER a number of Category 6 links between the patching frames and ER racks will be installed. The presentation will be RJ45 at both ends.

The outlets will be presented upon 24-way 1U patch panels at both ends. These will be installed using Angled Outlets within Flat Unloaded panels, we will be responsible for fitting these within the ER racks. Where racks are not installed day one, cables will be installed, tested and neatly coiled at the future rack location. All patch panels to be left within the floor void with suitable protection.

### 3.2.3 CW1308B Voice cable

Within the MER a number of CW1308B connections will be installed between the City 80 voice frame and patching frames. The presentation will be RJ45 24-way 1U patch panels at the patching frame and 237A Style Terminal Strips at the City 80 frame end. The cables will be terminated 2 pairs per RJ45 port

### 3.2.4 Power Distribution Units (PDUs)

Potentially three different types of power strips will be required within the racks. An example of which is as follows.

800 x 1000 ER Racks – 12-way Vertical PDU complete with 12 x 13AMP UK Sockets. 32 Amp Commando Plug

800 x 1000 SR Racks – 12-way Vertical PDU complete with 12 x 13AMP UK Sockets. 32 Amp Commando Plug

The maximum draw from each strip will be no more than 32 Amperes.

The rack's power is to be supplied from above, and the racks have the appropriate cable aperture to the top of the rack.

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## 3.3 GOP MOUNTING

As part of this tender, we have provided for the fixing of GOPs to desks we are aware that the mounting process will take place in conjunction with the furniture installation, and will require two visits, one to re-arrange GOPs under the floor prior to furniture installation, and a second to mount the GOPs following furniture installation.

We have allowed for this and covered the details in **Appendix E - Costing Spreadsheet**

## 3.4 CABLE MATTING

We have proposed the use of 18mm, LSOH cable matting manufactured by CableLay and supplied by Mayflex.

# 4. INSTALLATION

Outlined below are some of the key installation points. Adherence to the relevant section of BS EN50174-2 and the Excel Installation Guidelines are followed at all times.

## 4.1 ELEMENTS

### 4.1.1 Cable Routes

All communications cables will be run on defined cable routes. These routes will comprise of main cable highways, lateral routes and vertical cable trays.

### 4.1.2 Cable Risers



Riser positions and sizes are shown on the tender drawings. Two risers are provided each containing 2 x 150mm cable trays. If necessary a former will be constructed from bent cable tray or similar in order to prevent the cables from bending beyond the manufacturer's recommended guidelines.

### 4.1.3 Cable Ties

Velcro cable ties will be used for all cable bundles to assist during pre-termination and installation. PVC cable ties will be used on vertical cable runs only.

### 4.1.4 Labelling

#### 4.1.4.1 Cables

All distribution cables will be clearly labelled using (The Client) numbering scheme as detailed below. Labelling will be applied at each end of the cable, at the faceplates, on the GOP, at the anchor point and at the front of any patch panel. The numbering scheme will have the following format:

GOPs will be numbered as per the following convention F/xxx

Where F = floor number

xxx = Unique FOB number (from 1 to number of positions)

GOP outlet positions should be labelled A to C.

Cabling will be numbered using the convention OOO/Uxx – DDD/Uxx

Where OOO = Originating room and rack or frame (ER/A4, ER/APF12, etc.)

Uxx = U position on frame (xx = 01 – 42)

DDD = Destination rack, frame or FOB (F1/A2, F2/APF2, 1A/001, etc.)

Uxx = U position on frame (xx = 01 – 42)

ER/APF04/U32 – ER/A2/U42

Examples –

ER/APF04/U32 – F2/APF2/U28

Rack Outlets will be numbered using the convention – OOO/Uxx/PP

Where OOO = Originating room and rack or frame (ER/A4, ER/APF2, etc.)

Uxx = U position on frame (xx = 01 – 42)

PP = Outlet or Pair

Examples –

ER/APF04/U32/24

#### 4.1.4.2 ER Racks and Patching Frames

All ER racks, patching frames, will be clearly labelled using (The Client) numbering scheme detailed on the respective Equipment Room drawings. All permanent labelling will be completed prior to testing with 'Computer Engraved Laminate Labels' and have a life expectancy of ten years or more.

### 4.1.5 Bridging

Permanent bridges will be required where large quantities of data cable cross power services. Cables shall be installed so as to minimise crossovers.

The EP is not responsible for the supply and installation of all cable bridges, which should be provided by others. Cable mat is to be applied to all bridges which will be the responsibility of the EP.

### 4.1.6 Power Cables

Any crossovers with electrical cables will occur at right angles and consideration must be given to 'bridging' these cables where necessary.

### 4.1.7 Standards

The installation shall be carried out in accordance with but not be limited to BS 6701:2004, ISO/IEC 11801:2002, CENELEC EN 50173-2 and BS EN 50174-2. Furthermore the installation method will comply with the Excel Installation Guide.

## 5. TESTING

All testing will be undertaken with the Fluke DSX 5000 or DTX 1800 or an equivalent level tester In line with the Excel Installation Guidelines

A complete set of test results will be provided in a Fluke Linkware format or the equivalent software.

(The Client) is welcome to exercise their right to witness any or all of the system testing. To this end the EP will provide a full test schedule to (The Client) one week prior to the commencement of testing.

### 5.1 HORIZONTAL CABLING (CATEGORY 6)

As a minimum, we will test all cables for:

- Disconnections, contacts, crosses and splits on all pairs
- Resistance of all conductors
- Attenuation of all pairs
- Near end cross-talk of all pair combinations
- Length of each cable

All cables must be tested to meet ISO/IEC 11801:2002 and CENELEC EN 50173, Cat 6/Class E standards.

All permanent Links will be tested to this standard (100% testing regime off site and on).

Full results of all tests will be recorded during testing and will be copied to the Manufacturer for their comment.

### 5.2 COPPER AND FIBRE BACKBONE DISTRIBUTION CABLES

All cables will be subjected to 100% test. Fibre cabling should as a minimum be tested at both windows in both directions, In line with the Excel Installation Guidelines.

All fibre optic cabling & testing will be compliant to BS EN50173, IEC 60793-1-49, IEC 60794-1 & ISO/IEC 11801.

All test results will be supplied in tester manufacturers format, along with a copy of the software required to read the results, the latter being a free download package.

## 6. DOCUMENTATION

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The Bid Price includes a set of complete systems documentation, including floor plans indicating cable routing, floor outlet naming and locations for every outlet, sketches for specialist areas such as patching/wiring frame and rack layouts. These will be provided prior to final completion. Patching is not part of this package.

This documentation will take the form of one bound site manual together with an electronic copy. Both copper and fibre cable test results must be issued in electronic format together with all necessary software to view.

All manufacturers' warranties will be presented to (The Client) on final acceptance.

## 7. TRAINING

At hand-over, the EP will provide one day on-site training for a maximum of six members of (The Client) staff.

Training will include, but not limited to the following basic introductory elements:-

- Labelling convention and scheme implemented
- Patching methodologies
- Rack alterations

## 8. WARRANTY

### 8.1 SYSTEM COMPONENTS

The following elements of the cabling system will form part of the warranty coverage:

- Fibre Cable
- Floor Distribution Category 6 Cable
- Voice Cable
- Patch leads
- ER Racks

### 8.2 WARRANTY CONDITIONS

The (EP) will provide 'post-installation warranty' in one year from acceptance date.

The Excel Warranty is for 25 years

Please see: **Appendix F – Excel Warranty Brochure**

# Excel Structured Cabling System (SCS) Specification Document - Overview

The following documents are aimed at Consultants, End User clients and M&E Contractors who are looking to issue a specification for an Excel Category 6<sub>A</sub> solution. It is offered as a suggested template and will need reviewing prior to use to ensure suitability for the project in question.

The template has been written with the latest standards in mind and form the basis of the specification but will need additional information in each section to complete the specific design. Each includes the following information:

## Section 1 - Document Control

This section covers the document authority and history together with some basic definitions.

## Section 2 - Summary of Works

This gives a brief description of the project, site and lists all relevant site contacts

## Section 3 - Scope of Works

This section gives an outline to the nature of the project and the construction of the SCS infrastructure. Information along with defining the Standards that must be followed throughout. It also starts to outline some of the SCS contractors responsibilities.

## Section 4 - Component Manufacturer Details

This section outlines the details of the chosen system manufacturer to use. For the purposes of these documents they have been written around Excel for both the structured cabling and the cabinets.

## Section 5 - Interpretation & Comms Room Locations

This section looks at the installation in more detail and provides the building block for the numbering scheme within the design. It also covers how each of the telecoms spaces are located and numbered.

## Section 6 - General Specification & Requirements of the SCS Contractor

This section discusses in detail the actual technical solution proposed; this is a standard section and does not need to be adapted for each project. It also covers some of the contractual deliverables that are expected to be carried out.

## Section 7 - Documentation

This section lists the expectations regarding post install documentation and training.

## Section 8 - Specifications & Requirements – Copper Infrastructure

This is the section that outlines the specifications of the copper products required and their performance.

It covers both Horizontal and Backbone cabling and specifies the nature of the containment expected and the testing regime to be undertaken. This testing element is based on the latest standards.

## Section 9 - MER and SER Configurations - Horizontal Cabling Requirements

This section details the Rack Requirements and gives a detailed specification of the Server (SR) and Equipment (ER) Racks plus PDU requirements this again has been written around the existing Excel range

## Section 10 -Horizontal Infrastructure Additional Restrictions & Requirements

This section covers the additional elements not covered elsewhere such as Grounding and Bonding, Witness Testing and Containment requirements

## Section 11 - Specification & Requirements – Fibre Infrastructure

Specification and Requirements of the Fibre Optic Infrastructure is covered in this section, the standards to be followed and the products to be used.

## Section 12 - Backbone Fibre Optic Infrastructure Requirements

This section looks at the specific requirement for the fibre backbone, including design layout, and most importantly testing to be followed.

## Section 13 - Specification & Requirements - ER and SR Racks

This section covers the rack layouts and specifies both the layouts and locations along with the methodology to be used for grounding and bonding the racks.



### Section 14 - Additional Requirements

This is a generic section looking at additional requirements of the project.

### Section 15 - Drawings Schedule of Applicable Drawings

List here the drawing schedule for the project.

### Section 16 - Installer Accreditation

This section outlines the requirements of the Installer and covers their training and certification.

### Section 17 - SCS Infrastructure - Pricing Schedule

This section allows the pricing schedule for the total project to be added.

### Section 18 – Appendices

Finally this section can include a series of elements not covered elsewhere. At present it contains an example spreadsheet to present the cabinet layout that is discussed in Section 13

# Category 6<sub>A</sub> - SCS Infrastructure Specification Document

## 1 Document Authority

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_

### 1.1 Document History

Version	Date Issued	Status	Description
1.1		Draft	For Review

### 1.2 Document Definitions

SCS	- Structured Cabling System
TO	- Telecommunications Outlet
TR	- Telecommunications Room
UPS	- Uninterruptible Power Supply
IIM	- Intelligent Infrastructure Management

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Download this document from the 'Encyclopaedia' section of the 'Partner Area' located at [www.excel-networking.com](http://www.excel-networking.com)



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## 2 Summary of Works

### 2.1 Site address

Project site address:

### 2.2 Site contact:

### 2.3 SCS requirement

Based upon the SCS specification as detailed within this document, the requirements for this installation will include, but not limited to (example)

- Minimum Category 6<sub>A</sub> U/FTP cabling throughout.
- Patch Room to facilities – Doors, Cameras etc as required by security/facilities
- Multi core OM4 or OS2 fibre optic cables between distribution locations

### 2.4 Equipment Room locations

Final locations of all MER/SERs shall be coordinated with The Client, although as an initial guide:

MER (Main Equipment Room)

SER (Secondary Equipment Room)

### 2.5 The MER shall contain:

X No. ER Rack

X No. SR Rack

X No. OR Rack (Open Frame)

### 2.6 The SER shall contain:

X No. ER Rack

X No. OR Rack

Specification for each ER or SR Rack is to be defined further within this document.

## 3 Scope of Works

Includes Equipment, materials, labour and services to provide The SCS Infrastructure including, but not limited to:

Horizontal Infrastructure (Category 6<sub>A</sub> U/FTP).

Backbone Infrastructure (Optical Fibre OS1/OS2 and/or OM3/OM4).

ER racks, frames and enclosures.

Termination frames and panels.

Multi-purpose Telecommunication Outlets.

Supply of drop cables to connect horizontal cabling to connect network services.

Generation of base line patching schedules.

Documentation and submissions.

The SCS Contractor must also as part his works properly ground and bond all installed apparatus, equipment and components to ensure equal potential is maintained through his installation in accordance with EN50174 & EN50310

The SCS Contractor works shall be completed to suit the requirements of the Main Contractors programme.

The SCS Contractor must also obtain written approval from Main Contractor and the appointed Electrical subcontractor before any ground and bonding connections to be made on site for use by SCS Installation prior to commencement of his connections or works.

Associated works by others include:

Horizontal and vertical containment 'Communications Containment' (i.e. cable trays, trunking, conduits), together with floor boxes, wall and ceiling mounted back boxes, provided by the appointed Electrical Subcontractor.

Telecommunications grounding and bonding points.

Builder's work in connection with the SCS Contract, include removal and replacement of fire-stopping.

Patching of users.

## 4 Component Manufacturers Details

### 4.1 Structured Cabling System Manufacturer

The chosen structured cabling system shall be Excel Networking.

- A complete solution from a single manufacturer shall be provided, and shall be covered by a single 25 year warranty.
- The SCS Contractor shall provide 'ongoing' independent compliance certification at both Channel and Component level from a trusted test establishment such as Delta Labs of Denmark. One off 'Approvals' and 'Attestations of Conformance' will not be acceptable.
- The SCS Contractor shall provide valid credentials detailing their status as either an Excel Solutions Partner (ESP), or Excel Cabling Partner (ECP)

### 4.2 SCS Equipment & SR Racks

All Equipment, Server and Open Racks shall be Excel Environ® and covered under the Manufacturer's single warranty.

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## 5 Interpretation & Comms Room Locations

The physical building design incorporates multiple-use units and administrative offices in a closed environment. The Telecommunication transport Media or Structured Cabling System provides the physical connectivity from the Entrance Facility (EF) to a centralised Equipment Room (MER), through to Secondary Equipment Rooms (SER) to the final work area Telecommunication Outlet.

Entrance Facility (EF) Defined as the point of demarcation and interface between site-based services and incoming services from the outside world. Space is allocated at this point for the installation of primary / secondary protection devices.

Location: To be confirmed

MER (Main Equipment Room) Defined as host equipment room in which site based servers, LAN, WAN and call processing equipment are housed in a secure and protected environment.

SER (Secondary Equipment Room) Defined as a location where telecommunication, data equipment, connecting backbone cabling and horizontal sub-systems reside in a secure and protected environment on a floor by floor basis.

NOTE: Upon drawings supporting other site services these spaces may be described as 'ICT Closets'.

## 6 General Specification & Requirements of the SCS Contractor

The SCS Contractor shall apply the methodologies for installation in accordance with BS EN 50174 and following the Manufacturers Installation Guidelines these shall be used during all installation activities.

Should conflicts exist in local law, codes and regulations, then local law, codes and regulations shall take precedent.

The SCS Contractor for all Horizontal and Backbone cabling must ensure it is fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacture company of the cabling system.

### 6.1 Labelling

The SCS Contractor shall draw up full details of the cable plant labelling scheme for every cable, patch panel, wiring closets, termination frames, and telecommunication outlets and agree the format with the Main Contractor prior to installation.

- Typeface Labels shall have an agreed typeface size and font. Hand-written labels will not be accepted, except on a temporary basis during installation and will not be acceptable for cable plant testing purposes.
- Characteristics All labels shall be permanently fixed. Legible, durable and robust.
- Orientation All labels shall be fixed horizontally on fixed equipment or longitudinally along the line of cables.
- Positions The following positions at which labels are fixed shall apply as a minimum:
  - Cable terminations shall be labelled at patch panel outlets.
  - Cable shall be labelled at telecommunication outlets.
  - Cables shall be labelled at the entry/exit points of rooms and buildings.
  - Cables shall be labelled at all access chamber, cable turning chambers and draw pits.

### 6.2 Cable Plant Test Failures

The SCS Contractor upon detection of cable plant failures during testing shall be duly noted each failure. The SCS Contractor shall rectify all faults any damaged cabling shall be replaced with new cables in complete runs.

### 6.3 Cable Plant Witness Tests

The Main Contractor reserves the right to attend site to witness cable plant tests and complete random sample testing upon completion of test. Witness testing and random sample testing will be agreed with the SCS Contractor prior to commencement of site testing and will be no more than 10% of the total number of outlets. Any further testing will be chargeable at an agreed hourly rate prior to the testing.

## 7 Documentation

### 7.1 General

The Operations and maintenance manual for the project will be compiled in accordance with BS 6701 and shall include but not limited to the following documents. These shall be presented where required to the Main Contractor during bidding and on completion of the installation of the SCS Physical Infrastructure by the SCS Contractor:

- Current Independent 3rd Party Component Compliance Certification, indicating manufacture and component reference, for all items installed and supplied.
- Manufacturers' literature for products installed complete with SCS contractor logo and contact details embedded.

- Uniquely number test certificates for copper and fibre optic (link and channel where appropriate) for the entire SCS Physical Infrastructure.
- Electronic records of all test results in tester manufacturer format. PDF copies are NOT accepted unless accompanied by original format records.
- SCS Physical Infrastructure warranty (25-Year).
- Warranty against defective parts or workmanship for a minimum of 1 year after Practical Completion.

## 7.2 Drawings

The SCS Contractor shall allow for as-built installation drawings in AutoCAD or other format agreed with the Main Contractor shall be handed over in paper and electronic formats upon completion detailing the following information:

- Horizontal cable routes. These drawings shall detail the number of TOs per floor, area or location.
- Backbone cabling routes. These drawings shall detail the quantity, type and routes of backbone cabling (both copper and fibre optic).
- Layout of termination frames, panels and closets, clearly identifying the number of frames or panels used in each MER and SER.
- Layout of Equipment Rooms throughout the entire project. These drawings shall identify the particular frames, panels and closets in each room.
- Telecommunication Outlet distribution. These drawings shall indicate the location and unique identifier of TOs throughout the entire project.

## 7.3 Acceptance

For acceptance of the SCS Physical Infrastructure the SCS Contractor shall complete the following:

- All labelling.
- All installation of SCS Physical Infrastructure (to the correct standards).
- All cabling test results showing positive results (to the correct standards).
- All documentation.

## 7.4 Training

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The SCS Contractor is to provide Training to the clients IT Staff where required in the correct method of patching and system administration. The SCS Contractor shall allow for a suitable amount of time for onsite Training.

# 8 Specification & Requirements – Horizontal Category 6<sub>A</sub>

## 8.1 The Horizontal Structured Cabling System

The Horizontal structured cabling system selected is Excel Networking. The SCS must be installed by an Approved Excel Cabling Partner (ECP), or Approved Excel Solutions Partner (ESP) according to the manufacturer's instructions. Valid Certification shall be provided with all bids and prior to any works commencing.

The Horizontal structured cabling system shall provide in strict accordance to tender drawings. The system will be used to connect voice and data services, WLAN, CCTV, and Access Control devices to the network.

The drawings showing telecommunications outlets shall be used to identify the precise quantity of MER/SERs to which each outlet must be connected to maintain cable length restrictions in the use of Category 6<sub>A</sub> cabling.

Horizontal -Telecommunication Outlet requirements shall be taken from the following tender drawings:  
(Supplied Separately)



The performance of the SCS Contractors Horizontal structured system being provided shall meet ISO 11801:Ed2.2, ISO 60603-7-5, ISO 61156-5, EN 50173-1, EN50310 standards operating at frequencies up to 500Mhz, supporting Voice, Data & Video applications at data rates of up to 10Gbit/s to full 100m channel requirements.

The Horizontal Category 6<sub>A</sub> compliant system must also be backwards compatible with ISO 11801:Ed2.2, ISO 61156-5, EN 50173-1:A2:2011,

### 8.2 Cable

The cabling must be four-pair 100Ohm Category 6<sub>A</sub> type. **The cable must have current independent third party approval status at component level and include specification references.**

Horizontal cables shall be constructed with a Low Smoke Zero Halogen jacket meeting IEC 60332-1 flammability standard as a minimum. The cable must also be available in various colours including White, Violet and Orange, in case the client wishes to identify Horizontal Services by way of colour.

Acceptable construction of cable is as follows:

Category 6<sub>A</sub> U/FTP "S-Foil" LSOH Ice Blue 500m Reel – Excel Part No. [100-191](#)

Category 6<sub>A</sub> U/FTP "S-Foil" LSOH Ice Blue 305m Box – Excel Part No. [100-191-305m](#)

Or

Category 6<sub>A</sub> F/FTP "S-Foil" LSOH Ice Blue 500m Reel – Excel Part No. [100-196](#)

### 8.3 Connecting hardware

#### 8.3.1 Patch Panels:

As a minimum the Patch Panels must:

- Be 19" rack mountable, in exact multiples of 1U in height.
- Cable terminations must be Insulation Displacement Connectors (IDC).
- Front connectors to be RJ45 style
- Label System
- Lifetime Product Warranty

The client preference for High Density Frames is:

Excel 100-181 Keystone Toolless Jacks within an Excel 100-041 0.5U patch Panel Frame, or: Excel 100-185 Keystone Toolless Angled Outlets in Excel 100-024 Unloaded Frames in the following configuration:



[100-041 & 100-181](#)



[100-024 & 100-185](#)

- Straight or Angled side-by-side Presentation of Chrome Finish
- Front connectors to be straight or angled RJ45 style
- Front presentation of Jack outlet to be angled at 45 degrees
- Rear cable presentation to be 180 degrees

#### 8.3.2 Outlet Connectors:

- Cable terminations must be Toolless Insulation Displacement Connectors (IDC).
- Connector style to be RJ45
- Toolless Termination or punch down
- Lifetime Product Warranty
- Must have current independent third party approval status at component level to a minimum of ISO/IEC 11801.

The form factor of the data outlet plate shall be from the Excel Office range, and shall be made up of:

1 x Excel Office Single gang faceplate – Excel Part No. 100-270

2 x Excel Office White Angled Shutter – Excel Part No. 100-280

2 x Excel Category 6<sub>A</sub> Low Profile Screened Keystone Jack – Excel Part No. 100-181



[100-270](#)



[100-280](#)



[100-181](#)

### 8.3.3 Horizontal Category 6<sub>A</sub> F/FTP Patch Leads

The SCS Contractor shall allow for the supply only of the following [Excel Category 6<sub>A</sub> compliant Patch leads](#).

Each patch lead shall be complete with strain relief boot and RJ45 connector. **The patch leads must have current independent third party approval status at component level and include specification references.**

The Clients standard dictates the following (example)

- Grey for general Comms Room patching
- Black for Security

These items shall be available from stock within 1,2,3,5 and 10 metre lengths. Bespoke lengths and colours should be available, but it is understood they will be subject to a longer lead time for delivery.

The SCS Contractor will allow for patch leads to be available for the Patching Fields, these are supplied in standard lengths.

## 9 MER and SER Configurations - Horizontal Cabling Requirements

Main Equipment Room and Secondary Equipment Rooms will contain a quantity of Equipment and Server Racks as defined within the Summary of Works.

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### a. Server Rack

The Server Rack shall be from the Excel [Environ® SR](#) (Server Rack) range of racks and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey-White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 1300Kg.
- Jacking Feet and Castors
- Baying Kit



[Environ® SR Series](#)

### b. Equipment Rack

SER Enclosures shall be Excel [Environ® ER series](#) and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 600Kg.
- Jacking Feet and Castors
- Baying Kit

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[Environ® ER Series](#)

### c. Open Rack

The Two Post Patching frames shall be Excel [Environ® OR series](#) and conform as a minimum with the following:

- DIN414 compliant
- 2 post aluminium construction
- 42,48 or 52U height
- 19" profiles marked with U height positions
- 1500Kg static load bearing
- High Density Cable Management
- Lockable double hinged doors on vertical management
- Cable spools as required
- Black RAL 9005



[Environ® OR Series](#)

### d. Intelligent Power Distribution Units

It is the requirement of The Client that Excel Intelligent PDU's be installed within each ER and SR Rack.

Select the appropriate Excel Intelligent PDU from the following list according to the size and load bearing requirements, and pay particular attention to the required equipment termination plugs.

Managed Intelligent PDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed Intelligent PDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed Intelligent PDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed Intelligent PDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed Intelligent PDU 24 way BS1363 with 32A IEC6039 plug - vertical

*Further detail is given for typical layouts of wiring and equipment closets at a later date.*

## 10 Horizontal Infrastructure Additional Restrictions & Requirement

The restrictions & requirements listed below are in addition to those stated in standards set with the scope of works.

Horizontal structured cabling shall emanate from the MER/SER terminated upon 19" rack mountable 24-Port, RJ45 patch panels. There will be 1U horizontal cable management panel installed for a maximum of every 3U of patch panels.

Rack mounted equipment passive or active in nature shall be bonded to a sub-TGB (Telecommunications Grounding Bar) positioned in each equipment rack which is in turn shall be bonded to the TR/ER room, TMGB/TGB.

Work area MER/SERs shall consist of an RJ45 socket presented as either a single or dual formation. MER/SERs faceplates must be in keeping with the environment they are being installed i.e. Suitable IP Rating, and have a finish appropriate to those areas which they have been installed i.e. Brass, Stainless or other.

In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be earthed according to the manufacturer's instructions and EN50174-2, EN50310 standards.

A labelling and administration system must be designed into the cabling system in line with BS 6701, EN 50174 Standards. The system shall be approved by the Client before completion.

### a. Equipment Room – Analogue Voice Cabling

There is a requirement for [multi-pair voice cabling](#) to be run through to certain parts of the building to handle the requirements of emergency lift phones and disabled refuge call points, the SCS subcontractor should allow provision within their tender response as a separate line item.

*Further detail is given for typical layouts of wiring and equipment closets later in this document.*

### b. Horizontal Category 6<sub>A</sub> Infrastructure Testing

The SCS Contractor shall test 100% of the Category 6<sub>A</sub> horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in EN50173, ISO/IEC 11801 Class D. Sample testing for ANEXT will not be required. The SCS Contractor must use a level IV Cable tester it should have a current calibration certificate issued by the manufacturer of the tester.

Computed test results that indicate that some part of the result is closer to the limit than the tolerance of the test equipment may be noted as 'PASS\*' or 'FAIL\*'. A 'PASS\*' test result shall not be accepted and shall be treated in the same way as a 'FAIL'.

### c. Horizontal Category 6<sub>A</sub> – Containment

Horizontal cabling must be fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacturer of the structured cabling system.

## 11 Specification & Requirements - Backbone Fibre Optic Infrastructure

The selected [Fibre Optic Cabling System](#) is manufactured by Excel Networking. Performance objectives of backbone fibre optic infrastructure shall be to support error free signal transmission between MER and SERs throughout the campus. The performance of the installed fibre optic cable plant shall support bandwidth-intensive applications including 1Gbit/s through 10Gbit/s and beyond as defined in IEEE 802.3z, 802.3ae, 802.3aq and 802.3ak Standards.

Designated media shall consist of multi core Multi-Mode/Singlemode cabling compliant with ISO 11801 standards.

ALL CONNECTOR END FACES SHALL BE INSPECTED FOR DAMAGE AND DEBRIS USING A VIDEO MICROSCOPE AND IF NECESSARY CLEANED BEFORE INSERTION INTO COUPLERS IN ACCORDANCE BS/ISO 14763-3

a. OS2, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	0.40	0.32
1550	0.30	0.21

b. OM4, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.0	2.5
1300	1.0	0.5

c. Fibre optic patch panels:

- Suitable for mounting in 19" frames within termination closets. Fixed using securing bolts and captive nuts at either side.
- With sufficient finger space around connectors to allow patch cables to be connected and disconnected and to allow individual connectors to be mounted and dismounted without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding, tilting or other mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Includes 24 splice bridge, 2 x cable entry glands, Cable tie bridges in base of draw.

Excel 24 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-464](#)

Excel 48 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-466](#)

Excel 24 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-474](#)

Excel 48 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-476](#)

d. Connectors & Fibre Patch Leads

Optical fibre cables shall be terminated LC-Duplex connectors that conform to EN 186000 Part 1, by means of fusion splicing using factory terminated pigtails.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

LC-LC duplex OM4 fibre lead, aqua, 1 mtr , [204-300](#)

LC-LC duplex OM4 fibre lead, aqua, 2 mtr, [204-301](#)

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e. Splices

Splices shall be retained within a protective sleeve by either friction or adhesive bonds to the optical fibre and additional strain relief for the completed joint shall be provided. All splice, joints and their strain relief shall be fixed within the optical fibre management system of the enclosure. The insertion loss through any splice shall not be greater than 0.15dB.

f. Pigtails

Fibre optic pigtails shall be made from the same fibre type as the fixed cabling. Pigtails shall be kept slack when the cable is terminated.

OM4 LC pigtails, 2metre, [204-320](#)

## 12 Backbone Optical Fibre Testing

Single and Multi mode backbone links shall be tested at both wavelength and in both directions in accordance with BS/ISO/IEC 14763-3. Testing of the fibre optic cabling using the One Jumper Reference Method using Light Source and Power Meter with reference grade test cords and couplers.

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

### a. OTDR Testing

Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

- Each fibre link and channel shall be tested in both directions wavelengths
- A launch cable shall be installed between the OTDR and the first link connection.
- A tail cable shall be installed after the last link connection.

### b. Length Measurement

- The length of each fibre shall be recorded.

### c. Polarity Testing

Paired duplex fibres in multi-fibre cables shall be tested to verify polarity.

The polarity of the paired duplex fibres shall be verified using a Power source and light meter in accordance with BS/EN 50174-1.

The following information would be recorded from all tests:

- Name of personnel conducting the test.
- Project Name
- Date test is being performed.
- Optical source wavelength, spectral width, and CPR (for multimode tests only).
- Type of test equipment used (manufacturer, model, and serial number).
- Fibre identification.
- End point locations.
- Test direction.
- Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- Measured attenuation of the link segment.
- Acceptable link attenuation.
- Reference cord identification
- Calibration certification of any test equipment used.

Each rack must be laid out using the attached spreadsheet, the following image is an example of what the SCS contractor is expected to submit prior to final sign-off and installation.

### d. Mandatory Requirement of All Enclosure Styles

Each rack or cabinet shall have a proprietary earth bar kit (vertical and/or horizontal as required) connected directly to the main earth. The size of the cable shall be determined by the electrical sub-contractor, but shall not be less than 16mm<sup>2</sup>.

All parts of the rack including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the eXK earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm<sup>2</sup>.

A full height vertical earth bar shall be used for all floor mounted racks and shall be sized to accommodate all earth connections as a single individual connection. There shall be no "double lugged" connections or "curls" of earth bonds.

Connections to the Earth Bar shall be by appropriately sized crimp lugs secured by brass nuts, bolts and shake proof washers.

A safety warning label "SAFETY ELECTRICAL EARTH DO NOT REMOVE" (or similar wording) shall be fitted to the main earth connection points (i.e. in the rack, connection at the room building earth point, MTGB, TGB(s) etc.).

All metal containment and tray work shall be earth bonded for safety and EMC. Sections of containment shall be securely earth bonded together by manufacturers' interleaves joints.

A labelling and administration system must be designed for each enclosure in line with EN 50174 or ISO 14763-2 or TIA/EIA-606. The system shall be approved by the Client before installation.

## 13.2 Additional Requirements

Additional to the main contract for the SCS Infrastructure there are a number of requirements that The Client would like a cost proposal for within SCS Contractors Tender response. The fundamental reason for this is to try and provide additional savings and efficiencies by combining these under the one contract. It will be to the advantage of the SCS Contractor if he can supply and install more than one product group.

The Client however retains the legal right, not to purchase all of these additional items from the SCS Contractor under the one contract.

# 13 Drawings Schedule of Applicable Drawings

# 14 Installer Requirements

The SCS Contractor shall be qualified to ECP (Excel Cabling Partner) or ESP (Excel Solutions Partner) status. Certification of this shall be provided with all bid documentation.

The SCS Contractor will preferably have an RCDD® (Registered Communications Distribution Designer) or CNIDP (Certified Network Infrastructure Design Professional) on staff that will be ultimately responsible for this section of the project.

The RCDD/CNIDP or Project Engineer must have sufficient experience to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts.

A CV of the responsible RCDD/CNIDP or Project Engineer must be attached to The Vendor's response for evaluation by The Customer. Should the RCDD/CNIDP or Project Engineer assigned to this project change during the installation, the new RCDD/CNIDP or Project Engineer assigned must also submit a CV for review by The Client.

If, in the opinion of The Client, the RCDD/CNIDP or Project Engineer does not possess adequate qualifications to support the project, they reserve the right to require the SCS Contractor to assign an RCDD/CNIDP or Project Engineer who, in The Clients opinion, possesses the necessary skills and experience required of this project.

The SCS Contractor would ideally have BICSI Registered Installers, CNCI Certified Network Cable Installers or equivalent on staff and assign them to this project. The project shall be staffed at all times by Installers and Technicians who, in the role of lead crafts-persons, will be able to provide leadership and technical resources for the remaining crafts-persons on the project.

A copy of all their registrations must be submitted in SCS Contractors response to this tender.

The SCS Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

The Preferred Installer for this project shall be:

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## 15 SCS Infrastructure - Pricing Schedule

The SCS Contractor shall fully populate the following pricing schedule for each item listed. Any items listed with no pricing shown will be deemed to be zero rated all fully inclusive in the summary total price shown.

The SCS Contractor will be required to submit and full bill of material and schedule of rates to support the following price schedule upon request from the Main Contractor.

The SCS Contractor must consider and allow for all aspects, scope, requirements and specifications sighted in (SCS Infrastructure) duly before completing the pricing section below.

The SCS Contractors are reminded that any alternative manufacture pricing must be provided as an addendum to their tender response.

Item	Description	Price
1	Horizontal Category 6 <sub>A</sub> Elements	£
2	Backbone Optical Fibre Elements	£
3	Equipment Cabinet Elements	£
4	Multi-pair Voice Cabling	£
5	Project Management	£
7	Documentation & Warranty	£
8	Training	£
<b>Summary Total</b>		£

# 16 Appendices

## Appendix A Rack Layout Spreadsheet

CAB 1		
SR Rack (Rear)		
42U	1U (4 hoop)Cable Manager	42U
41U	1U MTP Fibre Cassette Unit	41U
40U	1U (4 hoop)Cable Manager	40U
39U	48 Port POE Ethernet Switch	39U
38U	48 Port POE Ethernet Switch	38U
37U	1U (4 hoop)Cable Manager	37U
36U	1U 24 Port Patch Panel	36U
35U	1U 24 Port Patch Panel	35U
34U	1U (4 hoop)Cable Manager	34U
33U	1U 24 Port Patch Panel	33U
32U	1U 24 Port Patch Panel	32U
31U	1U (4 hoop)Cable Manager	31U
30U		30U
29U		29U
28U		28U
27U		27U
26U		26U
25U		25U
24U		24U
23U		23U
22U		22U
21U		21U
20U		20U
19U		19U
18U		18U
17U		17U
16U		16U
15U		15U
14U		14U
13U		13U
12U		12U
11U	Power Distribution	
10U	Power Distribution	
9U	Power Distribution	
8U	Power Distribution	
7U		7U
6U		6U
5U		5U
4U		4U
3U		3U
2U		2U
1U		1U

# Category 6 - SCS Infrastructure Specification Document

## 1 Document Authority

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_

### 1.1 Document History

Version	Date Issued	Status	Description
1.1		Draft	For Review

### 1.2 Document Definitions

SCS	-	Structured Cabling System
TO	-	Telecommunications Outlet
TR	-	Telecommunications Room
UPS	-	Uninterruptible Power Supply
IIM	-	Intelligent Infrastructure Management

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Download this document from the 'Encyclopaedia' section of the 'Partner Area' located at [www.excel-networking.com](http://www.excel-networking.com)

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## 2 Summary of Works

### 2.1 Site address

Project site address:

### 2.2 Site contact:

### 2.3 SCS requirement

Based upon the SCS specification as detailed within this document, the requirements for this installation will include, but not limited to (example)

- Category 6 U/UTP cabling throughout.
- Patch Room to facilities – Doors, Cameras etc as required by security/facilities
- Multi core OM4 or OS2 fibre optic cables between distribution locations

### 2.4 Equipment Room locations

Final locations of all MER/SERs shall be coordinated with The Client, although as an initial guide:

MER (Main Equipment Room)

SER (Secondary Equipment Room)

### 2.5 The MER shall contain:

X No. ER Rack

X No. SR Rack

X No. OR Rack (Open Frame)

### 2.6 The SER shall contain:

X No. ER Rack

X No. OR Rack

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Specification for each ER or SR Rack is to be defined further within this document.

## 3 Scope of Works

Includes Equipment, materials, labour and services to provide The SCS Infrastructure including, but not limited to:

Horizontal Infrastructure (Category 6).

Backbone Infrastructure (Optical Fibre OS1/OS2 and/or OM3/OM4).

ER racks, frames, racks and enclosures.

Termination frames and panels.

Multi-purpose Telecommunication Outlets.

Supply of drop cables to connect horizontal cabling to connect network services.

Generation of base line patching schedules.

Documentation and submissions.



## Excel Pre-Sales Support

The SCS Contractor must also as part his works properly ground and bond all installed apparatus, equipment and components to ensure equal potential is maintained through his installation in accordance with EN50174 & EN50310

The SCS Contractor works shall be completed to suit the requirements of the Main Contractors programme.

The SCS Contractor must also obtain written approval from Main Contractor and the appointed Electrical subcontractor before any ground and bonding connections to be made on site for use by SCS Installation prior to commencement of his connections or works.

Associated works by others include:

Horizontal and vertical containment 'Communications Containment' (i.e. cable trays, trunking, conduits), together with floor boxes, wall and ceiling mounted back boxes, provided by the appointed Electrical Subcontractor.

Telecommunications grounding and bonding points.

Builder's work in connection with the SCS Contract, include removal and replacement of fire-stopping.

Patching of users.

## 4 Component Manufacturers Details

### 4.1 Structured Cabling System Manufacturer

The chosen structured cabling system shall be Excel Networking.

- A complete solution from a single manufacturer shall be provided, and shall be covered by a single 25 year warranty.
- The SCS Contractor shall provide 'ongoing' independent compliance certification at both Channel and Component level from a trusted test establishment such as Delta Labs of Denmark. One off 'Approvals' and 'Attestations of Conformance' will not be acceptable.
- The SCS Contractor shall provide valid credentials detailing their status as either an Excel Solutions Partner (ESP), or Excel Cabling Partner (ECP)

### 4.2 SCS Equipment & SR Racks

All Equipment, Server and Open Racks shall be Excel Environ® and covered under the Manufacturer's single warranty.

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## 5 Interpretation & Comms Room Locations

The physical building design incorporates multiple-use units and administrative offices in a closed environment. The Telecommunication transport Media or Structured Cabling System provides the physical connectivity from the Entrance Facility (EF) to a centralised Equipment Room (MER), through to Secondary Equipment Rooms (SER) to the final work area Telecommunication Outlet.

Entrance Facility (EF) Defined as the point of demarcation and interface between site-based services and incoming services from the outside world. Space is allocated at this point for the installation of primary / secondary protection devices.

Location: To be confirmed

MER (Main Equipment Room) Defined as host equipment room in which site based servers, LAN, WAN and call processing equipment are housed in a secure and protected environment.

SER (Secondary Equipment Room) Defined as a location where telecommunication, data equipment, connecting backbone cabling and horizontal sub-systems reside in a secure and protected environment on a floor by floor basis.

NOTE: Upon drawings supporting other site services these spaces may be described as 'ICT Closets'.

## 6 General Specification & Requirements of the SCS Contractor

The SCS Contractor shall apply the methodologies for installation in accordance with BS EN 50174 and following the Manufacturers Installation Guidelines these shall be used during all installation activities.

Should conflicts exist in local law, codes and regulations, then local law, codes and regulations shall take precedent.

The SCS Contractor for all Horizontal and Backbone cabling must ensure it is fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacture company of the cabling system.

### 6.1 Labelling

The SCS Contractor shall draw up full details of the cable plant labelling scheme for every cable, patch panel, wiring closets, termination frames, and telecommunication outlets and agree the format with the Main Contractor prior to installation.

- Typeface Labels shall have an agreed typeface size and font. Hand-written labels will not be accepted, except on a temporary basis during installation and will not be acceptable for cable plant testing purposes.
- Characteristics All labels shall be permanently fixed. Legible, durable and robust.
- Orientation All labels shall be fixed horizontally on fixed equipment or longitudinally along the line of cables.
- Positions The following positions at which labels are fixed shall apply as a minimum:
  - Cable terminations shall be labelled at patch panel outlets.
  - Cable shall be labelled at telecommunication outlets.
  - Cables shall be labelled at the entry/exit points of rooms and buildings.
  - Cables shall be labelled at all access chamber, cable turning chambers and draw pits.

### 6.2 Cable Plant Test Failures

The SCS Contractor upon detection of cable plant failures during testing shall be duly noted each failure. The SCS Contractor shall rectify all faults any damaged cabling shall be replaced with new cables in complete runs.

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### 6.3 Cable Plant Witness Tests

The Main Contractor reserves the right to attend site to witness cable plant tests and complete random sample testing upon completion of test. Witness testing and random sample testing will be agreed with the SCS Contractor prior to commencement of site testing and will be no more than 10% of the total number of outlets. Any further testing will be chargeable at an agreed hourly rate prior to the testing.

## 7 Documentation

### 7.1 General

The Operations and maintenance manual for the project will be compiled in accordance with BS 6701 and shall include but not limited to the following documents. These shall be presented where required to the Main Contractor during bidding and on completion of the installation of the SCS Physical Infrastructure by the SCS Contractor:

- Current Independent 3rd Party Component Compliance Certification, indicating manufacture and component reference, for all items installed and supplied.
- Manufacturers' literature for products installed complete with SCS contractor logo and contact details embedded.



## Excel Pre-Sales Support

- Uniquely number test certificates for copper and fibre optic (link and channel where appropriate) for the entire SCS Physical Infrastructure.
- Electronic records of all test results.
- SCS Physical Infrastructure warranty (25-Year).
- Warranty against defective parts or workmanship for a minimum of 1 year after Practical Completion.

### 7.2 Drawings

The SCS Contractor shall allow for as-built installation drawings in AutoCAD or other format agreed with the Main Contractor shall be handed over in paper and electronic formats upon completion detailing the following information:-

- Horizontal cable routes. These drawings shall detail the number of TOs per floor, area or location.
- Backbone cabling routes. These drawings shall detail the quantity, type and routes of backbone cabling (both copper and fibre optic).
- Layout of termination frames, panels and closets, clearly identifying the number of frames or panels used in each MER and SER.
- Layout of Equipment Rooms throughout the entire project. These drawings shall identify the particular frames, panels and closets in each room.
- Telecommunication Outlet distribution. These drawings shall indicate the location and unique identifier of TOs throughout the entire project.

### 7.3 Acceptance

For acceptance of the SCS Physical Infrastructure the SCS Contractor shall complete the following:

- All labelling.
- All installation of SCS Physical Infrastructure (to the correct standards).
- All cabling test results showing positive results (to the correct standards).
- All documentation.

### 7.4 Training

The SCS Contractor is to provide Training to the clients IT Staff where required in the correct method of patching and system administration. The SCS Contractor shall allow for a suitable amount of time for onsite Training.

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## 8 Specification & Requirements – Horizontal Category 6

### 8.1 The Horizontal Structured Cabling System

The Horizontal structured cabling system selected is Excel Networking. The SCS must be installed by an Approved Excel Cabling Partner (ECP), or Approved Excel Solutions Partner (ESP) according to the manufacturer's instructions. Valid Certification shall be provided with all bids and prior to any works commencing.

The Horizontal structured cabling system shall provide in strict accordance to tender drawings. The system will be used to connect voice and data services, WLAN, CCTV, and Access Control devices to the network.

The drawings showing telecommunications outlets shall be used to identify the precise quantity of MER/SERs to which each outlet must be connected to maintain cable length restrictions in the use of Category 6 cabling.

Horizontal -Telecommunication Outlet requirements shall be taken from the following tender drawings:  
(Supplied Separately)

The performance of the SCS Contractors Horizontal structured system being provided shall meet ISO 11801:Ed2.2, ISO 60603-7-5, ISO 61156-5, EN 50173-1, EN50310 standards operating at frequencies up to 250Mhz, supporting Voice, Data & Video applications at data rates of up to 1Gbit/s to full 100m channel requirements.

The Horizontal Category 6 compliant system must also be backwards compatible with ISO 11801:Ed2.2, ISO 61156-5, EN 50173-1:A2:2011,

## 8.2 Cable

The cabling must be four-pair 100Ohm Category 6 type. **The cable must have current independent third party approval status at component level and include specification references.**

Horizontal cables shall be constructed with a Low Smoke Zero Halogen jacket meeting IEC 60332-1 flammability standard as a minimum. The cable must also be available in various colours including White, Violet and Orange, in case the client wishes to identify Horizontal Services by way of colour.

Acceptable construction of cable is as follows:

Category 6 U/UTP LSOH Violet – Excel Part No. [100-071](#)

Category 6 F/UTP LSOH Violet – Excel Part No. [100-076](#)

## 8.3 Connecting hardware

### 8.3.1 Patch Panels:

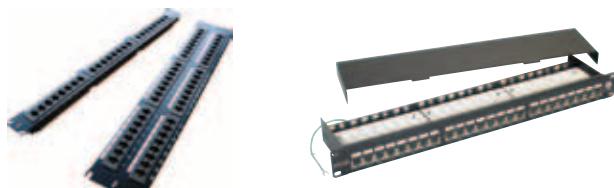
As a minimum the Patch Panels must:

- Be 19" rack mountable, in exact multiples of 1U in height.
- Cable terminations must be Insulation Displacement Connectors (IDC).
- Front connectors to be RJ45 style
- Label System
- Lifetime Product Warranty

The client preference for High Density Frames is:

Excel 100-304 24 Way Unscreened Patch Panel, or 100-306 48 Way Unscreened Patch Panel

Excel 100-013 24 Way Screened Patch Panel:



[100-304](#) & [100-306](#)

[100-013](#)

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- Black finish
- Front connectors to be RJ45 style
- Rear IDC Termination
- Rear cable presentation to be 180 degrees

### 8.3.2 Outlet Connectors:

- Cable terminations must be Insulation Displacement Connectors (IDC).
- Connector style to be RJ45
- Toolless Termination or punch down
- Lifetime Product Warranty
- Must have current independent third party approval status at component level to a minimum of ISO/IEC 11801.



The form factor of the data outlet plate shall be from the Excel Office range, and shall be made up of:

1 x Excel Office Single gang faceplate – Excel Part No. 100-270

2 x Excel Office Category 6 Unscreened Module – Low Profile – Excel Part No. 100-276

Or

2 x Excel Office Category 6 screened keystone Jack – Excel Part No. [100-210](#)

2 x Excel Office Angled Shutter – Excel Part No. [100-280](#)



[100-270](#)



[100-276](#)



[100-210](#)



[100-280](#)

### 8.3.3 Horizontal Category 6 U/UTP Patch Leads

The SCS Contractor shall allow for the supply only of the following [Excel Category 6 compliant Patch leads](#).

Each patch lead shall be complete with strain relief boot and RJ45 connector. **The patch leads must have current independent third party approval status at component level and include specification references.**

The Clients standard dictates the following (example)

- Grey for general Comms Room patching
- Black for Security

These items shall be available from stock within 1,2,3,5 and 10 metre lengths. Bespoke lengths and colours should be available, but it is understood they will be subject to a longer lead time for delivery.

The SCS Contractor will allow for patch leads to be available for the Patching Fields, these are supplied in standard lengths.

## 9 MER and SER Configurations - Horizontal Cabling Requirements

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Main Equipment Room and Secondary Equipment Rooms will contain a quantity of Equipment and Server Racks as defined within the Summary of Works.

### a. Server Rack

The Server Rack shall be from the Excel [Environ® SR](#) (Server Rack) range of racks and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock

- Minimum Load Capacity 1300Kg.
- Jacking Feet and Castors
- Baying Kit



Environ® SR Series

### b. Equipment Rack

SER Enclosures shall be Excel [Environ® ER series](#) and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 600Kg.
- Jacking Feet and Castors
- Baying Kit

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Environ® ER Series



### c. Open Rack

The Two Post Patching frames shall be Excel [Environ® OR series](#) and conform as a minimum with the following:

- DIN414 compliant
- 2 post aluminium construction
- 42,48 or 52U height
- 19" profiles marked with U height positions
- 1500Kg static load bearing
- High Density Cable Management
- Lockable double hinged doors on vertical management
- Cable spools as required
- Black RAL 9005



[Environ® OR Series](#)

### d. Intelligent Power Distribution Units

It is the requirement of The Client that Excel Intelligent PDU's be installed within each ER and SR Rack.

Select the appropriate Excel Intelligent PDU from the following list according to the size and load bearing requirements, and pay particular attention to the required equipment termination plugs.

Managed Intelligent PDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed Intelligent PDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed Intelligent PDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed Intelligent PDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed Intelligent PDU 24 way BS1363 with 32A IEC6039 plug - vertical

*Further detail is given for typical layouts of wiring and equipment closets at a later date.*

## 10 Horizontal Infrastructure Additional Restrictions & Requirement

The restrictions & requirements listed below are in addition to those stated in standards set with the scope of works.

Horizontal structured cabling shall emanate from the MER/SER terminated upon 19" rack mountable 24-Port, RJ45 patch panels. There will be 1U horizontal cable management panel installed for a maximum of every 3U of patch panels.

Rack mounted equipment passive or active in nature shall be bonded to a sub-TGB (Telecommunications Grounding Bar) positioned in each equipment rack which is in turn shall be bonded to the TR/ER room, TMGB/TGB.

Work area MER/SERs shall consist of an RJ45 socket presented as either a single or dual formation. MER/SERs faceplates must be in keeping with the environment they are being installed i.e. Suitable IP Rating, and have a finish appropriate to those areas which they have been installed i.e. Brass, Stainless or other.

In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be earthed according to the manufacturer's instructions and EN50174-2, EN50310 standards.

A labelling and administration system must be designed into the cabling system in line with BS 6701, EN 50174 Standards. The system shall be approved by the Client before completion.

### a. Equipment Room – Analogue Voice Cabling

There is a requirement for [multi-pair voice cabling](#) to be run through to certain parts of the building to handle the requirements of emergency lift phones and disabled refuge call points, the SCS subcontractor should allow provision within their tender response as a separate line item.

*Further detail is given for typical layouts of wiring and equipment closets later in this document.*

### b. Horizontal Category 6 Infrastructure Testing

The SCS Contractor shall test 100% of the Category 6 horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in EN50173, ISO/IEC 11801 Class D. Sample testing for ANEXT will not be required. The SCS Contractor must use a level IV Cable tester it should have a current calibration certificate issued by the manufacturer of the tester.

Computed test results that indicate that some part of the result is closer to the limit than the tolerance of the test equipment may be noted as 'PASS\*' or 'FAIL\*'. A 'PASS\*' test result shall not be accepted and shall be treated in the same way as a 'FAIL'.

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### c. Horizontal Category 6 - Containment

Horizontal cabling must be fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacturer of the structured cabling system.

## 11 Specification & Requirements - Backbone Fibre Optic Infrastructure

The selected [Fibre Optic Cabling System](#) is manufactured by Excel Networking. Performance objectives of backbone fibre optic infrastructure shall be to support error free signal transmission between MER and SERs throughout the campus. The performance of the installed fibre optic cable plant shall support bandwidth-intensive applications including 1Gbit/s through 10Gbit/s and beyond as defined in IEEE 802.3z, 802.3ae, 802.3aq and 802.3ak Standards.

Designated media shall consist of multi core Multi-Mode/Singlemode cabling compliant with ISO 11801 standards.

ALL CONNECTOR END FACES SHALL BE INSPECTED FOR DAMAGE AND DEBRIS USING A VIDEO MICROSCOPE AND IF NECESSARY CLEANED BEFORE INSERTION INTO COUPLERS IN ACCORDANCE BS/ISO 14763-3



a. OS2, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	0.40	0.32
1550	0.30	0.21

b. OM4, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.0	2.5
1300	1.0	0.5

c. Fibre optic patch panels:

- Suitable for mounting in 19" frames within termination closets. Fixed using securing bolts and captive nuts at either side.
- With sufficient finger space around connectors to allow patch cables to be connected and disconnected and to allow individual connectors to be mounted and dismounted without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding, tilting or other mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Includes 24 splice bridge, 2 x cable entry glands, Cable tie bridges in base of draw.

Excel 24 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-464](#)

Excel 48 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-466](#)

Excel 24 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-474](#)

Excel 48 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-476](#)

d. Connectors & Fibre Patch Leads

Optical fibre cables shall be terminated LC-Duplex connectors that conform to EN 186000 Part 1, by means of fusion splicing using factory terminated pigtailed.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

LC-LC duplex OM4 fibre lead, aqua, 1 mtr , [204-300](#)

LC-LC duplex OM4 fibre lead, aqua, 2 mtr, [204-301](#)

e. Splices

Splices shall be retained within a protective sleeve by either friction or adhesive bonds to the optical fibre and additional strain relief for the completed joint shall be provided. All splice, joints and their strain relief shall be fixed within the optical fibre management system of the enclosure. The insertion loss through any splice shall not be greater than 0.15dB.

f. Pigtailed

Fibre optic pigtailed shall be made from the same fibre type as the fixed cabling. Pigtailed shall be kept slack when the cable is terminated.

OM4 LC pigtailed, 2mtr, [204-320](#)

## 12 Backbone Optical Fibre Testing

Single and Multi mode backbone links shall be tested at both wavelength and in both directions in accordance with BS/ISO/IEC 14763-3. Testing of the fibre optic cabling using the One Jumper Reference Method using Light Source and Power Meter with reference grade test cords and couplers.

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

### a. OTDR Testing

Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

- Each fibre link and channel shall be tested in both directions wavelengths
- A launch cable shall be installed between the OTDR and the first link connection.
- A tail cable shall be installed after the last link connection.

### b. Length Measurement

- The length of each fibre shall be recorded.

### c. Polarity Testing

Paired duplex fibres in multi-fibre cables shall be tested to verify polarity.

The polarity of the paired duplex fibres shall be verified using a Power source and light meter in accordance with BS/EN 50174-1.

The following information would be recorded from all tests:

- Name of personnel conducting the test.
- Project Name
- Date test is being performed.
- Optical source wavelength, spectral width, and CPR (for multimode tests only).
- Type of test equipment used (manufacturer, model, and serial number).
- Fibre identification.
- End point locations.
- Test direction.
- Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- Measured attenuation of the link segment.
- Acceptable link attenuation.
- Reference cord identification
- Calibration certification of any test equipment used.

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Each rack must be laid out using the attached spreadsheet, the following image is an example of what the SCS contractor is expected to submit prior to final sign-off and installation.

### d. Mandatory Requirement of All Enclosure Styles

Each rack or cabinet shall have a proprietary earth bar kit (vertical and/or horizontal as required) connected directly to the main earth. The size of the cable shall be determined by the electrical sub-contractor, but shall not be less than 16mm<sup>2</sup>.

All parts of the rack including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the eXK earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm<sup>2</sup>.



## Excel Pre-Sales Support

A full height vertical earth bar shall be used for all floor mounted racks and shall be sized to accommodate all earth connections as a single individual connection. There shall be no "double lugged" connections or "curls" of earth bonds.

Connections to the Earth Bar shall be by appropriately sized crimp lugs secured by brass nuts, bolts and shake proof washers.

A safety warning label "SAFETY ELECTRICAL EARTH DO NOT REMOVE" (or similar wording) shall be fitted to the main earth connection points (i.e. in the rack, connection at the room building earth point, MTGB, TGB(s) etc.).

All metal containment and tray work shall be earth bonded for safety and EMC. Sections of containment shall be securely earth bonded together by manufacturers' interleaves joints.

A labelling and administration system must be designed for each enclosure in line with EN 50174 or ISO 14763-2 or TIA/EIA-606. The system shall be approved by the Client before installation.

### 13.2 Additional Requirements

Additional to the main contract for the SCS Infrastructure there are a number of requirements that The Client would like a cost proposal for within SCS Contractors Tender response. The fundamental reason for this is to try and provide additional savings and efficiencies by combining these under the one contract. It will be to the advantage of the SCS Contractor if he can supply and install more than one product group.

The Client however retains the legal right, not to purchase all of these additional items from the SCS Contractor under the one contract.

## 13 Drawings Schedule of Applicable Drawings

## 14 Installer Requirements

The SCS Contractor shall be qualified to ECP (Excel Cabling Partner) or ESP (Excel Solutions Partner) status. Certification of this shall be provided with all bid documentation.

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The SCS Contractor will preferably have an RCDD® (Registered Communications Distribution Designer) or CNIDP (Certified Network Infrastructure Design Professional) on staff that will be ultimately responsible for this section of the project.

The RCDD/CNIDP or Project Engineer must have sufficient experience to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts.

A CV of the responsible RCDD/CNIDP or Project Engineer must be attached to The Vendor's response for evaluation by The Customer. Should the RCDD/CNIDP or Project Engineer assigned to this project change during the installation, the new RCDD/CNIDP or Project Engineer assigned must also submit a CV for review by The Client.

If, in the opinion of The Client, the RCDD/CNIDP or Project Engineer does not possess adequate qualifications to support the project, they reserve the right to require the SCS Contractor to assign an RCDD/CNIDP or Project Engineer who, in The Clients opinion, possesses the necessary skills and experience required of this project.

The SCS Contractor would ideally have BICSI Registered Installers, CNCI Certified Network Cable Installers or equivalent on staff and assign them to this project. The project shall be staffed at all times by Installers and Technicians who, in the role of lead crafts-persons, will be able to provide leadership and technical resources for the remaining crafts-persons on the project.

A copy of all their registrations must be submitted in SCS Contractors response to this tender.

The SCS Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

The Preferred Installer for this project shall be:

## 15 SCS Infrastructure - Pricing Schedule

The SCS Contractor shall fully populate the following pricing schedule for each item listed. Any items listed with no pricing shown will be deemed to be zero rated all fully inclusive in the summary total price shown.

The SCS Contractor will be required to submit and full bill of material and schedule of rates to support the following price schedule upon request from the Main Contractor.

The SCS Contractor must consider and allow for all aspects, scope, requirements and specifications sighted in (SCS Infrastructure) duly before completing the pricing section below.

The SCS Contractors are reminded that any alternative manufacture pricing must be provided as an addendum to their tender response.

<b>Item</b>	<b>Description</b>	<b>Price</b>
1	Horizontal Category 6 Elements	£
2	Backbone Optical Fibre Elements	£
3	Equipment Cabinet Elements	£
4	Multi-pair Voice Cabling	£
5	Project Management	£
7	Documentation & Warranty	£
8	Training	£
<b>Summary Total</b>		£



## 16 Appendices

### Appendix A Rack Layout Spreadsheet

CAB 1		
SR Rack (Rear)		
42U	1U (4 hoop)Cable Manager	42U
41U	1U MTP Fibre Cassette Unit	41U
40U	1U (4 hoop)Cable Manager	40U
39U	48 Port POE Ethernet Switch	39U
38U	48 Port POE Ethernet Switch	38U
37U	1U (4 hoop)Cable Manager	37U
36U	1U 24 Port Patch Panel	36U
35U	1U 24 Port Patch Panel	35U
34U	1U (4 hoop)Cable Manager	34U
33U	1U 24 Port Patch Panel	33U
32U	1U 24 Port Patch Panel	32U
31U	1U (4 hoop)Cable Manager	31U
30U		30U
29U		29U
28U		28U
27U		27U
26U		26U
25U		25U
24U		24U
23U		23U
22U		22U
21U		21U
20U		20U
19U		19U
18U		18U
17U		17U
16U		16U
15U		15U
14U		14U
13U		13U
12U		12U
11U	Power Distribution	
10U		
9U		
8U		
7U		
6U		
5U		
4U		
3U		
2U		
1U		

# Category 5e - SCS Infrastructure Specification Document

## 1 Document Authority

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_

### 1.1 Document History

Version	Date Issued	Status	Description
1.1		Draft	For Review

### 1.2 Document Definitions

SCS	- Structured Cabling System
TO	- Telecommunications Outlet
TR	- Telecommunications Room
UPS	- Uninterruptible Power Supply
IIM	- Intelligent Infrastructure Management

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Download this document from the 'Encyclopaedia' section of the 'Partner Area' located at [www.excel-networking.com](http://www.excel-networking.com)



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## 2 Summary of Works

### 2.1 Site address

Project site address:

### 2.2 Site contact:

### 2.3 SCS requirement

Based upon the SCS specification as detailed within this document, the requirements for this installation will include, but not limited to (example)

- Category 5e U/UTP cabling throughout.
- Patch Room to facilities – Doors, Cameras etc as required by security/facilities
- Multi core OM4 or OS2 fibre optic cables between distribution locations

### 2.4 Equipment Room locations

Final locations of all MER/SERs shall be coordinated with The Client, although as an initial guide:

MER (Main Equipment Room)

SER (Secondary Equipment Room)

### 2.5 The MER shall contain:

X No. ER Rack

X No. SR Rack

X No. OR Rack (Open Frame)

### 2.6 The SER shall contain:

X No. ER Rack

X No. OR Rack

Specification for each ER or SR Rack is to be defined further within this document.

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## 3 Scope of Works

Includes Equipment, materials, labour and services to provide The SCS Infrastructure including, but not limited to:

Horizontal Infrastructure (Category 5e).

Backbone Infrastructure (Optical Fibre OS1/OS2 and/or OM3/OM4).

ER racks, frames, racks and enclosures.

Termination frames and panels.

Multi-purpose Telecommunication Outlets.

Supply of drop cables to connect horizontal cabling to connect network services.

Generation of base line patching schedules.

Documentation and submissions.

The SCS Contractor must also as part his works properly ground and bond all installed apparatus, equipment and components to ensure equal potential is maintained through his installation in accordance with EN50174 & EN50310

The SCS Contractor works shall be completed to suit the requirements of the Main Contractors programme.

The SCS Contractor must also obtain written approval from Main Contractor and the appointed Electrical subcontractor before any ground and bonding connections to be made on site for use by SCS Installation prior to commencement of his connections or works.

Associated works by others include:

Horizontal and vertical containment 'Communications Containment' (i.e. cable trays, trunking, conduits), together with floor boxes, wall and ceiling mounted back boxes, provided by the appointed Electrical Subcontractor.

Telecommunications grounding and bonding points.

Builder's work in connection with the SCS Contract, include removal and replacement of fire-stopping.

Patching of users.

## 4 Component Manufacturers Details

### 4.1 Structured Cabling System Manufacturer

The chosen structured cabling system shall be Excel Networking.

- A complete solution from a single manufacturer shall be provided, and shall be covered by a single 25 year warranty.
- The SCS Contractor shall provide 'ongoing' independent compliance certification at both Channel and Component level from a trusted test establishment such as Delta Labs of Denmark. One off 'Approvals' and 'Attestations of Conformance' will not be acceptable.
- The SCS Contractor shall provide valid credentials detailing their status as either an Excel Solutions Partner (ESP), or Excel Cabling Partner (ECP)

### 4.2 SCS Equipment & SR Racks

All Equipment, Server and Open Racks shall be Excel Environ® and covered under the Manufacturer's single warranty.

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## 5 Interpretation & Comms Room Locations

The physical building design incorporates multiple-use units and administrative offices in a closed environment. The Telecommunication transport Media or Structured Cabling System provides the physical connectivity from the Entrance Facility (EF) to a centralised Equipment Room (MER), through to Secondary Equipment Rooms (SER) to the final work area Telecommunication Outlet.

Entrance Facility (EF) Defined as the point of demarcation and interface between site-based services and incoming services from the outside world. Space is allocated at this point for the installation of primary / secondary protection devices.

Location: To be confirmed

MER (Main Equipment Room) Defined as host equipment room in which site based servers, LAN, WAN and call processing equipment are housed in a secure and protected environment.

SER (Secondary Equipment Room) Defined as a location where telecommunication, data equipment, connecting backbone cabling and horizontal sub-systems reside in a secure and protected environment on a floor by floor basis.

NOTE: Upon drawings supporting other site services these spaces may be described as 'ICT Closets'.

## 6 General Specification & Requirements of the SCS Contractor

The SCS Contractor shall apply the methodologies for installation in accordance with BS EN 50174 and following the Manufacturers Installation Guidelines these shall be used during all installation activities.

Should conflicts exist in local law, codes and regulations, then local law, codes and regulations shall take precedent.

The SCS Contractor for all Horizontal and Backbone cabling must ensure it is fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacture company of the cabling system.

### 6.1 Labelling

The SCS Contractor shall draw up full details of the cable plant labelling scheme for every cable, patch panel, wiring closets, termination frames, and telecommunication outlets and agree the format with the Main Contractor prior to installation.

- Typeface Labels shall have an agreed typeface size and font. Hand-written labels will not be accepted, except on a temporary basis during installation and will not be acceptable for cable plant testing purposes.
- Characteristics All labels shall be permanently fixed. Legible, durable and robust.
- Orientation All labels shall be fixed horizontally on fixed equipment or longitudinally along the line of cables.
- Positions The following positions at which labels are fixed shall apply as a minimum:
  - Cable terminations shall be labelled at patch panel outlets.
  - Cable shall be labelled at telecommunication outlets.
  - Cables shall be labelled at the entry/exit points of rooms and buildings.
  - Cables shall be labelled at all access chamber, cable turning chambers and draw pits.

### 6.2 Cable Plant Test Failures

The SCS Contractor upon detection of cable plant failures during testing shall be duly noted each failure. The SCS Contractor shall rectify all faults any damaged cabling shall be replaced with new cables in complete runs.

### 6.3 Cable Plant Witness Tests

The Main Contractor reserves the right to attend site to witness cable plant tests and complete random sample testing upon completion of test. Witness testing and random sample testing will be agreed with the SCS Contractor prior to commencement of site testing and will be no more than 10% of the total number of outlets. Any further testing will be chargeable at an agreed hourly rate prior to the testing.

## 7 Documentation

### 7.1 General

The Operations and maintenance manual for the project will be compiled in accordance with BS 6701 and shall include but not limited to the following documents. These shall be presented where required to the Main Contractor during bidding and on completion of the installation of the SCS Physical Infrastructure by the SCS Contractor:

- Current Independent 3rd Party Component Compliance Certification, indicating manufacture and component reference, for all items installed and supplied.
- Manufacturers' literature for products installed complete with SCS contractor logo and contact details embedded.

- Uniquely number test certificates for copper and fibre optic (link and channel where appropriate) for the entire SCS Physical Infrastructure.
- Electronic records of all test results.
- SCS Physical Infrastructure warranty (25-Year).
- Warranty against defective parts or workmanship for a minimum of 1 year after Practical Completion.

## 7.2 Drawings

The SCS Contractor shall allow for as-built installation drawings in AutoCAD or other format agreed with the Main Contractor shall be handed over in paper and electronic formats upon completion detailing the following information:

- Horizontal cable routes. These drawings shall detail the number of TOs per floor, area or location.
- Backbone cabling routes. These drawings shall detail the quantity, type and routes of backbone cabling (both copper and fibre optic).
- Layout of termination frames, panels and closets, clearly identifying the number of frames or panels used in each MER and SER.
- Layout of Equipment Rooms throughout the entire project. These drawings shall identify the particular frames, panels and closets in each room.
- Telecommunication Outlet distribution. These drawings shall indicate the location and unique identifier of TOs throughout the entire project.

## 7.3 Acceptance

For acceptance of the SCS Physical Infrastructure the SCS Contractor shall complete the following:

- All labelling.
- All installation of SCS Physical Infrastructure (to the correct standards).
- All cabling test results showing positive results (to the correct standards).
- All documentation.

## 7.4 Training

The SCS Contractor is to provide Training to the clients IT Staff where required in the correct method of patching and system administration. The SCS Contractor shall allow for a suitable amount of time for onsite Training.

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# 8 Specification & Requirements – Horizontal Category 5e

## 8.1 The Horizontal Structured Cabling System

The Horizontal structured cabling system selected is Excel Networking. The SCS must be installed by an Approved Excel Cabling Partner (ECP), or Approved Excel Solutions Partner (ESP) according to the manufacturer's instructions. Valid Certification shall be provided with all bids and prior to any works commencing.

The Horizontal structured cabling system shall provide in strict accordance to tender drawings. The system will be used to connect voice and data services, WLAN, CCTV, and Access Control devices to the network.

The drawings showing telecommunications outlets shall be used to identify the precise quantity of MER/SERs to which each outlet must be connected to maintain cable length restrictions in the use of Category 5e cabling.

Horizontal -Telecommunication Outlet requirements shall be taken from the following tender drawings:  
(Supplied Separately)

## Excel Pre-Sales Support

The performance of the SCS Contractors Horizontal structured system being provided shall meet ISO 11801:Ed2.2, ISO 60603-7-5, ISO 61156-5, EN 50173-1, EN50310 standards operating at frequencies up to 100Mhz, supporting Voice, Data & Video applications at data rates of up to 1Gbit/s to full 100m channel requirements.

The Horizontal Category 5E compliant system must also be backwards compatible with ISO 11801:Ed2.2, ISO 61156-5, EN 50173-1:A2:2011,

### 8.2 Cable

The cabling must be four-pair 100Ohm Category 5e type. **The cable must have current independent third party approval status at component level and include specification references.**

Horizontal cables shall be constructed with a Low Smoke Zero Halogen jacket meeting IEC 60332-1 flammability standard as a minimum. The cable must also be available in various colours including White, Violet and Orange, in case the client wishes to identify Horizontal Services by way of colour.

Acceptable construction of cable is as follows:

Category 5e U/UTP LSOH Violet – Excel Part No. [100-066](#)

Category 5e F/UTP LSOH Violet – Excel Part No. [100-217](#)

### 8.3 Connecting hardware

#### 8.3.1 Patch Panels:

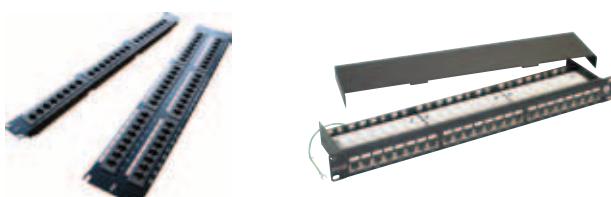
As a minimum the Patch Panels must:

- Be 19" rack mountable, in exact multiples of 1U in height.
- Cable terminations must be Insulation Displacement Connectors (IDC).
- Front connectors to be RJ45 style
- Label System
- Lifetime Product Warranty

The client preference for High Density Frames is:

Excel 100-470 24 Way Unscreened Patch Panel, or 100-480 48 Way Unscreened Patch Panel

Excel 100-736 24 Way Screened Patch Panel:



[100-470 & 100-480](#)

[100-736](#)

- Black finish
- Front connectors to be RJ45 style
- Rear IDC Termination
- Rear cable presentation to be 180 degrees

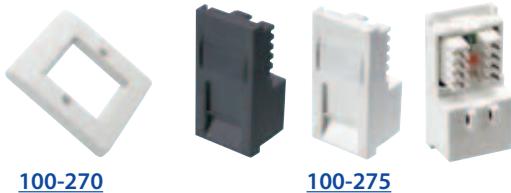
#### 8.3.2 Outlet Connectors:

- Cable terminations must be Insulation Displacement Connectors (IDC).
- Connector style to be RJ45
- Toolless Termination or punch down
- Lifetime Product Warranty
- Must have current independent third party approval status at component level to a minimum of ISO/IEC 11801.

The form factor of the data outlet plate shall be from the Excel Office range, and shall be made up of:

1 x Excel Office Single gang faceplate – Excel Part No. 100-270

2 x Excel Office Category 5e Unscreened Module – Low Profile – Excel Part No. 100-275



### 8.3.3 Horizontal Category 5e U/UTP Patch Leads

The SCS Contractor shall allow for the supply only of the following [Excel Category 5e compliant Patch leads](#).

Each patch lead shall be complete with strain relief boot and RJ45 connector. **The patch leads must have current independent third party approval status at component level and include specification references.**

The Clients standard dictates the following (example)

- Grey for general Comms Room patching
- Black for Security

These items shall be available from stock within 1,2,3,5 and 10 metre lengths. Bespoke lengths and colours should be available, but it is understood they will be subject to a longer lead time for delivery.

The SCS Contractor will allow for patch leads to be available for the Patching Fields, these are supplied in standard lengths.

## 9 MER and SER Configurations - Horizontal Cabling Requirements

Main Equipment Room and Secondary Equipment Rooms will contain a quantity of Equipment and Server Racks as defined within the Summary of Works.

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### a. Server Rack

The Server Rack shall be from the Excel [Environ® SR](#) (Server Rack) range of racks and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 1300Kg.
- Jacking Feet and Castors
- Baying Kit



[Environ® SR Series](#)

b. Equipment Rack

SER Enclosures shall be Excel [Environ® ER series](#) and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 600Kg.
- Jacking Feet and Castors
- Baying Kit

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[Environ® ER Series](#)

### c. Open Rack

The Two Post Patching frames shall be Excel [Environ® OR series](#) and conform as a minimum with the following:

- DIN414 compliant
- 2 post aluminium construction
- 42,48 or 52U height
- 19" profiles marked with U height positions
- 1500Kg static load bearing
- High Density Cable Management
- Lockable double hinged doors on vertical management
- Cable spools as required
- Black RAL 9005



[Environ® OR Series](#)

### d. Intelligent Power Distribution Units

It is the requirement of The Client that Excel Intelligent PDU's be installed within each ER and SR Rack.

Select the appropriate Excel Intelligent PDU from the following list according to the size and load bearing requirements, and pay particular attention to the required equipment termination plugs.

Managed Intelligent PDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed Intelligent PDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed Intelligent PDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed Intelligent PDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed Intelligent PDU 24 way BS1363 with 32A IEC6039 plug - vertical

*Further detail is given for typical layouts of wiring and equipment closets at a later date.*

## 10 Horizontal Infrastructure Additional Restrictions & Requirement

The restrictions & requirements listed below are in addition to those stated in standards set with the scope of works.

Horizontal structured cabling shall emanate from the MER/SER terminated upon 19" rack mountable 24-Port, RJ45 patch panels. There will be 1U horizontal cable management panel installed for a maximum of every 3U of patch panels.

Rack mounted equipment passive or active in nature shall be bonded to a sub-TGB (Telecommunications Grounding Bar) positioned in each equipment rack which is in turn shall be bonded to the TR/ER room, TMGB/TGB.

Work area MER/SERs shall consist of an RJ45 socket presented as either a single or dual formation. MER/SERs faceplates must be in keeping with the environment they are being installed i.e. Suitable IP Rating, and have a finish appropriate to those areas which they have been installed i.e. Brass, Stainless or other.

In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be earthed according to the manufacturer's instructions and EN50174-2, EN50310 standards.

A labelling and administration system must be designed into the cabling system in line with BS 6701, EN 50174 Standards. The system shall be approved by the Client before completion.

### a. Equipment Room – Analogue Voice Cabling

There is a requirement for [multi-pair voice cabling](#) to be run through to certain parts of the building to handle the requirements of emergency lift phones and disabled refuge call points, the SCS subcontractor should allow provision within their tender response as a separate line item.

*Further detail is given for typical layouts of wiring and equipment closets later in this document.*

### b. Horizontal Category 5e Infrastructure Testing

The SCS Contractor shall test 100% of the Category 5e horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in EN50173, ISO/IEC 11801 Class D. Sample testing for ANEXT will not be required. The SCS Contractor must use a level IV Cable tester it should have a current calibration certificate issued by the manufacturer of the tester.

Computed test results that indicate that some part of the result is closer to the limit than the tolerance of the test equipment may be noted as 'PASS\*' or 'FAIL\*'. A 'PASS\*' test result shall not be accepted and shall be treated in the same way as a 'FAIL'.

### c. Horizontal Category 5e – Containment

Horizontal cabling must be fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' provided by the Electrical subcontractor.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacturer of the structured cabling system..

## 11 Specification & Requirements - Backbone Fibre Optic Infrastructure

The selected [Fibre Optic Cabling System](#) is manufactured by Excel Networking. Performance objectives of backbone fibre optic infrastructure shall be to support error free signal transmission between MER and SERs throughout the campus. The performance of the installed fibre optic cable plant shall support bandwidth-intensive applications including 1Gbit/s through 10Gbit/s and beyond as defined in IEEE 802.3z, 802.3ae, 802.3aq and 802.3ak Standards.

Designated media shall consist of multi core Multi-Mode/Singlemode cabling compliant with ISO 11801 standards.

ALL CONNECTOR END FACES SHALL BE INSPECTED FOR DAMAGE AND DEBRIS USING A VIDEO MICROSCOPE AND IF NECESSARY CLEANED BEFORE INSERTION INTO COUPLERS IN ACCORDANCE BS/ISO 14763-3

a. OS2, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	0.40	0.32
1550	0.30	0.21

b. OM4, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.0	2.5
1300	1.0	0.5

c. Fibre optic patch panels:

- Suitable for mounting in 19" frames within termination closets. Fixed using securing bolts and captive nuts at either side.
- With sufficient finger space around connectors to allow patch cables to be connected and disconnected and to allow individual connectors to be mounted and dismounted without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding, tilting or other mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Includes 24 splice bridge, 2 x cable entry glands, Cable tie bridges in base of draw.

Excel 24 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-464](#)

Excel 48 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-466](#)

Excel 24 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-474](#)

Excel 48 core fibre panel, LC singlemode, sliding panel pre loaded – pt no. [200-476](#)

d. Connectors & Fibre Patch Leads

Optical fibre cables shall be terminated LC-Duplex connectors that conform to EN 186000 Part 1, by means of fusion splicing using factory terminated pigtails.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

LC-LC duplex OM4 fibre lead, aqua, 1 mtr , [204-300](#)

LC-LC duplex OM4 fibre lead, aqua, 2 mtr, [204-301](#)

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e. Splices

Splices shall be retained within a protective sleeve by either friction or adhesive bonds to the optical fibre and additional strain relief for the completed joint shall be provided. All splice, joints and their strain relief shall be fixed within the optical fibre management system of the enclosure. The insertion loss through any splice shall not be greater than 0.15dB.

f. Pigtails

Fibre optic pigtails shall be made from the same fibre type as the fixed cabling. Pigtails shall be kept slack when the cable is terminated.

OM4 LC pigtails, 2mtr, [204-320](#)

## 12 Backbone Optical Fibre Testing

Single and Multi mode backbone links shall be tested at both wavelength and in both directions in accordance with BS/ISO/IEC 14763-3. Testing of the fibre optic cabling using the One Jumper Reference Method using Light Source and Power Meter with reference grade test cords and couplers.

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

### a. OTDR Testing

Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

- Each fibre link and channel shall be tested in both directions wavelengths
- A launch cable shall be installed between the OTDR and the first link connection.
- A tail cable shall be installed after the last link connection.

### b. Length Measurement

- The length of each fibre shall be recorded.

### c. Polarity Testing

Paired duplex fibres in multi-fibre cables shall be tested to verify polarity.

The polarity of the paired duplex fibres shall be verified using a Power source and light meter in accordance with BS/EN 50174-1.

The following information would be recorded from all tests:

- Name of personnel conducting the test.
- Project Name
- Date test is being performed.
- Optical source wavelength, spectral width, and CPR (for multimode tests only).
- Type of test equipment used (manufacturer, model, and serial number).
- Fibre identification.
- End point locations.
- Test direction.
- Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- Measured attenuation of the link segment.
- Acceptable link attenuation.
- Reference cord identification
- Calibration certification of any test equipment used. Specification & Requirements – SER Cabinets

Each cabinet must be laid out using the attached spreadsheet, the following image is an example of what the SCS contractor is expected to submit prior to final sign-off and installation.

### d. Mandatory Requirement of All Enclosure Styles

Each rack or cabinet shall have a proprietary earth bar kit (vertical and/or horizontal as required) connected directly to the main earth. The size of the cable shall be determined by the electrical sub-contractor, but shall not be less than 16mm<sup>2</sup>.

All parts of the rack including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the eXK earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm<sup>2</sup>.

A full height vertical earth bar shall be used for all floor mounted racks and shall be sized to accommodate all earth connections as a single individual connection. There shall be no "double lugged" connections or "curls" of earth bonds.

Connections to the Earth Bar shall be by appropriately sized crimp lugs secured by brass nuts, bolts and shake proof washers.

A safety warning label "SAFETY ELECTRICAL EARTH DO NOT REMOVE" (or similar wording) shall be fitted to the main earth connection points (i.e. in the rack, connection at the room building earth point, MTGB, TGB(s) etc.).

All metal containment and tray work shall be earth bonded for safety and EMC. Sections of containment shall be securely earth bonded together by manufacturers' interleaves joints.

A labelling and administration system must be designed for each enclosure in line with EN 50174 or ISO 14763-2 or TIA/EIA-606. The system shall be approved by the Client before installation.

## 13.2 Additional Requirements

Additional to the main contract for the SCS Infrastructure there are a number of requirements that The Client would like a cost proposal for within SCS Contractors Tender response. The fundamental reason for this is to try and provide additional savings and efficiencies by combining these under the one contract. It will be to the advantage of the SCS Contractor if he can supply and install more than one product group.

The Client however retains the legal right, not to purchase all of these additional items from the SCS Contractor under the one contract.

# 13 Drawings Schedule of Applicable Drawings

# 14 Installer Requirements

The SCS Contractor shall be qualified to ECP (Excel Cabling Partner) or ESP (Excel Solutions Partner) status. Certification of this shall be provided with all bid documentation.

The SCS Contractor will preferably have an RCDD® (Registered Communications Distribution Designer) or CNIDP (Certified Network Infrastructure Design Professional) on staff that will be ultimately responsible for this section of the project.

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The RCDD/CNIDP or Project Engineer must have sufficient experience to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts.

A CV of the responsible RCDD/CNIDP or Project Engineer must be attached to The Vendor's response for evaluation by The Customer. Should the RCDD/CNIDP or Project Engineer assigned to this project change during the installation, the new RCDD/CNIDP or Project Engineer assigned must also submit a CV for review by The Client.

If, in the opinion of The Client, the RCDD/CNIDP or Project Engineer does not possess adequate qualifications to support the project, they reserve the right to require the SCS Contractor to assign an RCDD/CNIDP or Project Engineer who, in The Clients opinion, possesses the necessary skills and experience required of this project.

The SCS Contractor would ideally have BICSI Registered Installers, CNCI Certified Network Cable Installers or equivalent on staff and assign them to this project. The project shall be staffed at all times by Installers and Technicians who, in the role of lead crafts-persons, will be able to provide leadership and technical resources for the remaining crafts-persons on the project.

A copy of all their registrations must be submitted in SCS Contractors response to this tender.

The SCS Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

The Preferred Installer for this project shall be:

## 15 SCS Infrastructure - Pricing Schedule

The SCS Contractor shall fully populate the following pricing schedule for each item listed. Any items listed with no pricing shown will be deemed to be zero rated all fully inclusive in the summary total price shown.

The SCS Contractor will be required to submit and full bill of material and schedule of rates to support the following price schedule upon request from the Main Contractor.

The SCS Contractor must consider and allow for all aspects, scope, requirements and specifications sighted in (SCS Infrastructure) duly before completing the pricing section below.

The SCS Contractors are reminded that any alternative manufacture pricing must be provided as an addendum to their tender response.

Item	Description	Price
1	Horizontal Category 5e Elements	£
2	Backbone Optical Fibre Elements	£
3	Equipment Cabinet Elements	£
4	Multi-pair Voice Cabling	£
5	Project Management	£
7	Documentation & Warranty	£
8	Training	£
<b>Summary Total</b>		£

# 16 Appendices

## Appendix A Rack Layout Spreadsheet

CAB 1		
SR Rack (Rear)		
42U	1U (4 hoop)Cable Manager	42U
41U	1U MTP Fibre Cassette Unit	41U
40U	1U (4 hoop)Cable Manager	40U
39U	48 Port POE Ethernet Switch	39U
38U	48 Port POE Ethernet Switch	38U
37U	1U (4 hoop)Cable Manager	37U
36U	1U 24 Port Patch Panel	36U
35U	1U 24 Port Patch Panel	35U
34U	1U (4 hoop)Cable Manager	34U
33U	1U 24 Port Patch Panel	33U
32U	1U 24 Port Patch Panel	32U
31U	1U (4 hoop)Cable Manager	31U
30U		30U
29U		29U
28U		28U
27U		27U
26U		26U
25U		25U
24U		24U
23U		23U
22U		22U
21U		21U
20U		20U
19U		19U
18U		18U
17U		17U
16U		16U
15U		15U
14U		14U
13U		13U
12U		12U
11U	Power Distribution	
10U	Power Distribution	
9U	Power Distribution	
8U	Power Distribution	
7U		7U
6U		6U
5U		5U
4U		4U
3U		3U
2U		2U
1U		1U

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# Data Centre Specification Document including Category 6<sub>A</sub> Copper Cabling and OM4 Fibre

## 1 Document Authority

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_

### 1.1 Document History

Version	Date Issued	Status	Description
1.0		Draft	For Review

### 1.2 Document Definitions

- SCS - Structured Cabling System  
TO - Telecommunications Outlet  
UPS - Uninterruptible Power Supply

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Download this document from the 'Encyclopaedia' section of the 'Partner Area' located at [www.excel-networking.com](http://www.excel-networking.com)

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## 2 Summary of Works

### 2.1 Site address

Project site address:

### 2.2 Site contact:

## 3 Scope of Works

Includes Equipment, materials, labour and services to provide the Communication Infrastructure for the Data Centre this will include but not limited to:

Horizontal Infrastructure (Category 6<sub>A</sub>).

Backbone Infrastructure (Optical Fibre OS2 and OM4).

Inter-Racks Links, both Copper and Fibre.

ER racks, frames, racks.

Aisle Containment System.

Power Distribution Units (PDUs).

Generation of base line patching schedules.

Documentation and submissions.

The Contractor must also as part his works properly ground and bond all installed apparatus, equipment and components to ensure equal potential is maintained through his installation in accordance with ISO/IEC 14763-2, EN50174 & EN50310

The Contractor works shall be completed to suit the requirements of The Clients programme.

The Contractor must also obtain written approval from The Client and the appointed Electrical subcontractor before any ground and bonding connections to be made on site for use by SCS Installation prior to commencement of his connections or works.

Associated works by others include:

Horizontal and vertical containment 'Communications Containment' (i.e. cable & ladder trays)

Telecommunications grounding and bonding points.

Patching of Inter-Rack Links

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### 3.1 Exclusions

This Specification excludes the Power and Environmental/Cooling requirements of the project unless otherwise stated elsewhere in the document.

### 3.2 SCS requirement

Based upon the specification as detailed within this document, the requirements for this installation will include, but not limited to (example)

- Provision of 4 x Copper links to each Server Location
- Redundant route between main patching field and cabinet locations
- OM4 fibre between core and edge switch locations
- Provision for OM4 fibre between edge switch and storage cabinet locations
- 2 Post frames for Main Patching Location
- Equipment Grade Racks for Switch and Storage devices



- Server Grade Racks for all Processing Equipment
- Aisle Containment system comprising of:
  - Motorised Sliding Doors, with Keypad/Swipe Card operation.
  - Thermally Controlled Collapsible Roof
- Local provision of SCS for Access control, Doors, Cameras etc as required by security/facilities

## 4 Component Manufacturers Details

### 4.1 Structured Cabling System Manufacturer

The chosen structured cabling system shall be Excel Networking.

- A complete solution from the one manufacturer and shall be covered by One 25 year warranty.
- The SCS shall have 'ongoing' independent compliance certification at both Channel and Component level from a trusted test establishment such as Delta Labs of Denmark. One off 'Approvals' and 'Attestations of Conformance' will not be acceptable.

### 4.2 Equipment & SR Racks

The Equipment and Server Racks are also provided by the same manufacturer as the SCS system and are covered by the one 25 year warranty.

### 4.3 Aisle Containment System

Aisle containment shall be provided by Excel Networking to fit to the specified Cabinets, this will be manufactured by Nubis Solutions.

### 4.4 Patching Frames and Equipment

All 2 Post Frames and Vertical Management will be provided by the same manufacturer as the SCS system and will be covered by a single 25 year warranty.

### 4.5 Cable Pathways

The cable pathways will be constructed of either basket or ladder tray and run at high level above each cabinet, approval of the system manufacturer will be made by the client prior to installation.

The high level approach is to be taken to remove the chance of restrictions to the air flow to the cabinets.

If the Cable Pathway is to be supplied and installed by others the Contractor must provide the design and specification for all routes.

### 4.6 Interpretation of fault tolerant routing

The data centre design incorporates multiple rack locations and patching fields in a closed environment. The Structured Cabling System provides the physical connectivity from the Core Switch via centralised patching field to each switches located in rack locations.

Core Switch Rack defined as the point of demarcation and interface between the data centre and incoming services from the Service Provider.

MPF (Main Patching Field) defined as the point of interconnection between services

Server Rack defined as a location Data Processing Servers and Storage devices

Edge Switch Rack defined as a location for Core and Edge switching services

It is specified that each server will have 4 copper connections, therefore 2 each will be directed via different routes

All cable routes will provide a fault tolerant routing, between Switching Racks and the MPF and then on to Server and Storage Cabinets, this will be achieved by way of designated Red and Blue routes which will run in opposite directions on the Cable Pathway, these cables will be clearly labelled as Blue and Red route as described later in this specification.

## 5 General Specification & Requirements of the Contractor

The Contractor shall apply the methodologies for installation in accordance with BS EN 50174, BS EN 50600 as well as following the Manufacturers Installation Guidelines these shall be used during all installation activities.

Should conflicts exist in local law, codes and regulations then local law, codes and regulations shall take precedent.

The Contractor for all Horizontal and Backbone cabling must ensure it is fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated Containment.

The Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacture company of the cabling system.

### 5.1 Labelling

The Contractor shall draw up full details of the cable plant labelling scheme for every cable, patch panel, cabinet, termination frames, and outlets and agree the format with The Client prior to installation.

- Typeface Labels shall have an agreed typeface size and font. Hand-written labels will not be accepted, except on a temporary basis during installation and will not be acceptable for cable plant testing purposes.
- Characteristics - All labels shall be permanently fixed. Legible, durable and robust.
- Orientation - All labels shall be fixed horizontally on fixed equipment or longitudinally along the line of cables.
- Positions The following positions at which labels are fixed shall apply as a minimum:-
  - Cable terminations shall be labelled at patch panel outlets.
  - Cable shall be labelled at telecommunication outlets.
  - Cable bundles shall be labelled at the entry/exit points to each cabinet and frame showing route (red or blue) along with destination locations
  - Cables shall be labelled at the entry/exit points of rooms and buildings.

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### 5.2 Cable Plant Test Failures

The Contractor upon detection of cable plant failures during testing shall be duly noted each failure. The Contractor shall rectify all faults any damaged cabling shall be replaced with new cables in complete runs.

### 5.3 Cable Plant Witness Tests

The Client reserves the right to attend site to witness cable plant tests and complete random sample testing upon completion of test.

Witness testing and random sample testing will be agreed with the Contractor prior to commencement of site testing and will be 10% of the total number of outlets. Any further testing will be chargeable at an agreed hourly rate prior to the testing.

## 6 Documentation

### 6.1 General

The Operations and maintenance manual for the project will be compiled in accordance with BS 6701 and shall include but not limited to the following documents. These shall be handed over to The Client on completion of the installation by the Contractor:



- Component conformance certification, indicating manufacture and component reference, for all items installed and supplied.
- Manufacturers' literature for products installed complete with SCS contractor logo and contact details embedded.
- Uniquely numbered test certificates for copper and fibre optic (link and channel where appropriate) for the entire Physical Infrastructure.
- Electronic records of all test results.
- Manufacturer's warranty (25-Year).
- Warranty against defective parts or workmanship for a minimum of 1 year after Practical Completion.

### 6.2 Drawings

The Contractor shall allow for as-built installation drawings in AutoCAD or other format agreed with The Client shall be handed over in paper and electronic formats upon completion. This will include but not limited to detailing the following information:

- Copper cable routes. These drawings shall detail the quantity, direction of high level cable pathway above cabinets
- Fibre cable routes. These drawings shall detail the quantity, type and routes of fibre cable
- Layout of termination frames, panels and closets, clearly identifying the number of frames or panels used for each service and route (red or blue)
- Layout of the entire project. These drawings shall identify the particular frames, panels and cabinets in each room.

### 6.3 Acceptance

For acceptance of the Data Centre Infrastructure the Contractor shall complete the following:

- All labelling.
- All installation of the Copper and Fibre Infrastructure (to the correct standards).
- All installation of Racks & Frames (to the correct standards).
- All cabling test results showing positive results (to the correct standards).
- All documentation.

### 6.4 Training

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The Contractor is to provide Training to the clients IT Staff in the correct method of patching and system administration. The Contractor shall allow for 2 full days on site Training.

## 7 Specification & Requirements – Copper Category 6<sub>A</sub>

### 7.1 The Copper Structured Cabling System

The structured cabling system must be installed according to the manufacturer's instructions.

The structured cabling system shall provide in strict accordance to tender drawings.

The drawings showing telecommunications outlets shall be used to identify and maintain cable length restrictions in the use of Category 6<sub>A</sub> cabling.

Telecommunication Outlet requirements shall be taken from the following tender drawings:

(Supplied Separately)

The performance of the SCS Contractors Horizontal structured system being provided shall meet ISO 11801: Ed2.2, ISO 60603-7-5, ISO 61156-5, EN 50173-1:2011, EN50310 standards operating at frequencies up to 500Mhz, supporting Voice, Data & Video applications at data rates of up to 10Gbit/s to full 100m channel requirements.

The Horizontal Category 6<sub>A</sub> compliant system must also be backwards compatible with ISO 11801:2002, ISO 61156-5, EN 50173-1:A2; 2011,

## 7.2 Cable

The cabling must be four-pair 100Ohm Category 6<sub>A</sub> type. **The cable must have current independent third party approval status at component level and include specification references.**

Horizontal cables shall be constructed with a Low Smoke Zero Halogen jacket meeting IEC 60332-1 flammability standard as a minimum. Be of an F/FTP 'S-Foil' construction and be Ice Blue in Colour.

## 7.3 Horizontal Category 6<sub>A</sub> F/FTP Patch Leads

The SCS Contractor shall allow for the supply only of the following Category 6<sub>A</sub> compliant Patch leads.

Each patch lead shall be complete with strain relief boot. **The patch leads must have current independent third party approval status at component level and include specification references.**

These items are available from stock within 1,2,3,5 and 10 metre lengths. Bespoke lengths and colours should be available, but it is understood they will be subject to a longer lead time for delivery.

The Contractor will allow for patch leads to be available for the Patching Fields, these are supplied in standard lengths.

## 7.4 Patch Panels:

- Must be 19" rack mountable, in exact multiples of 1U in height.
- Will be Unloaded patch panels fitted with screened toolless keystone jack
- Angled side-by-side Presentation of Chrome Finish
- Front connectors to be angled RJ45 style
- Front presentation of Jack outlet to be angled at 45 degrees
- Rear cable presentation to be 180 degrees
- Lifetime Product Warranty

Consistent Parts

Excel Angled Keystone Jack – [100-185](#)

24pt Unloaded Keystone Frame – Chrome – [100-024](#)

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## 7.5 Cabinet & Rack Requirements

### a. Server Rack

The Server Cabinet shall be from the Excel [Environ® SR](#) (Server Rack) range of racks and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 1300Kg.
- Jacking Feet and Castors
- Baying Kit



[Environ® SR Series](#)

b. Equipment Rack

SER Enclosures shall be Excel [Environ® ER series](#) and conform, as a minimum, to the following specification:

- Comply with ANSI/EIA-310-E, IEC60297-2, DIN41494 Part 1&7
- Fabricated from steel or aluminium.
- Colour scheme: Grey/White RAL 9002
- Overall height less than 2300mm.
- Footprint of 800x1000mm
- Capacity 42U.
- 4No. 19" Vertical mounting angles, each fully adjustable.
- Internal equipment mounting depth minimum of 895mm front to rear.
- Lockable Quick release front and rear doors and metal side panels.
- 'Wave Style' ventilated metal front door with 2 point swing handle CAM lock
- Ventilated metal split rear doors with 3 point swing handle CAM lock
- Minimum Load Capacity 600Kg.
- Jacking Feet and Castors
- Baying Kit

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[Environ® ER Series](#)

### c. Open Rack

The Two Post Patching frames shall be Excel [Environ® OR series](#) and conform as a minimum with the following:

- DIN414 compliant
- 2 post aluminium construction
- 42,48 or 52U height
- 19" profiles marked with U height positions
- 1500Kg static load bearing
- High Density Cable Management
- Lockable double hinged doors on vertical management
- Cable spools as required
- Black RAL 9005



[Environ® OR Series](#)

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## 7.6 Aisle Containment System

The Aisle Containment system will be from Nubis Solutions and designed as a complete package to support the Racks specified.

- Dual sliding doors with full height visibility panel.
- Fully enclosed track system with single pull feature.
- Soft close and opening action.
- Integrated base of door track system with protector.
- Vertical and horizontal brush seals.
- Motorised Doors to be integrated with site Access Control solution
- Finished in matching cabinet colour
- Roof panels in 800mm wide sections to replicate rack footprint
- Designed to be used with overhead fire suppression.
- Designed to drop into aisle when temperature exceeds 56 degrees.
- 10mm twin wall construction used for increased strength.
- Fire rated to data centre regulations.
- Central roof cabling channel for environmental / lighting sensors or CCTV camera mounting.



### 7.7 Intelligent Power Distribution Units

It is the requirement of The Client that Excel Intelligent PDU's be installed within each ER and SR Rack.

Select the appropriate Excel Intelligent PDU from the following list according to the size and load bearing requirements, and pay particular attention to the required equipment termination plugs.

Managed Intelligent PDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed Intelligent PDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed Intelligent PDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed Intelligent PDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed Intelligent PDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed Intelligent PDU 24 way BS1363 with 32A IEC6039 plug - vertical

*Further detail is given for typical layouts of wiring and equipment closets at a later date.*

## 8 Horizontal Infrastructure Additional Restrictions & Requirement

The restrictions & requirements listed below are in addition to those stated in standards set with the scope of works.

In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be earthed according to the manufacturer's instructions and EN50174-2, EN50310 standards.

A labelling and administration system must be designed into the cabling system in line with BS6701, EN 50174. The system shall be approved by the Client before completion.

### 8.1 Copper Infrastructure Testing

The SCS Contractor shall test 100% of the Category 6<sub>A</sub> horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in ISO 11801 Class E<sub>A</sub> & EN50173 Class E<sub>A</sub>. Sample testing for ANEXT will not be required. The Contractor must use a level IIIe Cable Tester or above it should have a current calibration certificate issued by the manufacturer of the tester.

NB. Testing to EIA/TIA 568C-0 will not be accepted.

Computed test results that indicate that some part of the result is closer to the limit than the tolerance of the test equipment may be noted as 'PASS\*' or 'FAIL\*'. A 'PASS\*' test result shall not be accepted and shall be treated in the same way as a 'FAIL'.

### 8.2 Category 6<sub>A</sub> – Tray/Containment

Copper cabling must be fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment'

All cabling must be fully supported throughout all transitions and 'waterfalls' used as cables transition from high level into the vertical for the cabinets.

Cable bundles must be fully supported within the cabinet and while 'socking' may be used this does not remove the need for the cables to be secure to cable tray within the cabinet by the use of 'hook and loop' tapes

The Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacturer of the structured cabling system.

# 11 Specification & Requirements - Fibre Optic Infrastructure

Performance objectives of backbone fibre optic infrastructure shall be to support error free signal transmission between locations. The performance of the installed fibre optic cable plant shall support bandwidth-intensive applications including 1Gbit/s through 10Gbit/s and beyond as defined in IEEE 802.3z, 802.3ae, 802.3aq and 802.3ak Standards.

Designated media shall consist of multi core Multi-Mode cabling compliant with ISO 11801 (OM4) standards.

ALL CONNECTOR END FACES SHALL BE INSPECTED FOR DAMAGE AND DEBRIS USING A VIDEO MICROSCOPE AND IF NECESSARY CLEANED BEFORE INSERTION INTO COUPLERS IN ACCORDANCE BS/ISO 14763-3

## 11.2 OM4, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.0	2.5
1300	1.0	0.5

## 11.3 Fibre optic patch panels:

- Suitable for mounting in 19" frames within termination closets. Fixed using securing bolts and captive nuts at either side.
- With sufficient finger space around connectors to allow patch cables to be connected and disconnected and to allow individual connectors to be mounted and dismounted without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding, tilting or other mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Includes 24 splice bridge, 2 x cable entry glands, Cable tie bridges in base of draw.

Excel 24 core fibre panel, LC multimode, sliding panel pre loaded –pt no. [200-464](#)

Excel 48 core fibre panel, LC multimode, sliding panel pre loaded – pt no. [200-466](#)

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## 11.4 Connectors & Fibre Patch Leads

Optical fibre cables shall be terminated LC-Duplex connectors that conform to EN 186000 Part 1, by means of fusion splicing using factory terminated pigtails.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

LC-LC duplex OM4 fibre lead, aqua, 1 mtr , [204-300](#)

LC-LC duplex OM4 fibre lead, aqua, 2 mtr, [204-301](#)

## 11.5 Splices

Splices shall be retained within a protective sleeve by either friction or adhesive bonds to the optical fibre and additional strain relief for the completed joint shall be provided. All splice, joints and their strain relief shall be fixed within the optical fibre management system of the enclosure. The insertion loss through any splice shall not be greater than 0.15dB.

## 11.6 Pigtails

Fibre optic pigtails shall be made from the same fibre type as the fixed cabling. Pigtails shall be kept slack when the cable is terminated.

OM4 LC pigtails, 2mtr, [204-320](#)

## 11.7 Option – MTP Fibre Infrastructure

The Contractor shall provide an optional proposal for the Fibre Infrastructure to be of an MTP configuration, this will conform to the following additional requirements

- Be from the same manufacturer
- Use only the MTP Elite connector from US Conec
- Use the Method B polarity Configuration

# 12 Fibre Optic Infrastructure Requirements:

Fibre cabling must be fully supported, contained and managed along its entire length. Cabling must be routed and secured, fixed or positioned upon designated 'Communication Containment' typically provided by others.

The SCS Contractor shall ensure the containment system is suitable and adequate under the standards of this specification and against those set by the manufacture company of the cabling system.

## 12.1 Optical Fibre Testing

Single and Multi mode backbone links shall be tested at both wavelength and in both directions in accordance with BS/ISO/IEC 14763-3. Testing of the fibre optic cabling using the One Jumper Reference Method using Light Source and Power Meter with reference grade test cords and couplers.

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

## 12.2 OTDR Testing (Tier 2 Optional)

Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

- Each fibre link and channel shall be tested in both directions wavelengths
- A launch cable shall be installed between the OTDR and the first link connection.
- A tail cable shall be installed after the last link connection.

## 12.3 Length Measurement

- The length of each fibre shall be recorded.

## 12.4 Polarity Testing

Paired duplex fibres in multi-fibre cables shall be tested to verify polarity.

The polarity of the paired duplex fibres shall be verified using a Power Source and Light Meter in accordance with EN 50173-1.

The following information would be recorded from all tests:

- Name of personnel conducting the test.
- Project Name
- Date test is being performed.
- Optical source wavelength, spectral width, and CPR (for multimode tests only).
- Type of test equipment used (manufacturer, model, and serial number).
- Fibre identification.
- End point locations.
- Test direction.

- Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- Measured attenuation of the link segment.
- Acceptable link attenuation.
- Reference cord identification
- Calibration certification of any test equipment used.

## 12.5 Mandatory Requirement of All Enclosure Styles

Each rack or cabinet shall have a proprietary earth bar kit (vertical and/or horizontal as required) connected directly to the main earth. The size of the cable shall be determined by the electrical sub-contractor, but shall not be less than 10mm<sup>2</sup>.

All parts of the rack including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the eXK earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm<sup>2</sup>.

A full height vertical earth bar shall be used for all floor mounted racks and shall be sized to accommodate all earth connections as a single individual connection. There shall be no "double lugged" connections or "curls" of earth bonds.

Connections to the Earth Bar shall be by appropriately sized crimp lugs secured by brass nuts, bolts and shake proof washers.

A safety warning label "SAFETY ELECTRICAL EARTH DO NOT REMOVE" (or similar wording) shall be fitted to the main earth connection points (i.e. in the rack, connection at the room building earth point, MTGB, TGB(s) etc.).

All metal containment and tray work shall be earth bonded for safety and EMC. Sections of containment shall be securely earth bonded together by manufacturers' interleaves joints.

A labelling and administration system must be designed for each enclosure in line with EN 50174 or ISO 14763-2. The system shall be approved by the Client before installation.

## 12.6 Additional Requirements

Additional to the main contract for the Data Centre Infrastructure there are a number of requirements that The Client would like a cost proposal for within Contractors Tender response. The fundamental reason for this is to try and provide additional future proofing, savings and efficiencies by combining these under the one contract. It will be to the advantage of the Contractor if he can supply and install more than one product group.

The Client however retains the legal right, not to purchase all of these additional items from the Contractor under the one contract

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# 13 Drawings Schedule of Applicable Drawings

# 14 Installer Requirements

The Contractor will preferably have an RCDD® (Registered Communications Distribution Designer) or CDCDP (Certified Data Centre Design Professional) on staff that will be ultimately responsible for this section of the project.

The RCDD or CDCDP must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts.

A CV of the responsible RCDD/CDCDP must be attached to The Vendor's response for evaluation by The Customer. Should the RCDD/CDCDP assigned to this project change during the installation, the new RCDD/Project Engineer assigned must also submit a CV for review by The Client.

If, in the opinion of The Client, the RCDD/CDCDP does not possess adequate qualifications to support the project, they reserve the right to require the Contractor to assign an RCDD/CDCDP who, in The Clients opinion, possesses the necessary skills and experience required of this project.



## Excel Pre-Sales Support

The Contractor would ideally have BICSI Registered Installers and Technicians or equivalent on staff and assign them to this project. The project shall be staffed at all times by Installers and Technicians who, in the role of lead crafts-persons, will be able to provide leadership and technical resources for the remaining crafts-persons on the project.

A copy of all their registrations must be submitted in Contractors response to this tender.

The Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

## 15 DC Infrastructure - Pricing Schedule

The Contractor shall fully populate the following pricing schedule for each item listed. Any items listed with no pricing shown will be deemed to be zero rated all fully inclusive in the summary total price shown.

The Contractor will be required to submit and full bill of material and schedule of rates to support the following price schedule upon request form The Client.

The Contractor must consider and allow for all aspects, scope, requirements and specifications sighted in (SCS Infrastructure) duly before completing the pricing section below.

The Contractors are reminded that any alternative manufacture pricing must be provided as an addendum to their tender response.

Item	Description	Price
1	Copper Category 6 <sub>A</sub> Elements	£
2	Optical Fibre Elements	£
3	Equipment Cabinet Elements	£
4	Patching Frame Elements	£
5	Tray and Containment Elements	£
6	Aisle Containment Elements	£
7	Testing	£
8	Documentation & Warranty	£
9	Training	£
	<b>Summary Total</b>	£
10	Optional MTP Fibre Elements	£

# 16 Appendices

## Appendix A Rack Layout Spreadsheet

CAB 1		
SR Rack (Rear)		
42U	1U (4 hoop)Cable Manager	42U
41U	1U MTP Fibre Cassette Unit	41U
40U	1U (4 hoop)Cable Manager	40U
39U	48 Port POE Ethernet Switch	39U
38U	48 Port POE Ethernet Switch	38U
37U	1U (4 hoop)Cable Manager	37U
36U	1U 24 Port Patch Panel	36U
35U	1U 24 Port Patch Panel	35U
34U	1U (4 hoop)Cable Manager	34U
33U	1U 24 Port Patch Panel	33U
32U	1U 24 Port Patch Panel	32U
31U	1U (4 hoop)Cable Manager	31U
30U		30U
29U		29U
28U		28U
27U		27U
26U		26U
25U		25U
24U		24U
23U		23U
22U		22U
21U		21U
20U		20U
19U		19U
18U		18U
17U		17U
16U		16U
15U		15U
14U		14U
13U		13U
12U		12U
11U	Power Distribution	
10U	Power Distribution	
9U	Power Distribution	
8U	Power Distribution	
7U		7U
6U		6U
5U		5U
4U		4U
3U		3U
2U		2U
1U		1U

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# Powerful SPACE



## Less is More

Excel Category 6A cables offer reduced diameters compared to most of our competitors, these compact designs mean less containment, less weight, and faster, easier installation. All without effecting performance, each cable is 3rd party verified at component level, and supported by a 25 year warranty programme.

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space, time  
and money?**

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without compromise.

# Excel White Papers and Technical Notes

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# White Paper

## The impact of remote powering (PoE) on Balanced Twisted Pair Cables – Executive Summary



Powered Ethernet is a technology that continues to push accepted limits: the more power that can be delivered through copper Ethernet cables, the more industry seems to want to have available.

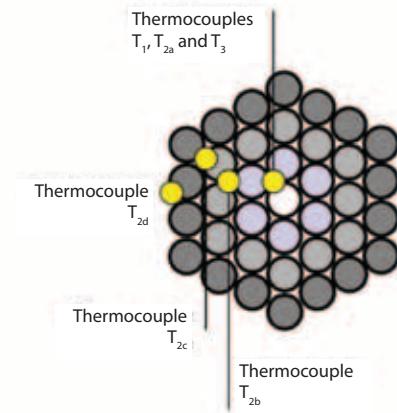
Powered Ethernet is a technology that continues to push accepted limits: the more power that can be delivered through copper Ethernet cables, the more industry seems to want to have available. The benefits are obvious: reduced cabling to equipment in terms of power and datacomms provides financial, weight and real estate savings.

However this has stimulated serious discussion surrounding the impact of PoE (Power over Ethernet) on structured cabling and the heating effect that is caused by pushing a current down a cable that was not designed originally for the purpose as more and more powered devices are being deployed.

With the higher levels of power being discussed such as PoE+ at 34.2 watts, Cisco's proprietary UPoE at 60 watts and in power excess of 100watts being discussed by the IEEE as the potential for 802.3bt, this is aside from some of the higher claims coming from proprietary systems such as HD Base-T which in reality is a hybrid application only truly intended for the AV market.

In response to this Cenelec has decided to produce a Technical Report to look at ways of mitigating the heating effect of PoE however to do so it first needed to come up with a robust testing methodology. This was published in 2013 as the first element of TR EN50174-99-1 calling for the optimum bundle size that allows for at least 6 temperature probes or thermocouples to be employed, as well as testing the cable bundle both in 'free air' and insulated, thereby allowing a more realistic investigation of the impact of having cables installed within a range of sealed containment and unventilated spaces etc.

Today there are very few test rigs that have been constructed to carry out this level of testing and even less are said to be independent, one of which is at De Montfort University, Dept of Engineering, Leicester, UK. Excel Networking commissioned a series of tests under the guidance of Dr Alistair Duffy of the University. This paper will look at the results of that testing, the findings have also shared with Cenelec to help complete the work on developing TR EN50174-99-1.



### TR EN50174-99-1 Testing Methodology

The first stage of testing was to construct a rig that allows for a bundle of 37 cables to be suspended with thermocouples installed within each layer. 37 is seen to be the ideal number as it results in a 4 layer round bundle, allowing thermocouples to be distributed throughout the layers, they are also positioned along the length of the cable sample to measure the difference in temperature closer to the actual source of the power.

### Results

All standards compliant PoE applications are intended to operate over standards compliant copper twisted pair cables from Category5e U/UTP grade upwards, with a channel distance of up to 100m regardless of power.

Therefore the following sample cables were chosen to be tested Category 5e U/UTP, Category 6 U/UTP, Category 6 F/UTP, Category 6<sub>A</sub> F/FTP, and Category 7<sub>A</sub> S/FTP.

In addition we took the opportunity to assess the impact of using cables with construction that differs from the industry norm, for example such as a Category 6 'Compact' cable that is 24 AWG rather than the more common 23 AWG. We also included Copper Clad Aluminium (CCA) Category 6 cable, a lot has been written about the potential problems with these latter cables, we wanted to get some real firm evidence.

Before going into the detail of the results it is important to understand, the background of the test methodology. The process is to create extremes of heat build up, to produce a worst case scenario from which a set of recommendations and mitigation strategies can be defined to ensure these scenarios are not reached, never mind exceeded in the 'real life' installations. Therefore the results show some extremes of temperature increase over the ambient of the test room environment.

The following summary tables show the complete set of results for the cables tested whilst in both 'Free Air' and 'insulation', however it only indicates the maximum temperatures reached not the time it takes to get to that point. The Category 5e, HD Category 6 and the Category 6 CCA, all failed very quickly after 100watts was introduced, whilst in 'insulation' the 23AWG Category 6 U/UTP lasted much longer before it also failed. In 'Free Air' the larger conductor cable reached very similar temperatures as the Category 5e and reduced diameter Category 6, however one major change was the time it took to reach the 'Steady State'. It took 4 times longer at 34.2Watts and twice as long for 60Watts and 1446 minutes at 100Watts, which is over 10 times longer.

The common peak temperature appears to be approx 114°C above ambient, before the dielectric starts to break down and eventually the conductors short with each other.

The other 3 cables never reached this crucial temperature to cause failure. The Category 7<sub>A</sub>, having both the largest conductors and outside diameter combined, with a different screening construction.

During testing we highlighted that some cables have physically FAILED during the tests. The common temperature being approx 115°C above the ambient temperature, which is not overly surprising when you consider that the insulating polyethylene compound is extruded on to the conductors during manufacture at a temperature of approx 160-180°C therefore the copper conductors can migrate to the surface and eventually short out.

Furthermore these results show a distinct and very clear argument for installing a Standards Compliant Category 6 cable rather than Category 5e or reduced diameter Category 6 cables. These lower cost cable designs have appeared on the market in recent years to address market demands for cheaper products, and are marketed around cost and space saving benefits, whilst still claiming to offer 100 metre Category 6 channel performance. These reduced diameter, or HD cables have physical characteristics closer to that of a Category 5e.

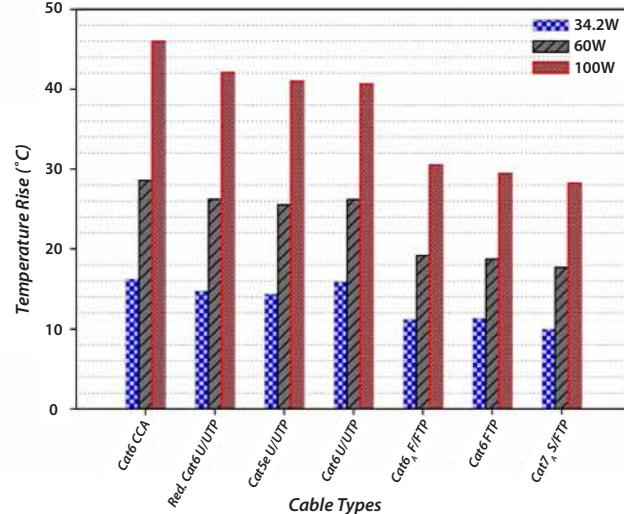
### Unscreened

$$L_{T>20^\circ\text{C}} = L / (1 + (T-20) \times 0,004)$$

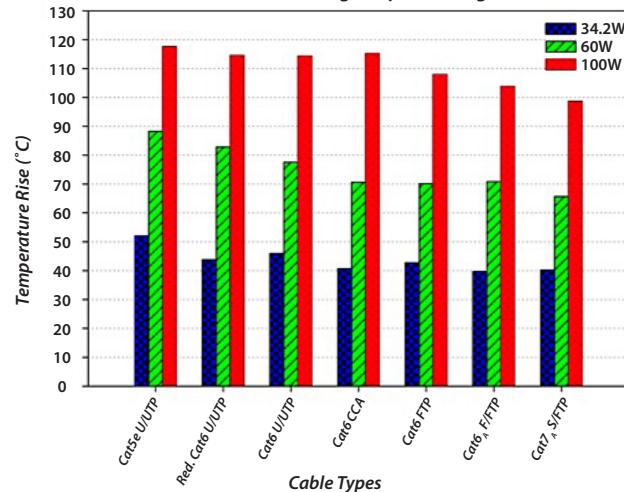
$$L_{T>40^\circ\text{C}} = L / (1 + (T-20) \times 0,004 + (T-40) \times 0,006)$$

All the performance criteria for the 100m Channel as outlined in EN 50173-2 is based upon it operating at an ambient temperature of 20°C and for every degree over this level this distance should be reduced. The following formula provided in the above standard gives the rate of reduction for unscreened

**Comparison of Temperature Profiles**  
*Free Air Heating (All pairs energized)*



**Comparison of Temperature Profiles**  
*Insulation + Heating (All pairs energized)*



cables. In short for temperature increases up to 20°C above the ambient, the Channel should be reduced by 4% and for temperatures over 20°C above the ambient there is an additional 6% that has to be added.

This could potentially have a dramatic effect to the performance of installed cabling as recent research shows that the level of heating can be significant in some cases 30-40°C above the ambient.

Screened Cabling performs much better, as the research has proved it does not heat up as much as an unscreened cable and when it does the de-rating formula is much simpler as it is based upon 2%.

### Screened

$$L_{T>20^\circ\text{C}} = L / (1 + (T-20) * 0,002)$$



## When Planning to implement PoE

Taking these calculations at some of the higher operating heat levels we have put forward an unscreened solution may only ever possibly work at 75-80% of the intended distance.

Some equipment manufacturers are now openly recommending the highest category of cabling possible to support the power levels their equipment now uses, therefore anyone planning to use Category 5e U/UTP just because it meets their current bandwidth requirements now has another consideration to factor in.

Furthermore as has been demonstrated anyone thinking of using a 26AWG solid core cable should seriously think again as the one common factor that has an impact on all of these results is the size of the conductor and the overall size of the cable has a direct relationship with how far and how fast the cables heat up. Therefore it is not about today, it is about tomorrow which brings us on to the very serious impact of these findings; the subject of 25 year Manufacturer Warranties.

All current warranties are written around current standards, irrespective of the manufacturer, they specifically relate to the operating temperature dictated in the cabling standards of -10°C to +60°C. When we go outside these boundaries who is going to become responsible? The manufacturers of the system, the end users, the designers or the manufacturers of the equipment vendors who are trying to push more and more down the cable and when they are given an inch want to take a mile?

## Recommendations

When planning for the future it is now obvious that PoE at some level is going to be deployed during the life of the cabling system, therefore this research shows installing the highest Category of Screened cabling system to be the most sensible decision.

The full version of the White Paper with more detailed results can be found on the Excel Networking Website  
[www.excel-networking.com](http://www.excel-networking.com)

# White Paper

## To Screen or not to Screen? – A subject re-visited.

**excel**  
without compromise.

### Should Class E<sub>A</sub> /Category 6<sub>A</sub> cabling installations be Screened?

#### Overview

The debate rages on in many sectors of the market concerning whether ISO/IEC 11801 Class E<sub>A</sub> or Category 6<sub>A</sub> should or in fact NEED to be Screened to effectively support 10Gig Ethernet transmission.

Each method has its pros and cons; there is a misguided belief that unscreened is cheaper and easier to install and terminate and that screened has its own issues in relation to grounding and bonding.

In this white paper we try to balance a number of these choices and dispel some of the myths and try to give the reader a balanced view on what is the best route to follow. In the last few years there have been a number of studies carried out by manufacturers in their own right and independent studies that have been part or wholly funded by manufacturers, we will look at some of those findings.

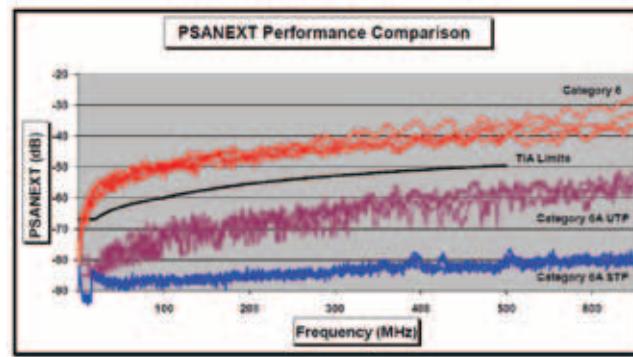
The IEEE 802.3an-2006 standard for 10GBASE-T operation was ratified in June 2006. It defined an application standard for 10 Gb/s data transmission over copper twisted pair cabling of up to 100 metres, it includes the use of both unscreened twisted pair (UTP) and screened twisted pair (STP) copper cabling systems.

#### Detail

In 10GBASE-T applications, the noise source that most limits the ability to transmit 10Gb Ethernet over copper cabling is alien crosstalk. Because the 10GBASE-T receiver cannot compensate for the noise from adjacent channels, this effect must be cancelled out wherever possible by the cabling system to ensure reliable data transmission. This noise is measured as Power Sum Alien Near-End Crosstalk (PSANEXT) and as Power Sum Alien Attenuation to Crosstalk Ratio at the Far-End (PSAACRF). Both ISO/IEC 11801 Ed 2.2 Class E<sub>A</sub> and TIA-EIA-568-C.2 Category 6<sub>A</sub> require that crosstalk be measured in a 6-around-1 cabling configuration that takes into account the worst-case effect on a centre cable with six cables tightly bundled around it.

A Category 6 U/UTP system will not meet the alien crosstalk limits required for 100 metres of 10GBASE-T transmission (see Figure 1).

Figure 1. 100-Metre Channel PSANEXT Performance Characteristics



The above shows the TIA limits, it must be noted that ISO/IEC limits are somewhat tighter, meaning the Category 6 and is even further from success and whilst Category 6<sub>A</sub> U/UTP still passes it is a lot closer to the limits than a screened system.

Coming back to the question of whether to screen are not there are some basic considerations to weigh up when making the choice. Some of the benefits for a screened solution are clear from the above chart, however there are a number of screening types available, each has a different level of effectiveness and we will look at that in more detail later however the basics remain the same.

In properly installed and bonded screened cabling, the foil screen within the cable prevents signals from coupling which reduces alien crosstalk well below the required limits. All the tests we mentioned in the opening of this paper indicate that screened cabling systems provide significant margin over the IEEE 802.3an-2006 specification for 10GBase-T PSANEXT and PSAACRF, thereby removing the need for time-consuming and complicated field-testing of alien crosstalk completely. Therefore ISO 11801 clearly states that Alien Crosstalk testing is NOT required for screened systems.

The standards also state that an unscreened solution may be 'compliant by design' this may be the products or the design of the installation or in fact a combination of both, however it is clear that much more care must be taken when considering an unscreened solution. This includes both selection of the



product, through to the design of the installation itself, taking into account specific routes the cables take and proximity to potential sources of external noise.

The client or their representative is fully within their rights to request proof that the unscreened system complies either by way of independent certification or if that is not available, by carrying out testing of the actual installation itself.

## Independent Testing

In a recent independent test a leading testing establishment selected 5, Class E<sub>A</sub> Cabling Systems from five different market-leading suppliers they included 2 x U/UTP systems 1 x F/UTP solution and 2 x S/FTP systems. The test set up involved the use of real 10GBase-T equipment and live 10Gb/s traffic.

## Initial Findings

The first and most important fact was the basic Class E<sub>A</sub> performance in all cases the screened solutions provided greater headroom than the unscreened systems

The second factor was the U/UTP systems tested demonstrated significantly weaker ANEXT performance and coupling attenuation in comparison to the screened systems.

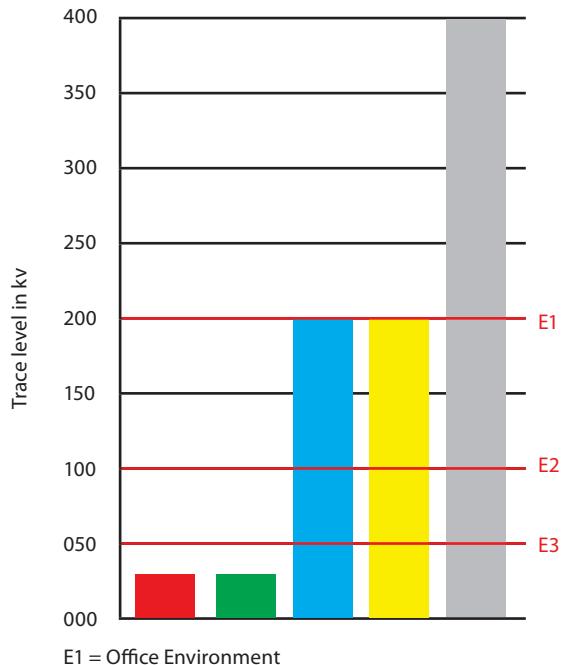
	System 01	System 02	System 03	System 04	System 05
Channel type	U/UTP	U/UTP	F/UTP	S/FTP	S/FTP
Insertion loss (margin) [db]	8.8	8.6	8.6	10.5	15.5
PS NEXT (margin) [db]	5.5	8.2	7.8	5.8	6.2
TCL (margin) [db]	9.2	8.9	9.6	5.45	10.4
RL (margin) [db]	8.8	9.5	3.4	6.9	8.2
PS ANEXT (margin) [db]	-7.6	0.93	27.44	31.37	37.92
Coupling Attenuation [db]	45.0	47.5	78.0	76.0	79.0

Other tests included immunity against fast transient electrical disturbances, such as Powering of Fluorescent Lamps and immunity against radiated electromagnetic fields, such as those produced by GSM based mobile phones. Once again the U/UTP systems performed badly in comparison to the Screened Systems.

Figure 3 – Practical Radiated HF

Test (3m distance)	System 01	System 02	System 03	System 04	System 05
Walkie-talkies	X	X	✓	✓	✓
Mobile communication devices (mobile phone, GSM card)	X	X	✓	✓	✓

Figure 4 – Fast Transients



E1 = Office Environment

Without knowing the full details of the systems selected and cable constructions used, it would be wrong to jump to the conclusion that all U/UTP systems will fail to meet the performance requirements, so we should look to consider some of the other factors that are being discussed.

## Field Testing

The reason why Alien Crosstalk testing be should avoided wherever possible is very simple, it comes down to time and money.

Performing a 100% alien crosstalk test in a cabling plant is impractical and virtually impossible in large cabling plants. Using the specified 6-around-1 method, the formula to determine the number of tests that would need to be run for 100% coverage is  $(n^2+n)/2$  where n is the number of links in the installation. For example, in an installation with 100 links, a total of 5,050 tests would need to be run to test every possible combination. In a 500-link installation the total number of tests climbs to 125,250 tests when testing every possible combination. Therefore the ISO/IEC 61935-1 standard provides guidelines for sample testing.

ISO/IEC 61935-1 states sample testing should be conducted based upon evaluating links that meet all of the following conditions:

- Links with the Highest Insertion Loss
- Links with the Lowest Insertion Loss
- Links with the Median Insertion Loss
- Longest installed lengths
- Cables within the same bundle
- Adjacent ports in the patch panel

The key weakness of a U/UTP system comes about when you have a large quantity of adjacent ports loaded into patch panels, a fact that is highlighted within the measurement of ANEXT within ISO/IEC 11801 ed.2 as by definition it does not meet the criteria of the infrastructure design element.

"Worst case conditions occur where ANEXT coupling occurs over the full length of disturbing and disturbed cabling and where all connections within each link are co-located".

"Simple models assume equal lengths of disturbed and disturbing links and co-location of connecting hardware (patch panels)".

### Power over Ethernet

Whilst not in the original scope of this White Paper (the full details are discussed in our 'Demystifying PoE' white paper) this technology has more of an impact on this matter than a lot of people realise.

It is widely accepted that the use of remote powering or PoE has the side effect of heating up bundles of cables. As the demand for higher levels of power increases the level of heating is also following on.

What some have forgotten is an increase in Temperature is one of the major contributors for the increase in Attenuation, what a lot don't realise is the extent of this and the fact that it differs for Unscreened and Screened.

All the performance criteria for the 100m Channel as outlined in EN 50173-2 is based upon it operating at an ambient temperature of 20°C and for every degree over this level this distance should be reduced. The following formula provided in the above standard gives the rate of reduction for unscreened cables. In short for temperature increases up to 20°C above the ambient the Channel should be reduced by 4% and for temperatures over 20°C above the ambient, there is an additional 6% that has to be added.

### Unscreened

$$L_{t>20^\circ C} = L / (1 + (T-20) \times 0,004)$$

$$L_{t>40^\circ C} = L / (1 + (T-20) \times 0,004 + (T-40) \times 0,006)$$

This could potentially have a dramatic effect to the performance of installed cabling as recent research shows that the level of heating can be significant in some cases 30-40°C above the ambient.

Again Screened Cabling performs much better, firstly research has proved it does not heat up as much as an unscreened cable and when it does the de-rating formula is much simpler as it is based upon 2%.

S11

### Screened

$$L_{t>20^\circ C} = L / (1 + (T-20) * 0,002)$$

*continued overleaf*



On this basis what are the real differences and myths.

Unscreened	Screened
No Screen, Simpler and quicker to terminate. Yes and No; more care is needed in the preparation to ensure twist ratios are maintained etc. Most U/UTP solutions are very tightly twisted pairs and a large plastic separator.	Most manufacturers offer either a termination aid or have toolless products which lead to the overall time taken being quicker than U/UTP. Certainly the cable pulling time will not change
Cable pulling time for an unscreened solution can vary from slightly to a lot worse depending on the actual construction of the cable	Most screened cables have a relaxed twist on each of the pairs meaning that the cable itself is much less stiff and easier to handle and install
Does not require Bonding – This is a Myth, all metal panels within a cabinet whether Screened or Unscreened need to be bonded within the cabinet in accordance with BS/EN50310	A small amount of additional time is required to ensure all the outlets within each panel have a clean contact with the frame.
UTP cables are smaller – Again a myth, some U/UTP cable have an elliptical design and overall OD which is on average anywhere between 7.3 - 9.3mm, depending upon the manufacturer, however they are all bigger requiring more containment, larger bends and larger back boxes.	Average size of an Excel F/FTP solution is 6.9mm U/FTP is 6.7mm. The U/FTP cable is also available in a 305m box, thereby reducing set up time for cable pulling by as much as 75%. For the same physical space, it is possible to get as many as 15% more cables in the same space based upon the smallest U/UTP available from a leading manufacturer.
Field Testing although not common Alien Cross Talk testing can be requested requiring a 6 around 1 test method. A number of field testers make assumptions for this and rely on the manufacturer to back them up. If the full 6 around 1 test is called for the additional time for testing is a minimum 10-15mins per link.  This is separate and on top of the Permanent Link Testing	Field Testing – ANEXT testing is not required, typical test time for a permanent link is approx 14-22 seconds, although there are next generation testers on the market that can test a Permanent Link less than 10 seconds.
Separation distances between Power and data are greatly increased with an unscreened cable e.g. for 10 circuits of 20A there has to be a physical separation between the Power and the Data cables of 80mm	The separation distances between the same number of power circuits is at least halved with foil screening requiring a distance of only 40mm and a S/FTP construction requiring even less.
Increased attenuation caused by temperature. Unscreened cable has a higher and more complex de-rating factor	Increased attenuation caused by temperature. Screened cable has a lower and simpler de-rating factor

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### Conclusions

It is clear that all the evidence shows that Screened is best, while Unscreened can be a viable option for those who choose to take that route, when they understand the implications highlighted in this paper.

One thing that is becoming clear is the number of companies choosing a screened solution is dramatically increasing across the globe, even in markets that have been firmly unscreened historically, as they start to understand the benefits while at the same time the myths of screening have been dispelled by better education.

# White Paper

## Why Test?



"Why Test?" is a question which is often asked, especially when copper infrastructure cabling is the subject. Some see it as an unnecessary burden when the cost of labour and materials is continuing to rise in the industry and the profit and margins are getting smaller. However, most installation contracts will require testing either in its own right (proof of specification), or to satisfy warranty application requirements.

Infrastructure cabling is first manufactured as a series of components and then installed to form the system. The installation of the components has a great affect on the performance of the system so can really be considered as a continuation of the manufacturing process. The components, cables and connecting hardware etc, are manufactured in a factory using various machines and processes. As this is a production line, batch testing lends itself very well to the sample size of testing. The testing will include the materials to manufacture the cable and connecting hardware and performance testing. In the case of the cable, the properties of the plastics and copper to be used – purity, composition and so on will be checked. Once the items are manufactured the testing of the cable will include physical measurement of the geometry of the conductor, pair twist, thicknesses of materials and then a performance test against the cable component standard. Additionally, the performance standards will lead into other requirements such as flammability etc.. Reputable manufacturers will often back this up with testing of the components by third party independent test laboratories of their premier products. Giving the installer and clients further confidence in the system.

Routine tests carried out are material and electrical parameter testing. They are tested against a series of limits defined by standards. These limits and specific parameters are designed so that they ensure the support of various applications and that the cabling and connecting hardware is suitable in the environment intended for the installation. The various categories of performance are designed to support different applications. Usually the standards will state the minimum category (or class) for the specific application. This means that by testing to the category or class it can be shown that all of the specified applications will be supported. Furthermore, when future applications are developed that can utilise existing categories, no further testing is required.

Manufacturers will test the products to ensure the required levels of quality and performance are met. They can then be assured that if during installation the guidelines and practices are followed the system will perform.

**test** n. a procedure intended to establish the quality, performance, or reliability of something.

The installation company tests for a number of reasons including:

- Manufacturer's warranty
- Good practice
- Contractual

More often than not, to register an installation for a manufacturer's warranty, a level of testing will be required. This, along with following the installation guidelines and standards, shows compliance to the performance standards. The installer has demonstrated that at the conclusion of the installation that the installed system met the specified standard. This is pertinent to showing compliance to the contract. In simple terms, if for example, the contract is to install 1,000 Class E Links, then supplying test results for these links (with the correct cable ID and to the correct Class) shows compliance of the contract.

For the manufacturer the testing carried out by the installer defines the links that require a warranty. It is a record of the performance on completion of the job and defines the liability that is undertaken by the warranty.

The installer's test results are important for the client as confirmation that the installed links are of the specified standard. The client can then create the channels needed to support applications during the life of the system. Occasionally the client may have specific applications that are in need of particular levels of performance. The test results supplied by the installer are useful for selecting specific, or combinations, of links that will best support the needs. In some instances clients will carry out testing of configured channels to confirm the specific performance.



The types of tests can be simplified to Component, Link and Channel. Broadly speaking these are for the different parties involved.

- **Components** – tested by manufacturer
- **Link (Permanent Link)** – tested by the installer as this is the part of the infrastructure that is not changed
- **Channel** – tested by the client if desired for specific applications. More commonly used for fault finding during the operation

Following the Permanent Link installation and testing, individual channel testing is not required by the client if the channels are formed using compliant connecting cords within the parameters of the standards for a channel configuration. Where channel testing may be useful is as a fault finding tool if there is an issue with the network during the operation. By testing the configured channel it may be determined whether the issue is with the infrastructure cabling, network design or operation.

Different infrastructure cabling test equipment is available. The permanent link testing and channel testing can be carried out by the same equipment using different adapters. What is important to assure the validity of the tests is to use test equipment that meets the standards for installation testing and models recognised by the manufacturer's warranty application conditions. Well looked after test equipment will deliver the most accurate test results. Looking after the test equipment includes having a valid calibration carried out in accordance with the manufacturer's specification and time scales. Typically this is by a manufacturer approved

facility on an annual basis. Calibration is the procedure of adjusting the test equipment to ensure that it is measuring the parameters to within the tolerances defined by the standard. Calibration, of any equipment, is normally carried out by checking the measurements against a more accurate piece of equipment. Infrastructure cabling test equipment has the added complication of measuring many different parameters across a range of frequencies. Calibration needs to be of all parameters across the frequency range, with adjustments made, where necessary to the hardware or software settings. To make it easy for all parties to determine that the calibration of the test equipment is valid, the calibration date is recorded in the electronic test result file. The calibration facility will also add a sticker to the unit as a reminder to the operator. If the calibration date shown in the test result file is out of date, the tests are invalid.

In summary, testing shows that the infrastructure cabling meets the standard and will therefore support the relevant applications. The test results are best stored electronically in the tester manufacturer's format as they can be correctly interrogated to check that – all links have been tested, to the correct standard, by equipment that is within calibration. Testing proves that the cabling system works to the category/class that is stated.

*This White Paper has been produced by Simon Robinson, Product Manager on behalf of Excel.*

# White Paper

## Copper v Fibre



In terms of the physical infrastructure mediums the main choice is between a copper or fibre based system. So, which is the best to install? Like all good, simple questions, the route to the answer is a little more complicated. Historically, fibre was used in the backbone and copper for the horizontal cabling. However, the boundaries are no longer as clearly defined as that.

Three general areas that can influence the decision of whether to use the copper or fibre are:

- Technical
- Installation and Environment
- Cost

All are as important as each other, and depending on the specific location/project, will influence the argument in either direction.

### Technical Decision

Starting with the technical decision, as mentioned above, the traditional principle was that fibre was used for the backbone and copper for the horizontal (to the outlet). Copper infrastructure cabling uses an electrical signal that is transmitted down the cable. A noticeable factor of electrical signals is the attenuation along the length of the cable. Horizontal copper data cabling is currently specified at a maximum channel length of 100m (this is the case for up to Category 7<sub>A</sub>/Class F<sub>A</sub>, this will change with the future Category 8.1 & 8.2/Class I & II which will be shorter). The distance of 100m for the maximum copper channel length was set as it gives the best compromise of length/performance/design for horizontal cabling. As Ethernet applications have increased in data rate, the signalling has increased in speed and the use of all four pairs has been utilised. As the signal is split into four at the transmitter and then combined at the receiver, it is important that the delay and delay skew are allowed for within the standards. Delay is the time it takes the signal to get down each pair. The delay must not exceed the limits; otherwise the information will not be received in the time needed for the application to work at full speed duplex. As each of the four pairs are of different lengths, the signals are received at the far end at different times. This is referred to as Delay Skew – the time between the quickest and slowest pair. Too great a Delay Skew and the signal will be interrupted by the next packet. Length/attenuation is not just limited to copper, it affects fibre too. However, with fibre the aim is to increase the distance that the application can be transmitted. With

single mode fibre the minimum bandwidth is expressed as a function of frequency and distance – MHz.km. So if distances that are greater than 100m are required then fibre optic is the preference.

Copper cabling systems currently support Ethernet applications up to 10 Gigabit Ethernet. Fibre optics is able to support faster applications. For Ethernet based, these include 40 & 100 Gigabit Ethernet. Fibre optics are able to employ such techniques as Parallel Optics (using more than one core to transmit the signal) or versions of WDM (Wave Division Multiplexing – using different wave lengths of light to share the data). With new methods of WDM being developed, the performance of installed fibre optics is being extended.

When it comes to power, copper has the advantage of being able to support and offer Power Over Ethernet (PoE). Power Over Ethernet delivers power with the data communication along the same cable. Assuming that the device can be driven by the power supplied by the type of PoE, then only one cable is required to the device, greatly improving the ease of installation and operation. With PoE types being developed to supply more power, and devices demanding less, there is greater scope for the application. Many products are currently available such as telephones, CCTV cameras, monitors and many more are being developed. Fibre optics has to have separately powered devices.

### Installation and Environment

Installation and Environment covers both the physical deployment and the location where the system is to be sited. When looking at the physical deployment, there are attributes that are common to both medium and factors that make the installation very different. Broadly speaking, care should be given to the cable whether it is copper or fibre to ensure that the bend radius is not compromised or the pull force applied to the cable is not exceeded. These are detailed on the specification sheets and should always be observed. The termination of copper and fibre uses different equipment and skills. The equipment used for fibre splicing, especially fusion splicer machines, are costly compared to copper cabling.



To get the return on investment sometimes lends itself to installation teams specialising in fibre terminations, this can add to the mystique of fibre termination. Copper and fibre termination techniques are skills that can be obtained by competent personnel with training.

Where fibre does have an advantage is containment size. An Excel Category 6<sub>A</sub> U/FTP Screened Cable is 6.7 mm in diameter and can support one 10 Gigabit Ethernet data channel. Compare this with an Excel 24 Core OM4 Loose Tube Indoor Outdoor Fibre which is 6.5 mm. It can support 12 (each needing one core transmit and one core receive) 10 Gigabit channels up to 550 mm in length. So, for the same number of channels, Fibre will use less containment than Copper.

When connecting two buildings with cable, consideration has to be given to the fact that they may be on different earth systems. Cabled optical fibre is readily available in all dielectric forms. Dielectric means that it will not conduct electricity. It is therefore safe to join two buildings with all dielectric fibre or use it in hostile environments that are sensitive, including the oil and gas industry or in locations where there is a risk of lightning strikes.

Don't always think in a traditional way! If the network is designed to support Gigabit Ethernet to the user, using Category 6, and the backbone is 10 Gigabit Ethernet then Category 6<sub>A</sub> for the backbone may suffice if the distance is within 100m. In an office environment it can be easier to upgrade the backbone rather than the cabling to the work area. There may be room in the backbone to install a new system and "cut across" with very little disruption to the users. Equally, the need for a data outlet in a remote location may result in a fibre optic cable being deployed as distance and earth bonding issues are overcome.

### Cost

The whole cost has to be considered when differentiating between a copper and fibre installation. The total cost of ownership, if possible, is a better measure. So many factors affect the cost of the system, especially when the life of the network is considered (£/year). Different costs include:

- Cable
- Connectors
- Installation
- Consumables – patch cords etc
- Active Equipment
- Possible number of upgrades before need of replacement

### Conclusion

Copper and Fibre are both very good cabling media each having pros and cons. Take the holistic approach and consider as many factors as possible when making your decision.

# White Paper

## Benefits of Pre-Terminated Solutions



Pre-terminated cabling systems have been around since the beginning of computing, well before the inception of Structured Cabling. Early IBM System 36 and 38 computers used to be connected to its peripherals by way of factory terminated twin-ax assemblies, very similar to the ones still used today for 40 & 100Gb connectivity within the Data Centre.

The use of pre-terminated solutions fall into a few key areas, one as previously mentioned is the Data Centre and the other increasingly used option is in commercial office fit-outs, as the project timescales are constantly being reduced by the competitive nature of the market.

Another area that we are starting to witness is the use of pre-fabrication within the construction industry. By that we mean not only the construction, but the partial fit-out of wall sections. This method of construction is increasingly popular for Hospitals and Schools, and involves levels of first and second fix being done in a factory and the completed wall craned into position onsite and effectively 'plugged in'. This includes not only the voice and data cabling but other systems such as electrical and plumbing and in the case of Hospitals, gas services as well to the 'bed heads'.

By way of continuing to innovate, Excel has continued to keep abreast of these developments by producing new ways of deploying both Copper and Fibre Pre-terminated solutions.

### Data Centres

This is the one area that is very competitive, not only the cost but also the delivery schedules required to satisfy the very quick turn-around of the modern Data Centre deployment. It is not uncommon for a DC operator to want to turn an empty data hall into a fully functioning and revenue generating suite in a matter of weeks, time is money, and as soon as the decision is made they want to start earning revenue.

Therefore the time pressure quite simply dictates that pre-termination is essential for the rapid commissioning of new data halls. This involves both copper and fibre connectivity, MPO/MTP fibre is fast becoming the de-facto system for both single and multimode connectivity in this space due to ease of use and speed, not to mention the high density.

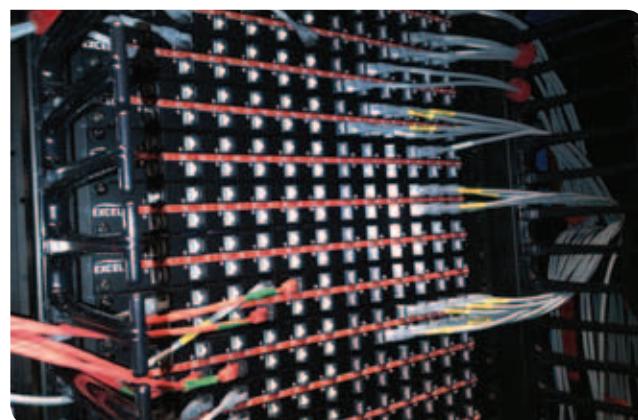
Copper Pre-terminated cassettes have been traditionally restricted to Category 6 and below due to the potential problems of Alien Cross Talk. Category 6<sub>A</sub> is usually installed by way of individual screened jacks, that are then mounted into patch frames. These assemblies typically involve harness links from switches to a central patching field and then further assemblies that emanate from there to provide connectivity to

the cabinets, both server and storage. On top of this there is sometimes the need for direct inter-cabinet links.

One of the traditional drawbacks of copper is the density that can be achieved, especially within the main patching field. The use of traditional outlets and patch management bars every 2U can be very restrictive and waste a lot of space. To get around this manufacturers have come up with a wide range of angled options, from angled V style panels, standard outlets mounted at an angle within a flat panel, an angled modular panel that houses a standard presentation outlet in groups of 6 etc.

All of these options have one drawback or another, some need the front profiles to be moved back to accommodate the angle of the V style panel, with the traditional outlet mounted at an angle, the problem appears at the rear with the cables having to crossover.

Excel has come up with a unique approach by having the front presentation of the jack itself at 45 degrees, this means the patch cables lie flat at the front of the panel with standard presentation at the rear, meaning the profiles do not need to be adjusted and the dressing of the cables within the cabinet can be optimised.



The image above shows a main patching field deployed within a DC, that is fully patched in a 45U 2post frame containing 960 outlets, almost 50% more than a traditional approach, all of which were pre-terminated and labelled off-site and then just plugged in and tested.



Whilst traditional termination of fibre is still used, increasingly using a fusion splicer within a DC is mainly restricted to rectifying faults. Almost all fibre assemblies are pre-terminated whether that is conventional construction fibre that is terminated at both ends with SC or LC connectors, or more commonly used, MPO/MTP 12 fibre assemblies that are used as inter-cabinet links (Trunk Cables) which are then connected to cassettes housing the fan-out cables to LC presentation.

Each approach has seen a 'step-phase' in the time to deploy. Using conventional and fusion splicing pigtails within patch panels, can take days if not weeks, pre-terminated conventional fibre, can take days, whereas the time taken to deploy MPO/MTP can be measured in just a day or so, if not hours.

### Commercial Office Pre-terminated Assemblies

The completion of the handover of a project is critical, mainly due to the fact that the lease deadline of the end user client's existing facilities, have to be met to avoid the costly penalty of having to extend their previous lease by a further 3-6 months. This is then compounded by protracted negotiations to get the best price.

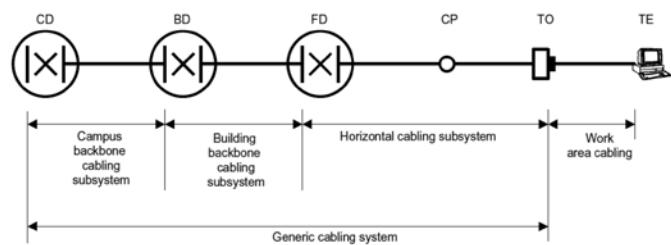
Therefore pre-termination for commercial office installations is becoming increasingly popular as the project timescales are being constantly shrunk. Some integrators have even taken the step to invest in their own facilities to keep up with the demand.

Whilst it is basically the same product set being used, there are a few key additions and techniques being utilised. One key difference is the lengths involved, they are usually much longer, and if there is a concern about the accuracy of drawings or measurements provided, some companies are opting to minimise their risks by just pre-terminating the floor outlet end at the factory. In effect producing extremely long outlet to outlet assemblies, that are tested fully if they are below 90m. If over this length, they are tested for continuity before being cut in half, labelled, packed and shipped to site to be pulled into position onsite.

This approach is being seen almost as a two visit approach, to the floor locations. First stage is to 'pull' or lay the loom, usually from the floor location back to the SERs (Secondary Equipment Rooms/Floor Distributors) at which point 'the floor' can be handed back to the main contractor for other trades, with the outlets or GOP (Grid Outlet Point) box bagged and coiled for safety under the raised floor and the termination of the other end can continue in the SERs. On some projects a two-shift process is used for speed, with the assemblies being pulled in overnight when the Data Installer has free access to the floors and the termination and testing is done through the day.

Along with the Solid Core Harness links used in the Data Centre we also see the use of longer versions of these assemblies being used as Consolidation Cables in coordination with Consolidation Points that are used to service zones or service areas within a floor or building.

Consolidation Points have been a building block within the standards for a long time however they have only recently started to come into their own due to the additional flexibility they provide in a dynamic office environment that undergoes a lot of moves and changes.



### The structure of a generic cabling installation as per EN50173-2

Pre-terminated cable assemblies can be produced for each element outlined above.

**BD** = Building Distributor and Solid Core Harness Links

**Building Backbone Cabling Subsystem** = Backbone Cabling (pre-terminated fibre)

**Floor Distribution Cabling Subsystem** = Horizontal Cabling

**CP** = Consolidation Point and Solid Core Consolidation Cables

**EO (Equipment Outlet)** = Including those housed in GOP boxes

We mustn't forget that most backbone cabling systems between the MER (Main Equipment Room) and the SERs on each floor are typically fibre, with the occasional copper links as back up.

There is an increasing demand for conventional tight buffered fibre to be pre-terminated offsite. This approach not only saves a great deal of time, it may be essential due to the lack of power onsite for a fusion splicer. The days of 'glue and polish' are gone especially with the lower losses of OM4 fibre, certainly I don't know of anyone who is attempting the manual approach for singlemode.

### Pre-fabrication

Another area on the increase is that of Pre-Fabrication where complete sections of buildings are being constructed in a factory style environment and all services are being 'pre-plumbed in' initially it used to just be the power and water but now complete walls for schools and hospitals are having all their services installed in a factory environment including items such as gas/oxygen and IT cabling. The completed wall is then wrapped up taken to site by lorry and craned into position.

Once delivered, it's a fairly quick and simple task to plug them together and test.

This approach moves the resources to where they are needed and where they perform best. The easy question is where do people perform their best work, a purpose built factory that is dry and warm or a building site open to the elements in the middle of winter?

This approach takes the use of Consolidation Points and Solid Core Consolidation cables to the next logical stage. By running Horizontal Cabling from the SER or Floor Distributor out to a consolidation point close to the location of the final position for the wall or walls for when they are craned into position. The solid core consolidation cables that have been installed within the wall, in the factory are just connected and tested.

This means the time and resources required onsite are dramatically reduced. If everything is labelled correctly it takes a fraction of the time and cost required for a traditional installation, hence the large number of construction companies that operate in the education and healthcare sectors who are looking to invest heavily in this approach.

### Considerations

With all things of this nature, there are some serious 'Pros and Cons' to take heed of one size does not fit all, however the Pros certainly outweigh the Cons.

#### Pros:

- Time Saving
- Cost Saving
- Less Wastage, both packaging and cable off-cuts
- Concentration of valuable resources
- Pre-Tested
- Less Failure onsite

#### Cons:

- Accuracy in measurement required
- Lacks on-site flexibility for change in program

### Benefits of Pre-Terminated Solutions

As can be seen throughout this paper if used correctly Pre-Terminated solutions can bring a raft of benefits to both the installer and the end-user.

It all comes down to money and all the Pros listed above have a 'Cash' value. Yes the assemblies have a higher initial cost as they include the factory termination time, however the savings go beyond this.

Time Saving which in itself brings benefits of cost saving, if you buy the assemblies pre-terminated you don't need as many onsite engineers pulling cables in and terminating them for as long, saving on the labour bill.

Cost Savings include all the other items of equipment that have to be hired, such as podiums and lifts, if the turnaround is quicker they don't need to be on hire as long.

Less Wastage, the installer in a lot of cases still has to pay for his waste to be removed from site on many projects, especially if they include cable drums, more importantly the installer is purchasing a more accurate quantity of cable, they are buying by the metre and not by the drum, how many installers have their facilities cluttered up with odd lengths of cables in boxes hoping for a project that will use them up.

Concentration of Resources, rather than having teams of engineers in pulling and terminating in less than ideal environments, have a select group of specialists pull the assemblies in the right manner, in a controlled environment and then test. This leads to smaller teams for a shorter time and subsequently a smaller labour bill.

Testing on this subject, if they have been tested in the factory sometimes means less testing onsite, Excel has one Data Centre customer who accepts the factory test results for warranty purposes. All he asks for onsite is random testing within the looms to validate the factory test data, if this is within an acceptable tolerance he is then happy to accept all of them, this has lead to a reduction of testing time by as much as 75%.

### Conclusion:

Pre-termination is not a fad, it is an increasingly popular way of delivering a project in a more timely and cost effective manner. It should not just be confined to the major projects delivered by the large integrators, this approach can provide benefits for all sizes of project.

Excel Networking is investing and will continue to invest in both products and services that can support any level of project with many different variations of product presentation, panel to panel, solid core harness links, panel to GOP, Panel to CP etc. including both copper and fibre, both traditional and MTP.



# White Paper

## Infrastructure Cabling for Future Buildings

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2013 will see the publication of a new standard from CENELEC titled EN 50173-6 Information technology – Generic cabling systems – Part 6: Distributed building services. This standard has been written to include the requirements of the various established and developing systems that can utilise the infrastructure cabling that is installed in buildings. It is also being written to encompass Distributed building services that did not use the infrastructure cabling for historic, topographic, application or connector reasons.

First, a look back how various systems were deployed in the past. These systems included telephone, data, alarms, control and lighting to name a few. The protocols to control and monitor these systems were developed by individual manufacturers often using different cabling and connectors following different rules. These systems used ring, mesh, star and bus topology networks to connect them. Computer networks saw the introduction of Ethernet over twisted pair copper within the enterprise leading their protocols. From this evolved the development of structured cabling. It soon became common to see structured cabling used for both data and voice systems. Each using different applications, but using a common Class of cabling.

**S11**

**Structured cabling** uses categories of components (connectors, cables and cords) to form Classes of channels. Within the standards are stated the minimum Class of cabling that will support various applications.

Now most telephone systems being installed within businesses are Voice over Internet Protocol (VoIP). VoIP systems use the same Ethernet network as the data within the

building, hence sharing the same network as well as the cable class. Furthermore, most new building networks are making provision for wireless access points, even if not being installed as part of the initial installation.

The purpose of the new standard is to allow the migration of distributed building systems onto generic cabling systems while acknowledging, and making allowance, for specific channel requirements. Distributed building systems detail the following systems as using the cabling:

- Telecommunications (Wireless access points, etc)
- Energy management (Lighting, Power distribution, Incoming utility metering, etc)
- Environmental control (Temperature, Humidity, etc)

**CENELEC** – European Committee for Electrotechnical Standardisation. CENELEC is the European Standards organisation responsible for the publication of infrastructure cabling standards, and others, including the EN 50173 series (Information technology – Generic cabling systems) and EN 50174 series (Information technology – Cabling installation). These “EN” standards, once published are automatically adopted by member states of CENELEC and become national standards. For example, EN 50173-1:2010 is published by the British Standards Institute as BS EN 50173-1:2010 in the United Kingdom.

- Personal management (Access control, Cameras, Passive infra-red (PIR) detectors, Time & attendance monitoring, Electronic signage, Audio visual (AV) projectors, etc)
- Personal information and alarms (Paging, Patient monitoring, Nurse call, Infant security, etc)

The standard details that balanced copper cable and optical fibre cable of classes detailed in EN 50173-2 shall be used either as an overlay (part of the structured cabling) or stand alone (installed after the initial infrastructure cabling). As you would expect, new standard brings new acronyms... We will now see SCP, SD and SO being introduced.

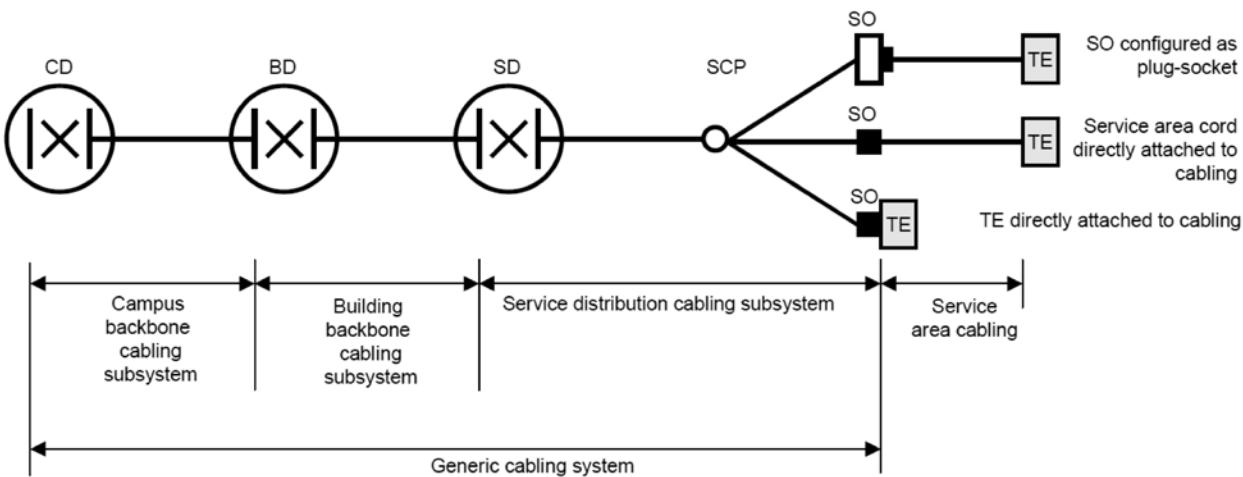
**SCP** – Service Concentration Point  
(similar to a CP – Consolidation Point)

**SD** – Service Distributor (similar to Floor or Building Distributor)

**SO** – Service Outlet (similar to a TO – Telecommunications Outlet)

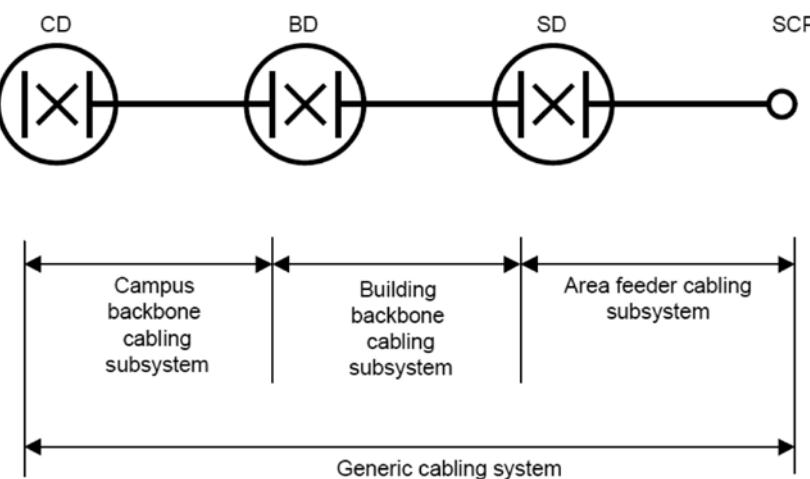
The cabling for Distributed Building Systems is split into two deployments.

#### Type A: Generic cabling to SO (Service Outlet)



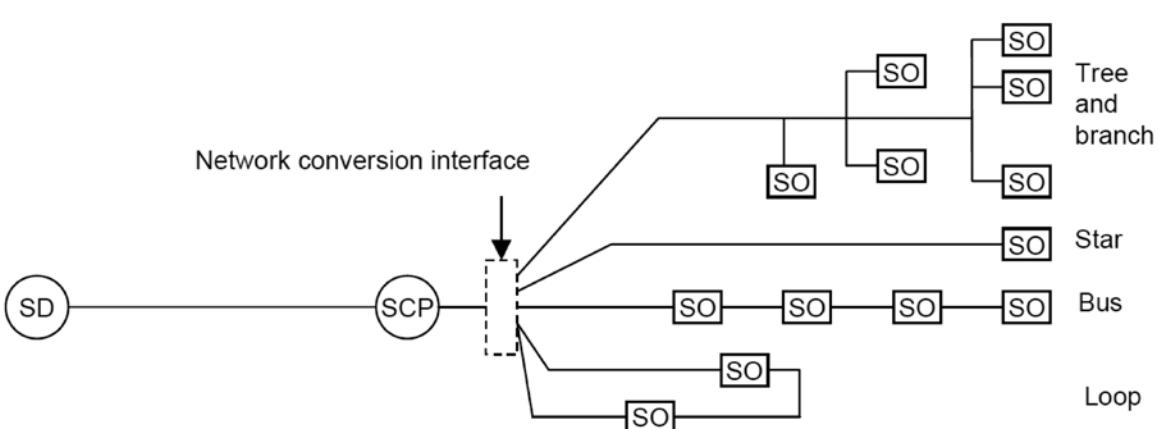
This type of deployment uses the same channel models as standard infrastructure cabling, as shown above. The schematic shows that the TE (Terminal Equipment) may be attached in different ways. For example having the SO as a plug socket and so a service area cord attaches the TE, directly attaching the service area cord to the cabling or even connecting the TE directly to the cabling.

#### Type B: Generic cabling to SCP (Service Concentration Point)



This deployment utilises generic cabling to the SCP. Thereafter the cabling is customised to suit the system being installed. At the SCP Network Concentration Equipment is installed to support the different topologies that may be employed.

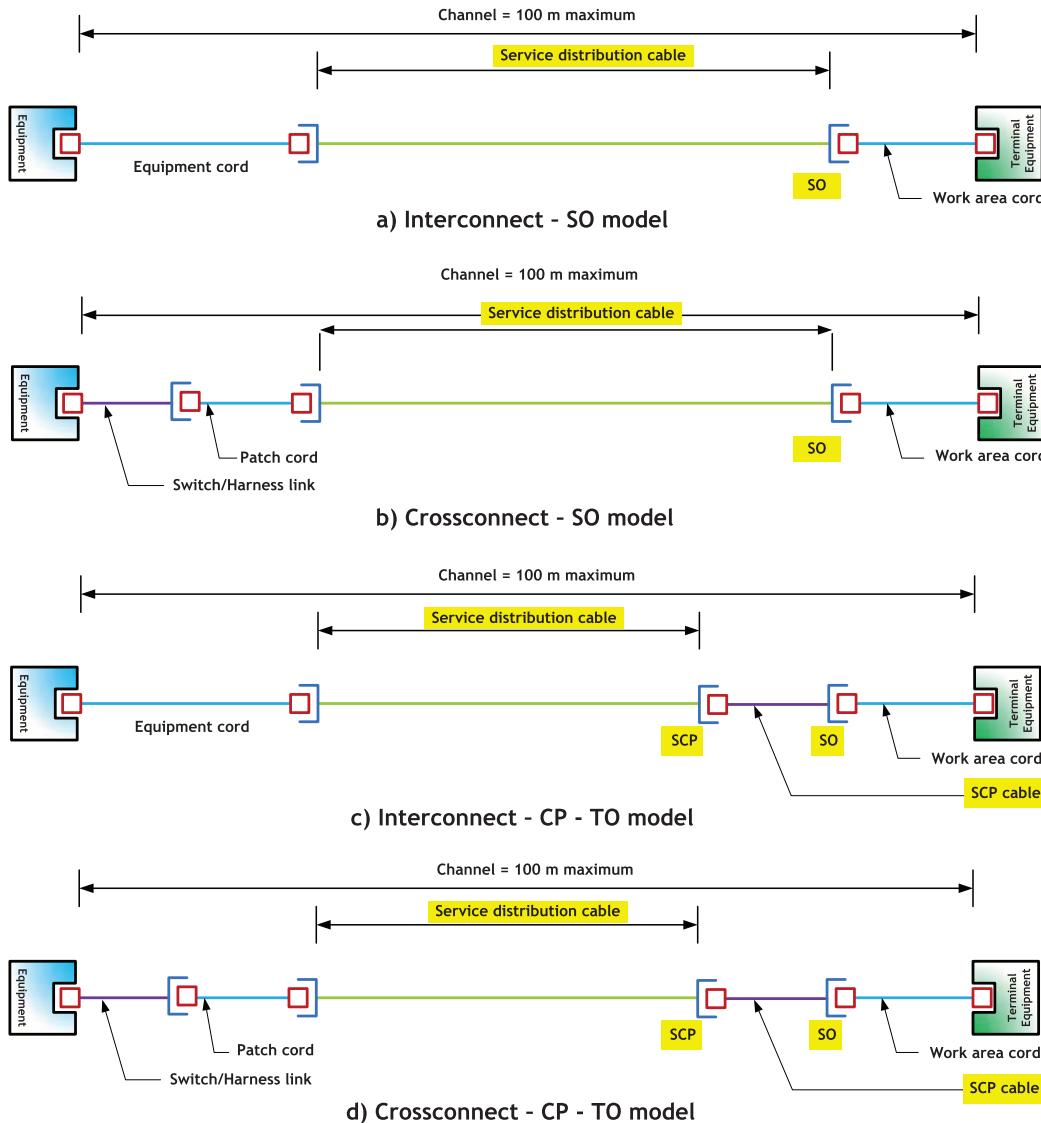
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This differs to other structured cabling systems by deploying active network equipment in the horizontal channel. This is not done at a Consolidation Point. The various distributed building services use the different topologies shown in the above diagram – Tree and branch, Star, Bus and Loop.



The rules for the distances between the various sections of the channel follow the rest of EN 50173, namely that the maximum horizontal channel (SD to SO) is a maximum of 100m (balanced copper cabling channel) and shows four models:



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The other dimension for consideration is that if an SCP is used, the minimum length of cable between the Service Distributor and the SO is 15m. Service Concentration Points should be located in accessible permanent locations (Ceiling voids, floor voids, etc).

In summary, the introduction of this new standard will see the cabling being encompassed within the infrastructure of the building and should be considered as such:

- Electric   ● Gas   ● Water   ● Structured Cabling

EN 50173-6 is currently in draft publication. Once ratified, this standard will be published by the British Standards Institute as BS EN 50173-6. It is anticipated that the publication will be around March 2013.

This white paper has been written using the draft of the standard; the published standard should be checked once published.

# White Paper

## The Perils Of Thin Conductor Cables



This White Paper has been produced by **Mike Gilmore**, e-Ready Building Limited, on behalf of Excel.

As most installers will know, every Category of balanced cable is specified in two forms - one for the fixed cabling links (which are termed horizontal cables) and the other for cords. The US TIA-568-C.2 specifications for the horizontal cable of all Categories require the use of solid conductors of 22 to 24 AWG with dc resistance of no more than  $9.38 \Omega/100\text{ m}$ . The European and international cable standards allow a wider range of conductor diameters but also limit the dc resistance to no more than  $9.5 \Omega/100\text{ m}$ . Cords can be produced with either single solid conductors or groups of thinner stranded conductors. The dc resistance for these cables is restricted to  $14 \Omega/100\text{ m}$  (US TIA) and  $14.5 \Omega/100\text{ m}$  (Europe and international).

In the current economic climate, a variety of approaches have been applied by reducing the diameter, or even changing the fundamental construction of the conductors in order to reduce the cost of cables. All of these approaches breach the spirit of the cabling standards and in some cases, as we will see below, claim compliance on a potentially fraudulent basis. This White Paper discusses these issues before looking at the longer term concerns resulting from the use of these, and similarly specified cables.

In order to understand the situation we have to consider what are known as the conformance requirements of the various cabling standards. The ANSI/TIA-568-C standards, in line with most other TIA standards, state that all "shall" statements constitute requirements that have to be complied with. One of these "shalls" is that channels of a given Category are produced using cables and connecting hardware of at least that Category. This makes life very simple - if horizontal and cord cables do not separately comply with the requirements outlined above then it is not possible to comply with ANSI/TIA-568-C - irrelevant of the Category claimed for the channel. In comparison, the European (EN 50173-x) and international (ISO/IEC 11801) structured cabling standards feature a "get-out" clause which is sometimes called the "channel approach to conformance". This allows any cable specification to be used provided that the resulting cabling channel meets the specified performance of the required Class. This is laudable and provides freedom to implement technological developments outside the confines of a given cable Category - but, as in other areas, with freedom comes responsibility. Unfortunately, we are now seeing exploitation of this "get-out" clause which crosses the border of responsible supply.

The first moves in this direction were heralded by the so-called zone cables. Because international cable standards define horizontal and cord cables in separate standards (IEC 61156-5 for horizontal and IEC 61156-6 for cords), some

suppliers decided to have their horizontal cables independently verified for conformance to a given Category using the IEC cord specification. This produces a cable that has less copper and is potentially smaller and lighter. However, the insertion loss performance per unit length is up to 50% worse than a horizontal cable of the same Category. As a result, the suppliers have to reduce the maximum length over which the cables should be used - and, to do so, invented the concept of the "zone" within which those cables may produce a conformant channel. The boundaries of such zones range between 50 m and 70 m. However, certain things cannot be claimed by such solutions: they cannot conform to the general requirements of TIA-568-C.2 for links or channels of a given Category because they do not conform to the horizontal cable requirements of that standard.

'they cannot conform to the general requirements of TIA-568-C.2 for links or channels'

The minimum diameter of 26AWG conductors is 0,40 mm. Some suppliers are providing cables with single solid conductors of diameter even lower than this value. As a result these cables do not conform to any horizontal or cord cable specification in any standards arena - and to underline the statement made in the previous paragraph, they cannot produce cabling that conforms to the general requirements of ANSI/TIA-568-C.2 channels of a given Category because the horizontal cables do not conform to any of the cable requirements of that standard. However, they can produce conformant channels of a certain Class in accordance with EN 50173-1 or ISO/IEC 11801 via their "channel approach to conformance".

It may have been noticed we have not yet mentioned permanent link specifications.



As has already been stated, ANSI/TIA-568-C requires that channels and permanent links of a given Category are produced using cables and connecting hardware of at least that Category. Unfortunately, if one simply focuses on the transmission performance requirements ANSI/TIA-568-C-2 for a permanent link, they are calculated by modelling a 90 m length of cable with addition of the appropriate connecting hardware. Therefore although these zone cable solutions cannot claim general or mechanical compliance to the TIA-568-C standards, they are able to state that their transmission performance meets the specified permanent link performance provided that the links are not too long. This is what was meant by "breaching

the spirit of the cabling standards" by selecting a particular aspect, rather than by observing the true requirements, of a standard.

By comparison, it is not possible for zone cable implementations to claim compliance to permanent links

of a given Class of EN 50173-1 or ISO/IEC 11801 because the requirements of those standards for permanent links are length-related based upon the modelling that length of cable with addition of the appropriate connecting hardware – and those models are implicitly based on the performance of horizontal cables of a given Category. Therefore cables of "cord style" insertion loss cannot produce conformant permanent links of any length.

**'it is not possible for zone cable implementations to claim compliance to permanent links of a given Class of EN 50173-1 or ISO/IEC 11801 because the requirements of those standards for permanent links are length-related'**

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Compliance claims by cables featuring "thin" copper		
	ANSI/TIA-568-C	ISO/IEC 11801 EN 50173-x
General conformance	No	Yes- via channel approach
Cables	No	No
Permanent link performance	Yes	No
Channel performance	Yes	Yes

This analysis provides a rather complex compliance table as shown above which shows the loopholes via which those suppliers offering zone type cables promote their products.

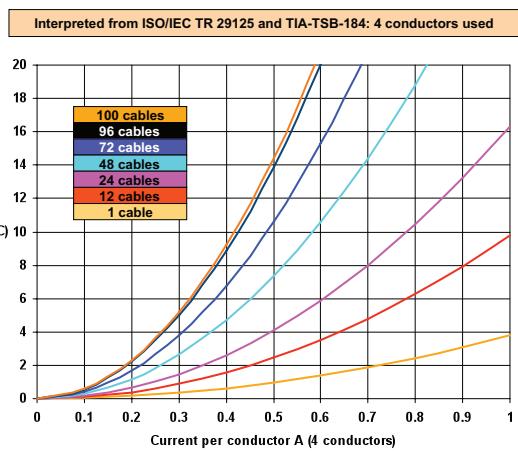
These suppliers support their product solutions by claiming a variety of benefits - both physical and economic as described above - but even extending these into areas of social responsibility in terms of reduced material usage and wastage. In the face of such evidently reasonable justifications for the introduction of zone cables, even if they are based on misrepresentations of their standards, one might ask why

concerns exist regarding these products. A primary concern relates to the delivery of remote powering over the cables and focuses on dc loop resistance, a parameter which has historically flown under the radar but one that obeys a very simple law of physics - Ohms Law.

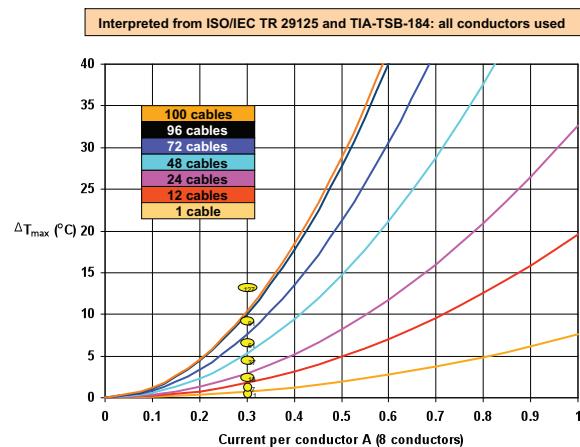
When balanced cables are used to deliver power, two separate issues have to be considered. Firstly, the cables dissipate power, in the form of heat, in proportion to their resistance which is, for a solid copper conductor, inversely proportional to the square of the conductor diameter. In other words, if you reduce the conductor diameter by half then the power dissipated per unit length increases fourfold. Secondly, the temperature that the cable reaches depends upon its surroundings (and will be higher in the centre of a bundle or when located in insulated pathway systems. These temperature rises also have two potential effects: if the cable gets too hot it will "fall apart" in a physical sense but even at lower temperatures the insertion loss of the cable increases which potentially reduces the maximum transmission distance over which applications can be supported.

## Graphical Representation of the Difference in the Heating Effect between a Standards Compliant PoE and a Non Standards Compliant PoE on Structured Cabling

Graph 1: Standards Compliant PoE



Graph 2: Non Standards Compliant PoE



As pointed out early in this White Paper, the expected dc resistance of a horizontal cable is no more than  $9.5 \Omega/100$  m. The use of the so-called zone cables which meet the cord specification of  $14.5 \Omega/100$  m represents a 53 % increase in heat dissipation per metre. Some suppliers are producing cables with conductor diameters even lower than 0.4 mm - which naturally exhibit higher resistance figures which will produce more heat. Some of these cables incorrectly claim that they have some form of compliance with TIA Categories 5e and 6 - against which their dc resistance uplift is  $\geq 60$  %.

It should be highlighted that the more responsible suppliers of zone cables clearly state that they are intended for use on "short" routes in data centres where remote powering would be relatively uncommon. However, more recent entrants are specifically suggesting that the cables are capable of providing remote power in accordance with IEEE PoE and PoEplus. While it is indeed true that the power delivered to the PoE equipment at the end of these zone cables over short routes will comply with the IEEE standard it is rarely made clear that the power lost per unit length along the cable will be much greater. Moreover, one of the key selling points of these cables is that they have smaller cross-sectional areas allowing more to be installed in the same physical space. This potential combination of higher packing density and greater resistance is clearly something that has to be viewed with caution.

In this respect these cables represent as much of a problem as copper clad aluminium and copper clad steel cables which exhibit a range of dc resistance performance levels depending on the amount of non-copper in the conductor. Some CCA and CCS cables show increases in dc resistance of as low as 40 % while others show values greater than 200 % - therefore from this perspective zone cables fall within the range of these truly counterfeit Category cables.

Set against this background, it is a shame that the test equipment we use to validate our installations is so ineffective at highlighting the potential problems. Admittedly, the ANSI/TIA-568-C specifications for permanent links do not contain a length-dependency and simply apply a  $21 \Omega$  limit for dc loop resistance (the total dc resistance of a looped pair). However, test equipment testing against Category 5e, 6 and 6A limits is not required to even highlight any test results failing to conform to this limit. By comparison, the ISO/IEC and EN standards specify length dependent requirements. Unfortunately few, if any, test equipment suppliers enact these limits – and simply apply the maximum value of  $21 \Omega$ . If they did so then all zone cable based permanent links would fail to meet the requirements of Class D, E, EA etc.

Finally, experienced data cabling installers are more than aware of the problems of connection reliability when using copper coated aluminium cables - and would not attempt to install them, even if the customer demanded it. However, they tend to be unaware that as conductor diameters reduce, we could begin to have similar problems with "all-copper" solutions. The connecting hardware specification of "jacks"

in EN cabling standards requires them to provide effective contact for conductors between 0.50 and 0.65 mm. ISO/IEC 11801 states its requirements in a slightly different way but provides warnings when conductor diameters outside the range of 0.50 and 0.65 mm are used. As a result, the use of small conductor cables may influence the general compatibility with standards-compliant connectors and therefore the reliability of such terminations may suffer.

### In conclusion .....

the use of cables with conductors with diameters lower than 0.5 mm undoubtedly produces lower cost and smaller cables. However, some suppliers are providing these cables by exploiting standardisation loopholes while others are going even further to create completely non-standards based cables - while still claiming Category status by the use of misleading advertising. While it is recognised that these "thin conductor" cables feature high insertion loss performance which restricts maximum lengths, the more worrying aspect is the associated high levels of dc resistance - which under circumstances of remote powering could cause excessive temperature rises in cable bundles and in unventilated pathways. Unless the suppliers provide full disclosure of these details, the supply of such products borders on irresponsibility - in some ways as worrying as the impact of CCA and CCS cable solutions. This apparent disregard of dc resistance should concern our industry.

While full compliance to PoEplus restricts the power delivery to between 25.5 and 34.2 W per cable, there are equipment suppliers who choose to provide double that value. There also appears to be a race to deliver even higher power levels by individual suppliers and "industry fora" which have undertaken no technical analysis of the impact of their solutions. HDBASE-T offers 100 W to power TVs and recently there are examples of mid-span insertion modules offering even more power to remote devices. CENELEC, the European standards body, have reacted to the concerns by initiating the development of a Technical Report which will provide guidance and support for the application of remote powering. Graphs 1 and 2 shown earlier in this paper shows the difference in the heating effect between a standards compliant PoE and a non standards compliant PoE.

The impact of such non-standard powering solutions coupled with the use of thin conductor cables represents a leap in the dark. Installers need to be very careful about what they commit to in terms of standards compliance (and need to review the claims of those cable suppliers very carefully). The potential concerns over power feeding, cable bundle temperatures and possible connector compatibility need to be balanced with any commercial advantages proffered by "thin" conductor cables.



# White Paper

## Class E Channel Frequency Myths and Misconceptions

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As the Structured Cabling market gets ever more competitive we see an increasing amount of FUD (Fear, Uncertainty & Doubt) being spread by vendors in an attempt to prove themselves better than their rivals.

Unfortunately some of this is being done by vendors quoting greater numbers that in reality do not demonstrate any better performance, than a system that states it meets or exceeds the required standard.

One of the most notable of these instances is when a manufacturer has a 350MHz cable and therefore claims it has better performance. This document will endeavour to expose this myth and correct the misconception.

As a point of note, Excel Networking has successfully run internal tests across all of its Category 6 cable to 350MHz, but we do not claim performance to this frequency for the reasons laid out in this document.

### Standards Requirement

In Cenelec (EN) or ISO terms each Class of Channel or Permanent link is made up by Categories of Components. The performance requirements of those components, whether cable, connecting hardware or patch cords are laid out in the general requirements of the respective Standards, namely EN50173-1: 2011 and ISO 11801: Ed 2.2: 2010.

The following extract from EN50172-1:2011 lays out the frequency requirements for each class of channel.

#### '5.2.2 Balanced cabling channel performance

##### 5.2.2.1 General

*This standard specifies the following classes for balanced cabling:*

- a) Class A: specified up to 0,1 MHz;
- b) Class B: specified up to 1 MHz;
- c) Class C: specified up to 16 MHz;
- d) Class D: specified up to 100 MHz;
- e) Class E: specified up to 250 MHz;
- f) Class EA: specified up to 500 MHz;
- g) Class F: specified up to 600 MHz;
- h) Class FA: specified up to 1 000 MHz'

The standard then goes on to define the performance for each required measurement at these set frequencies. In the case of Return Loss the table is as follows:

Table 5 - Return loss limits for a channel at key frequencies

Frequency MHz	Maximum return loss dB							
	0,1	1,0	16,0	100,0	250,0	500,0	600,0	1 000,0
Class C	N/A	15,0	15,0	N/A	N/A	N/A	N/A	N/A
Class D	N/A	17,0	17,0	10,0	N/A	N/A	N/A	N/A
Class E	N/A	19,0	18,0	12,0	8,0	N/A	N/A	N/A
Class E <sub>A</sub>	N/A	19,0	18,0	12,0	8,0	6,0	N/A	N/A
Class F	N/A	19,0	18,0	12,0	8,0	8,0	8,0	N/A
Class F <sub>A</sub>	N/A	19,0	18,0	12,0	8,0	8,0	8,0	6,0
Class BCT-B	N/A	19,0	18,0	14,0	11,0	10,2	10,0	8,0

For a true Channel compliance all elements MUST be of the stated Class or Higher. However, it is the lowest category of component that decides the Class, therefore if a 350MHz cable is used with Category 6 connecting hardware and Category 6 patch cords, you will still only have a Class E Channel.

Additional Frequency measurement is all well and good in theory but in practice, it starts to throw up a number of interesting problems, not least of which is the fact that no Field Test equipment has the in-built ability to test beyond the Standards base limit of 250MHz for a Class E Channel or Permanent Link. You can set up to test beyond the standard, but it is down to the user to then export the data and write a new set of limit lines using the existing formula for Category 6 in EN50173.

An example of that formula is as follows for Insertion Loss:

$$E \quad 1 \leq f \leq 250 \quad 1.05 \times (1.82 \times \sqrt{f} + 0.0169 \times f + 0.25/\sqrt{f}) + 4 \times 0.02 \times \sqrt{f}, 4.0 \text{ min.}$$

The subject gets even more complex when looking at using a Network Analyser, EN50346, (the testing parameters called for in EN50173-1 sets out 401 swept measurement points across the 250MHz). How is that then going to be applied to the 350MHz? Do you use the same points and calculate an additional number or do you space out those measured points and therefore start losing some of the granularity and accuracy of the results. Either way the outcome is less than ideal.

## Conclusions

Whilst on paper having a cable that is said to operate to a higher frequency may appear to be an attractive option. To gain a sense of reality and cut through the 'Marketing Spin' the following facts must be remembered and questions asked.

- Do all the component elements perform to the 350MHz, if not, then any supposed benefit is immediately lost.
- There is NO effective way of testing a 350MHz, once installed, or 'In the Field'
- There are NO applications that operate at this extended frequency. If talking in pure Ethernet terms, Category 6 already gives additional Headroom over Category 5e. When it comes to 1Gb Ethernet that operates at 100MHz the next level is 10Gb which requires 500MHz Class EA
- If this additional frequency comes at additional cost, and provides no known benefit, the cost has to be seriously questioned.

This is a classic case of 'Spin' over substance being used to try and confuse the end-user and get them to believe that having a bigger number means they are getting more for their money, when it is simply not the case.

*This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.*



# White Paper

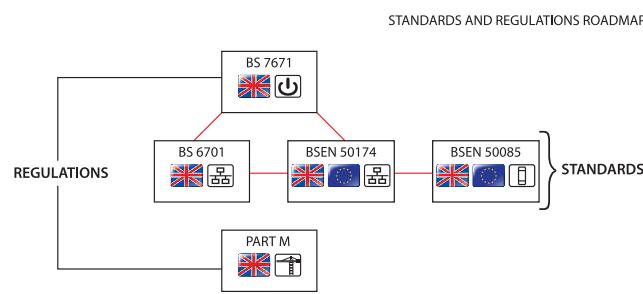
## The New Critical Factor – Containment

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One area where there continues to be a certain level of naivety is that of containment and trunking, and in the last 12-18 months this lack of awareness has really come to the fore.

There are, in fact, five separate elements that affect the installation of containment:

These elements include a combination of regulations and standards. The former are legal requirements as they involve Electricity, which, obviously, can be fatal. For this reason containment and trunking are normally involved as part of the electrical package, but how many structured cabling installers know the following element, or even want to?



### BS 7671 Wiring Regulations

- Safety
  - Protection against
    - > Electric shock
    - > Thermal effects
    - > Overcurrent
  - Inspection & testing
  - Requirements on special locations



Currently on 17th Edition since 1st July 2008

The most important standard to cabling installers is BS/EN 50174, which is in three main sections:

- Part 1. Installation specification of IT cabling
- Part 2. Planning and practices INSIDE buildings
- Part 3. Planning and practices OUTSIDE buildings

Part 1 also covers all aspects relating to the quality of the containment and its installation, ensuring the pathway systems SHALL have smooth surfaces and be free from burrs, sharp edges and other projections that can damage cables. Furthermore, pathway systems SHOULD provide all components with physical protection, and IT pathways

SHOULD not be supported in the other supply systems i.e. Heating and HVAC trunking etc.

NB. In Standards parlance SHALL = Mandatory and SHOULD = Recommended

There has been much written in the last 12-18 months about the move from Cat6 to Cat6<sub>A</sub>, with every article focusing on performance and the relative merits and advantages. The one major factor that is rarely discussed is the impact on containment. Currently, more time than ever before is being spent inspecting and assessing containment for suitability. With careful planning this could be minimised and the project could avoid some time-consuming and costly mistakes.

However, before that stage is reached a great deal of education is required, at all levels, from Installers to Building Services Consultants and M&E engineers, right the way through to some of the manufacturers of containment. The fundamentals have changed with Cat6<sub>A</sub> and are further complicated by capacity claims made by certain Containment Manufacturers.

On top of all this, the waters are muddied even further by the more increasingly critical factor of the separation of power and data; the higher the bandwidth the more susceptible it is to interference, hence the more common use of a screened cabling systems in current times.

Whether they are screened or unscreened Cat6<sub>A</sub> solutions, they both bring their separate, but not vastly different problems, both born by their physical construction. The common factor is the physical dimensions. The outside diameter (OD) has increased by a huge percentage, in fact a staggering 25-30% from approximately 6mm for Cat6 up to about 8mm for Cat6<sub>A</sub>. For example, where it used to be common to run 4 Cat6<sub>A</sub> cables in a length of 25mm Kopex to a GOP box it would now be difficult to get 3 Cat6<sub>A</sub> cables in.

And it doesn't end here; the impact is all the way down the line. Dado Trunking is one of the most sensitive areas. Many of these products' designs were based upon the electrical requirements and that of Cat6<sub>A</sub>, but without due care this can cause problems around not only the capacity but, more importantly, the bend radii. Already one manufacturers' capacity claim has reduced from 14 to just 3 Cat6<sub>A</sub> cables due to the design of their bends, which were compromised by the corner pieces having to be screwed into place and the screw positions being on the inside of the outer compartments.

The next major factor is the depth of the trunking. Not only does this contribute to the overall capacity when trunking it with Cat6<sub>A</sub>, but great care needs to be taken with the bend radii. This increase in the OD of the cable has a natural knock-on effect. What was a bend radii of 24mm for Cat6 suddenly becomes a minimum bend radius (MBR) of 40mm with Cat6<sub>A</sub>. This is usually well-catered for in the bends of the trunking, but is severely hampered when it comes to the back box depth. Add on outlet and an angled shuttered module, which in themselves can add a further 20mm, and the problem becomes apparent. If the trunking has a depth of 60mm or more, with the exception of MK Prestige 3D whose depth is only 57mm, its overall dimension has been designed to satisfy the data market, and it can accommodate even the thickest Cat6<sub>A</sub> cables, as long as good installation practices are maintained.

It may seem strange, but when dressing cables into back boxes, sometimes more is less. By creating a loop within the box (i.e. entering at the bottom), looping up to the top to terminate on a jack that is angled down usually makes it easier to then put the faceplate back on. Trying to bend a short length of a thick cable cannot only be difficult, but it could result in the cable being crushed back into place with a compromised bend radii. Part 1 of BS/EN 50174 states the design of the termination points SHALL:

- Allow safe access
- Ensure link performance (Keep MBR)
- Have adequate clearance to install components in accordance with cable manufacturer's instructions.

The following image gives an example of how to do it WRONG!



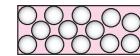
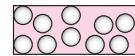
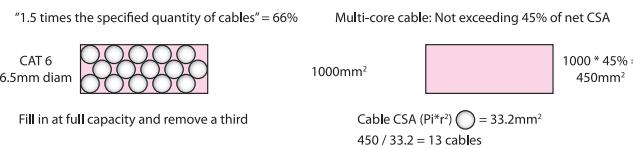
A manufacturer of dado trunking that has thought about these issues in detail is Rehau. They have widely consulted with cable manufacturers, and even members of the standards bodies, before finalising their design. This has resulted in their Profilla Data product being one of the best in the market, with an overall depth of 65mm and a variable depth back box which has punch out slots at various angles to ensure that even the bulkiest cables can be fitted without too many problems.

Whilst dado trunking poses the largest area of concern, there are still issues with the perforated tray and basket tray, which is not just down to the greater OD, it is also a factor of the weight. With both screened and unscreened cables, the thickness of the conductors has increased to 23AWG from 24AWG, which doesn't seem a large amount, but soon builds up. In the American Wire Gauge Standard, the lower the number, the thicker the cable, and this also relates to how many times the cable has gone through the drawing process.

Whilst the latter factor is more about the how the basket is fixed or mounted rather than the possibility of the bulk of the cable bundles crushing those on the lower levels, it is something to be aware of.

The major impact of the larger OD is that of capacity. A 300mm section of Basket Tray may comfortably hold 320 Cat6 cables with 20% spare capacity left. Given the same criteria it would be difficult to get 200 Cat6<sub>A</sub> cables in. This is a major consideration when planning main horizontal runs as approximately 35% more basket tray is required for the same amount of cable.

Both BS/EN50174 and BS7671 Wiring Regulations give different calculations to determine capacity. For consistency cabling installers should stick with BS/EN 50174.

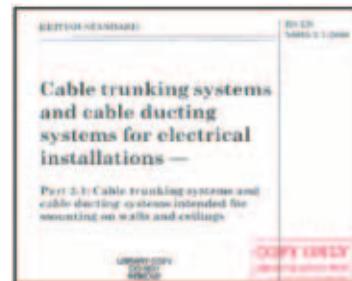


#### BSEN 50174

#### BS 7671 Wiring Regs.

Finally, there are two elements to consider; they are Part M of the BS7671 and BS/EN 50085 the European Trunking Standards; the latter being referenced in BS/EN 50174-2 as follows: Clause 4.5

- Trunking should comply with EN50085-2-1



The above is the Standard for safety and performance of trunking and covers:

- Fire Hazard
- Access to Live Parts
- Mechanical Strength
- Resistance to Heat

Part M is probably the most under used building regulation and covers, amongst other things, visibility requirements (BS 8300 – 2009). It effectively states that power sockets be identified by way of visual contrast. This visual contrast is achieved by 30 points difference in Light reflectance values (LRV). LRV is the proportion of light reflected by a colour. In essence, Pure White = 100 and Jet Black = 0

#### Conclusion

Containment used to be something that was 'installed by others'. That may remain the same, however the cabling installer needs to have an input, and early on, to ensure what is being put in is up to the job.



# White Paper

## Horizontal Cabling Solutions for 10G Ethernet

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This paper is designed to clarify a number points relating to the use of Horizontal Structured Cabling to support 10G Ethernet. With the ratification of ISO/IEC 11801 Class E<sub>A</sub> the IEEE agreed to use this for all future development involving 10G Ethernet over copper.

This paper is designed to clarify a number points relating to the use of Horizontal Structured Cabling to support 10G Ethernet. With the ratification of ISO/IEC 11801 Class E<sub>A</sub> the IEEE agreed to use this for all future development involving 10G Ethernet over copper.

ISO/IEC 11801 and BS/EN 50173-1 outlines a channel length based on 100m, the performance limits for balanced cabling channels are given in 6.4. These limits are derived from the component performance limits of Clause 9 and 10 assuming the channel is composed of 90 m of solid conductor cable, 10 m of cord(s) and four connections for Class E<sub>A</sub> (Cat 6<sub>A</sub>).

BS/EN 50173 references BS/EN50288 (Multi-Element Metallic Cables used in Analogue and Digital communication and control), which specifies the horizontal cable for both unscreened and screened cables, for example 50288-5-1 is the screened horizontal cable and 50288-5-2 defines the work area and patch cord cables for Class E.

At this moment in time the standard for Class E<sub>A</sub> cables has not been ratified however the respective cables are referenced as follows: 50288-10-1 for the screened horizontal cable and 50288-10-2 for the screened work area and patch cord cables.

The major difference between \*-1 and \*-2 in both documents is the diameter of the conductors, the first has to be a minimum of 0.5mm and the second limit being 0.4mm, this being defined by their intended use.

### Alternatives

There are some alternative solutions for providing a 10G Ethernet horizontal system, they include Fibre to the Desk, Class E (Cat 6) cabling over a limited length as well as a smaller diameter Class E<sub>A</sub> solid conductor work area cable being used in the Horizontal.

Each one of these has their pros and cons however only one of these options is truly compliant with the standards we have outlined. That being, Fibre to the Desk whilst its performance cannot be questioned it does come with a price and is usually deployed in high security environments.

A few years ago the TIA/EIA came up with TSB155 which was an interim proposal to allow 'existing' installations of CAT 6 to run 10G, this involved a long list of actions to be taken to

mitigate the risks, however it was limited to very short runs (below 55m). It was also only ever developed to assist 'existing' installations and was not designed for new installations.

The third alternative looks at utilising a cable that complies with 50288-5-2 and designed to meet 50288-10-2 (work area and patch cord) these are typically 26AWG cable with a higher attenuation therefore the distance needs to be de-rated accordingly.

Attenuation = Reduction of signal strength during transmission. Attenuation is the opposite of amplification, and is normal when a signal is sent from one point to another. If the signal attenuates too much, it becomes unintelligible; Attenuation is measured in decibels (dB).

Solid conductor cable meeting these standards was originally designed for use as Harness and Switch Links, predominantly in Inter Cabinet links within major communication rooms and Data Centres.

In this environment it is not a major issue that some of these cables have an Attenuation factor/rating of 1.5, which means a reduction in the permanent link length from 90metres to 60metres as anything over this length in a data centre would typically involve fibre. There are some that state they are 'zero loss' which has been achieved by a higher quality construction but they can still suffer one of the following key issue if not deployed in a suitable manner.

Furthermore the reduced dimensions and lower cost can be seen as a distinct advantage in some high density applications within the DC and Major Comms Rooms.

Now comes the key issue, possibly the largest concern about using 26 AWG cable throughout; it involves Power over Ethernet (PoE) it is being increasingly deployed to power devices such as a phones or cameras etc. The standard PoE has the capability to handle 15.4W over 4 pairs.

In September 2009 IEEE 802.3at (PoE Plus) was approved and devices are now starting to appear on the market that utilise enhanced PoE to support 34.2W for 2 pair powering, however this does not mean you can use all 4 pairs to double the power. This will have a dramatic knock on effect in ways we have never previously considered when designing structured cabling installations.

Number of cables	Temperature rise <sup>a</sup> °K				
	Category 5	Category 6	Category 6 <sub>A</sub>	Category 7 <sup>a</sup>	Category 7 <sub>A</sub> <sup>a</sup>
1	0.76	0.63	0.56	0.56	0.56 ffs
7	1.39	1.11	0.97	0.97	0.97 ffs
19	2.64	2.08	1.81	1.81	1.81 ffs
37	4.65	3.68	3.19	3.19	3.19 ffs
61	6.88	5.49	4.79	4.79	4.79 ffs
91	9.65	7.71	6.67	6.67	6.67 ffs
127	13.06	10.42	9.03	9.03	9.03 ffs
169	16.88	13.47	11.67	11.67	11.67 ffs

<sup>a</sup> Calculated values for worst case

The ISO/IEC TR 29125 lays out guidelines for remote powering and gives worst case temp rise for cable bundles of different Category vs. current carried per pair however it only covers down to 24 AWG Cat 5e cable. The table above gives an indication of the potential temperature rises.

At 600mA, which is the upper limit of PoE Plus, a bundle of 127, 24 AWG Cat5e cables will see a temperature rise equivalent to over 13° Centigrade. Using the above, it is not hard to imagine the heat produced by the not un-realistic number of 300 cables in a run.

To date no detailed analysis has been done to estimate the temperature increase that will result from using thinner 26 AWG cable, however if, as we have already established, the cable has a greater resistance, it is only reasonable to assume this will be reflected in an additional temperature increase.

As all twisted-pair cables are referenced in the cabling standards at 20°C +/- 3°C, beyond this the Attenuation is adjusted by a factor of 0.2% per degree Celsius. In turn the performance of the cable could be dramatically reduced as temperatures within bundles could be well above this level.

## Conclusions

Consideration must be given to the first paragraph of this paper. The IEEE agreed to use Class E<sub>A</sub> as defined by ISO/IEC 11801, BS/EN 50173 as the basis for any future developments around 10G Ethernet. Trying to implement a non standards based solution runs the risk of not being able to support future applications as they are developed.

To give an example, if IEEE were to come up with a High Definition Interactive Video Solution over 10G Ethernet, over a Class E<sub>A</sub> system, there are no guarantees this would work over a bespoke solution using either Cat 6 cabling or the 26AWG work area cable.

It is imperative to weigh up the very limited numbers of benefits against a large number of potential risks by going with either of the two options mentioned. The IEEE is constantly developing new applications and relevant standards, and are doing this based upon the physical medium i.e. the Cabling System meeting what ISO/IEC and BS/EN have defined.

The result may be a risk too far.

*This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.*



# White Paper

## Cabling Performance vs. Component Conformance

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Within international standards for generic cabling, such as ISO/IEC 11801, we have specifications for the transmission performance of balanced cabling channels and links defined as Classes A to E,  $E_A$ , F and FA. Conformance to the standard requires that the required channel Class is achieved. The same system is adopted in Europe and in the UK is published within the BS EN 50173 series of standards (although the BS EN 50173-1 amendment containing Classes  $E_A$  and FA is not published yet).

In the equivalent US standard, the ANSI/TIA/EIA-568-C series, the transmission performance of balanced cabling channels and links is defined in terms of Category - with Category 5e, 6 and augmented Category 6 being approximately the same as Class D, Class E and Class  $E_A$  of the ISO/IEC standards.

In all the standards the component requirements, covering cables, connecting hardware and cords, are specified in terms of Category.

One way of achieving the desired channel performance is to use components of the correct Category in the correct configuration (sometimes known as a "reference implementation"). Using such reference implementations Category 5 components may create Class D channels (in the ISO/IEC and BS EN world) or Category 5 channel (in ANSI/TIA/EIA world).

However, two important phrases are used in the preceding paragraph and are marked in italic text. The first is the use of the term "one way". There are in fact three separate routes to conformance with the desired ISO/IEC and BS EN channel performance and only one requires the use of components of a defined Category. The second important issue is the use of the word "may". This is because the use of components of a given Category in a reference implementation does not guarantee the required channel performance. Figure 1 shows the relevant text in the relevant BS EN 50173-x standards (it is essentially the same in ISO/IEC 11801). The key terms are in the third bullet and are "based upon a statistical approach to performance modelling" which undermine the traditional, and arguably perfectly reasonable, assumption that if cables, connecting hardware and cords conform to a specific Category then any resulting cabling will also meet the requirements for links and channels respectively. To understand why this text is included in the standards, one has to remember that cabling and component performance requirements are in a continual state of development. In the 1995 edition of ISO/IEC 11801 (and BS EN 50173) we only had to consider Class D:1995 channels created using Category 5:1995 components. In

- d) the performance of channels shall conform to the requirements of Clause 5. This shall be achieved by one of the following"
  - a channel design and implementation ensuring that the prescribed channel performance Class of Clause 5 is met;
  - attachment of appropriate components to a link design meeting the prescribed performance Class of Annex A. Channel performance shall be assured where a channel is created by adding more than one cord to either end of a link meeting the requirements of Annex A;
  - using the reference implementations of Clause 6 and compatible cabling components conforming to the requirements of Clauses 7, 8 and 9, based upon a statistical approach of performance modelling.

Figure 1 - Extract from the conformance clause of BS EN 50173-2

2002 the Class D channels and Category 5 components were updated - harmonising them with the then new Category 5e requirements specified in the North American Standards. In addition, we introduced channel Classes E and Class F along with Category 6 and 7 components. It was this that forced the universal amendment of the conformance clause exemplified in Figure 1 after the detailed performance modelling use to determine the performance of the components showed that channel performance could not be guaranteed in all circumstances - for all Classes.

The situation has not only not improved but has got worse with the current introduction of Category  $6_A$  and 7A components that may be used to create Class  $E_A$  and FA channel respectively. Now the modelling indicates that statistical risk has increased and, even worse, that certain configurations of Class FA cabling requires the use of components of performance significantly in excess of Category 7A.

So, in the face of this rather unwelcome news, how should customers specify their needs?

Quite clearly, simply specifying components of a given Category is not the way to proceed unless the specifier has a full understanding of the situations under which the statistical risk to either link to channel performance applies. In fact since two out of three routes to conformance do not require the use of specific components (and the third requires technical knowledge or advice) then a simple and dogmatic reliance on component Categorisation would seem to represent a demonstrably poor solution - particularly as the required channel performance increases.

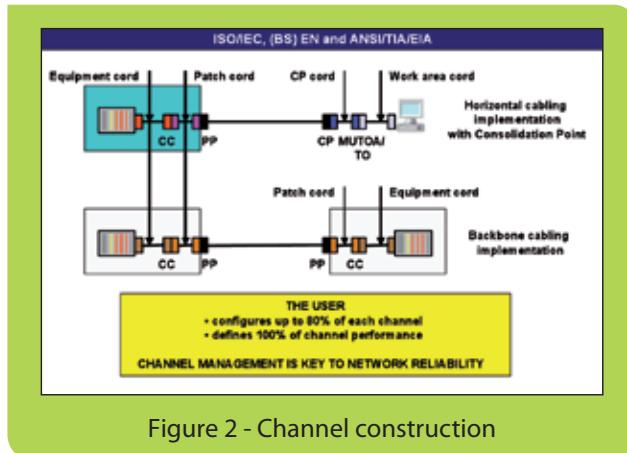


Figure 2 - Channel construction

The problems with relying on component performance alone begins with the structure of a channel. As shown in Figure 2, a channel is created by adding some cords to a fixed installation. The cords are added at the telecommunications outlet (TO), connecting the fixed cabling to the equipment in the work area (work area cord) and at the panels in the distributor, either as a direct interconnection to equipment (using an equipment cord) or an indirect connection via cross-connect (using both an equipment cord and a patch cord). If a consolidation point (CP) is used then two cords are needed to connect the CP to the work area equipment.

It is not only the presence of cords attached to the fixed cabling that creates the challenge to channel performance but their number, length and performance. It will be noted that

the second route to conformance described in Figure 1 states that "channel performance shall be assured when adding more than one cord to either end of a conformant link". This means that just because the fixed installation has been tested and shown to be conformant (e.g. a Class E link) there is no guarantee that Class E channels are automatically created by adding more than one cord of Category 6 at one or both ends. Instead, the standards require the attachment of "appropriate" components. This means "appropriate" to the design of the link and the resulting channel. A requirement of BS EN 50173-2 (applicable to all premises adopting office cabling structures) is to design horizontal cabling to provide a minimum of Class D channel performance - allowing the customer the option to specify a higher Class if required. The key thing is to have a design that ensures that the required channel Class can be created. This means that the supplier should advise the client of the conditions under which the desired Class will be achieved taking into account the configuration of the cabling and the environment to which the cabling is subjected.

For example, for a given length of equipment cord ask the distributor, which lengths of patch cords should be avoided if resonance-related failures are to be prevented. Similarly, what combinations of CP cord and work area cord lengths must be avoided for the same reasons. Furthermore, are there recommended restrictions of minimum fixed cabling lengths to prevent link test failures where CPs are used - and, finally, what is the impact on fixed cabling lengths of using long cords or where the cabling experiences elevated temperatures - such as those generated by Power over Ethernet.

The answers to these types of question are significantly more important than whether a specific component meets a particular Category. Moreover, it is impossible to determine from the results obtained from a link or channel test:

- Whether or not the components within the cabling met a specific Category
- Whether that Category of performance was achieved by those components in the installed condition.

Therefore, whilst it may be desirable to specify components of a given Category, it has to be considered to be a secondary consideration.

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## Bibliography

ANSI TIA/EIA-568-C	Generic Customer-Owned Telecommunications Networks series
BS EN 50173-x:2007	Information technology - Generic cabling series
BS EN 50173-2:2007	Information technology - Generic cabling - Office premises
ISO/IEC 11801	Information technology - Generic cabling for customer premises



# White Paper

## Racks versus Frames

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For those of you who have wondered why there is such a varied choice of mounting equipment and patch panels for installation in to either a rack or an open frame, this document aims to highlight those differences and discuss the most suitable products in a variety of situations. There are pros and cons for using both types of enclosure depending on the actual design. Ultimately both are designed to accept 19" rack mount patch panels and equipment.

### Racks

Available in different heights, widths and depths with various options for the doors and panels, racks are the most common way of mounting patch panels or equipment. The height is measured in "RU" Rack Units, or more commonly, "U" Units. This is the usable height available inside the cabinet, and not the physical height. As a reminder, 1U is 1 $\frac{3}{4}$ " (44.45 mm). The standard widths that are most commonly available are 600 & 800 mm, which is convenient as the standard raised floor system is constructed with 600 x 600 mm floor tiles. 19" profiles can be fitted in different positions (Front, Rear, Mid, etc) to support the patch panels and various equipment. By using the front and rear 19" profiles heavy equipment can be fitted.

### Pros

- Various heights, widths and depths
- Racks which can cope with large weight limits are available
  - 1000 kg or higher
  - Equipment can use front and rear profiles for added support
- Different door types can be fitted
  - Glass
    - Cabling and equipment are visible
    - Security
  - Solid Steel
    - Higher security
  - Vented
    - Airflow
    - Security
- Wardrobe style double doors available
  - Easier access in restricted spaces
  - Commonly fitted to the rear of cabinets
- Managing airflow
  - Improve cooling
  - Reduce costs of cooling systems – efficient usage of air
- Security
  - Restricting access to authorised personnel
  - Co-location of clients
- Earth Bonding for equipment and panels



## Frames

Frames are the simplest method of mounting patch panels and are available in various heights. They can take up very little floor space (footprint). 2 post frames consist of two vertical 19" profiles that have a simple base. This arrangement of profiles best suits where patch panels have to be mounted which can be due to a number of reasons such as:

- They are cantilever mounted from the front only
- No air flow management is required
- Works well where a cross-connect is employed
- Easy access to patching
  - No opening of doors
  - Between frame patching can be managed
- Smaller footprint
- Lighter

## Conclusion:

Racks and Frames have their different uses. Frames are common in larger communications rooms and data centres where security is controlled by means of access to the room. They are good for managing patching (copper and fibre) and offer a compact solution. Racks are versatile, offer airflow management and security meaning they can be used in work areas as well as dedicated rooms.



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*This White Paper has been produced by Simon Robinson, Product Manager, on behalf of Excel*



# White Paper

## What is Third Party Verification?

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Third party verifications are an independent 'tick in the box' confirming either a product or a set of products' compliance with a particular standard. In the Structured cabling industry, this verification testing, is performed by a small number of expert test laboratories, and can incorporate testing of components for communication cabling, i.e. horizontal / backbone cables, connecting hardware, patch cords, and permanent links and channels consisting of these components.

Testing is carried out in laboratory conditions using highly sophisticated, extremely accurate network analyzers and test rigs.

### Who Carries Out The Verification Testing

There are a small number of well known verification organisations, each of which offer a range of test and certification services, some of the most recognised service providers include , Delta, 3P, Intertek, GHMT.

Excel has chosen to work closely with Delta and the majority of the products offered by Excel which hold third party verification are part of Delta's EC VERIFIED programme.

EC VERIFIED is a globally recognised approval programme for cables and connecting hardware. It confirms that the products have been tested to, and meet, the relevant standard by Delta, whose processes and model are approved by the Danish quality standards body DANAQ, as an accredited independent third party testing laboratory.



### Are There Different Types of Certification programmes ?

Broadly speaking, there are two types of approval programmes available:

- Full Maintenance Approval
- Certificate of Compliance

The specific names for these approvals can be different from one test house to another, - for example assesttation of conformance has the same general meaning as certificate of compliance but the details of them are very similar. The table opposite highlights the general difference between the two.

Certification	Certification of Compliance	Full Maintenance Approval
<b>Validity of Certificate</b>	One year	As long as the programme is running, renewed annually
<b>Branding</b>	Cannot use the official logo of the test house	Can use the official Logo of the test house
<b>Statement in Literature</b>	May state that the product has been tested by the test house	The product can be accompanied by the Official Logo (E.g.: 3P Verified / EC Verified)
<b>Listing on the website of the Test House</b>	N/A	Listed until the approval is discontinued
<b>Sample Approval</b>	One time testing of production sample	Initial approval of production samples
<b>Factory Inspection</b>	N/A	Factory inspection will be required before qualification can be granted
<b>Follow up Activities</b>	N/A	Factory inspection and sample approval every 6 or 12 months

### Factory Inspections:

It can be seen that a major difference between the approval processes, is the use of factory inspection as part of the full maintenance option.

Approval certificates without factory inspections do not take into account or review the stability required in continued production performance. Factory inspection visits help develop understanding and confidence that the required production and quality control processes are in place before concluding that testing is done on representative samples from regular production. To summarise, Factory inspections by third party test houses will demonstrate that tested quality is in fact production performance, day in day out.

In comparison, products which list certification or attestation based approval are effectively confirming that a single sample provided to the test house has successfully passed the required test criteria. This method of gaining verification is sometimes referred to as a 'golden sample' due to the process of providing single samples once, to gain certification.

A further consideration is the level of certification gained by the product set being considered. Specifically, has the highest possible testing available – known as component compliance – been achieved, or the 'easier' channel verification. This is the subject of separate Excel white paper which can be found online and within the Excel Encyclopedia.

#### How can Consultants / End Users verify the Certification?

The test houses referred to in this document are generally happy to support end users if they are uncertain about any approvals. They understand that it is important to offer quick and efficient response to end users as this is key to secure market trust in their approvals. This service is generally offered free of charge for products that have 'Full Maintenance Approval'.

The validity and the authenticity of an approval can be confirmed by visiting the website of the relevant third party test house, or, by an e-mail / phone call. Listed below are the website addresses of the test providers referenced in this document of some of the major test houses:

- Delta - [http://www.madebydelta.com/delta/Business\\_units/LAN/LAN+Frontpage.page?](http://www.madebydelta.com/delta/Business_units/LAN/LAN+Frontpage.page?)
- 3P - <http://www.3ptest.dk/index.php/3ptest/3P-Qualified-Products/Introduction>
- Intertek - <http://www.intertek.com/cabling-products/>
- GHMT - [http://www.ghmt.de/ghmt2/index.php?option=com\\_content&task=view&id=31&Itemid=76&lang=en](http://www.ghmt.de/ghmt2/index.php?option=com_content&task=view&id=31&Itemid=76&lang=en)

As an example, visitors can visit the Delta web site and browse through the links on the left index of the page to a specific manufacturer (EC Verified Companies), or, to view a list of companies that have a valid approval for a specific product type they could use EC Verified Components to navigate their way through easily.

Screen shots of Delta, 3P websites are shown below.



#### Conclusion:

Third Party approvals provide assurance and peace of mind for End users and Consultants before choosing a product. End clients will benefit by going the extra mile to ensure that the approval shown by a manufacturer is a 'Full Maintenance Approval' that includes factory inspection and random sample selection, that the verifications are valid – specifically check validation period and standards against which certification that is offered to ensure most recent versions.

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# White Paper

## Is this the way forward when deploying Power over Ethernet (PoE)?

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A lot has been written about Power over Ethernet PoE, yet it is still an area of great confusion and even concern in some quarters. This paper will endeavour to discuss the reality of what is available in today's market, both Standards Compliant and Non-Standards Compliant, it will give an opinion on what the future developments might be and what is happening that could mitigate some of the concerns that have been previously highlighted and are being discussed throughout the industry.

### State of Play

To start with we should first establish what the current state is with the PoE standards, as there are a large amount of false claims about levels of power that can be supported over standards compliant structured cabling.

IEEE 802.3af Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) the basics of this outlined 15.4Watts Powering and 12.95Watts Powered, this basically means what is sent from the Power Sourcing Equipment (PSE) such as an Ethernet Switch or a Power Injector etc and what is received by the Powered Device (PD) such as an IP Telephone, Wireless Access Point or IP CCTV Camera. The key with this configuration is the fact that the PD is the device that has the intelligence, it dictates what level and class of power it requires as well as which of the two pairs it needs to run over.

In 2009 IEEE 802.3at was published which introduced Enhanced PoE or PoE+. It increased the level of power to 34.2Watts Powering and 25.5Watts Powered, this document also redefined the term for the two levels of power to Type 1 and Type 2.

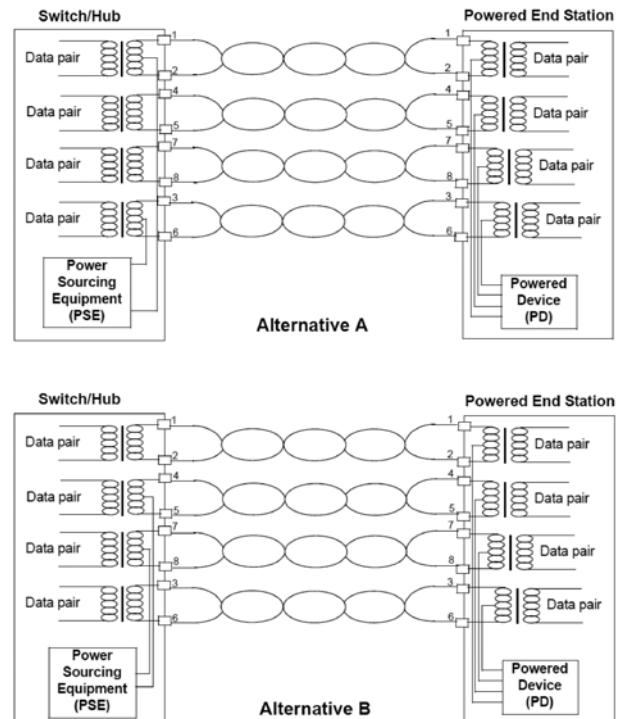
As has already been alluded to, Standards compliant PoE is based upon 2 pair powering and not all four pairs, this is highlighted within the following text from IEEE 802.3at;

*"A PSE shall implement Alternative A, Alternative B, or both. While a PSE may be capable of both Alternative A and Alternative B, PSEs shall not operate both Alternative A and Alternative B on the same link segment simultaneously"*

This means a PSE should be able to deliver power on either of the two pairs however the PD will only receive on one of those pairs. The following image gives an outline of Alternative A & B. The former delivers on pairs 1,2,3,6 and the latter 4,5,7,8.

### Standards Compliant Cabling

All of the developments of PoE both now and into the future are based around Standards Compliant Horizontal cabling, not thin conductor so called 'zone cable' and certainly not Copper Clad Aluminium (CCA) the latter seems to be creeping



in via distribution channels that have little or no experience of structured cabling and therefore do not fully understand the implications.

The main by-product of PoE is heat, the full extent of the impact and how it should be resolved, will be discussed later in this paper.

IEEE 802.3at is very clear about what should be used to support its operation.

*"Type 2 operation requires Class D, or better, cabling as specified in ISO/IEC 11801:1995 with the additional requirement that channel DC loop resistance shall be 25 Ω or less. These requirements are also met by Category 5e or better cable"*

Two parts of this statement should be clarified further with reference to the first line of the paragraph the standard also states that it should support PoE up to 100m in the channel. This can also be interpreted with the additional requirement for DC Loop resistance of  $25\ \Omega$  or less, this can only be achieved by the use of solid core cable that complies with the component standard for horizontal cable, ISO/IEC 61156-1 which calls for the conductors in the cables to be a minimum of 0.51mm (24AWG approx)

The use of 26AWG cables for anything other than patch and equipment cords is not allowed due to the higher attenuation of the cables which results in shorter compliant lengths and even higher temperatures than have been tested.

### What is on the Horizon?

A lot of discussion is currently going on about what the next level of power will be and when. The IEEE is under a great deal of pressure to approve an even higher level of PoE.

The current thinking is that it will approve a level of PoE called UPoE in the next 12 Months.

Cisco's Universal Power over Ethernet UPoE extends the current PoE+ by delivering 60Watts over all four pairs, whilst this is claimed in all the marketing material, they have actually adhered strictly with 802.3at, therefore the PD actually receives 51Watts at 50V. The one element that has not changed is the requirement for standards compliant cabling.

Given the involvement of Cisco Systems, there are a number of applications for this technology already being deployed such as the powering of Thin Client devices, Laptops and IP enabled Trading Turrets which further strengthens the assumption that this will be the next level we will see.

### Non-Compliant Systems

Unfortunately not all systems are standards compliant despite what they may claim in their marketing materials. There have been claims of systems that can support in excess of 100Watts over Category 5e UTP.

One of the main culprits of this is HDBase-T and which is a technology that has been developed by a number of vendors and because there wasn't a standard to meet their requirements they came up with their own. It is a technology for powering remote Audio Visual (AV) devices such as display screens and monitors.

The interesting revelation from white papers produced by suppliers of HDBase-T complaint AV systems is it doesn't work in the way it is being promoted and certainly does not support the model that has been developed by 802.3at.

These white papers highlight that the distances involved are far less than 100m in fact if Ultra HD video is involved the signal can only be supported at distances of less than 35m using a Category 6 UTP cable, the channel configurations are also non compliant with the channel we have come to know in ISO 11801. The typical installation is a two connector channel, therefore a length of horizontal cable with devices connected directly at either end so it does not allow for a cross-connect patching field.

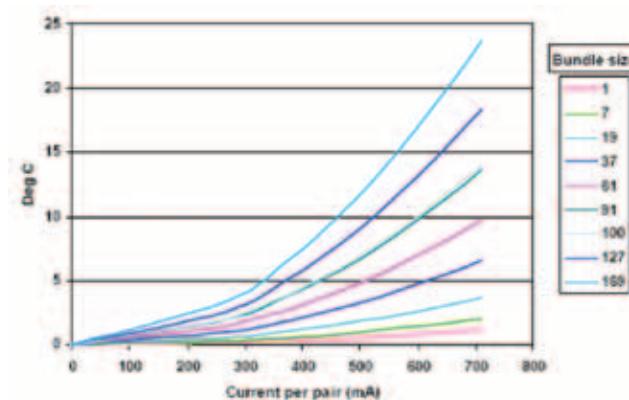
The problem is so great that one of the equipment manufacturers have developed their own high spec S/FTP cable to support the technology.

### The downsides of PoE

There are two big problems that come with PoE and a lot of end-users and specifiers are either not aware of or just choosing to ignore. Unfortunately they are not going away but you can do something about them.

The first of these problems has been discussed at great length in various quarters and something is being done about the impact of heat build-up in the cables carrying PoE or 'energised' this will be discussed in far greater detail in the next section. However go back to what standards compliant PoE+ is 34.2Watts Powering and 25.5Watts Powered, the approx 9Watts difference is 'lost' in transmission, however with energy nothing is ever lost, it is just converted into another form of energy and in this case it produces HEAT and if you are discussing large bundles of energised cables it could be a substantial amount of heat.

The following chart gives an indication of the potential levels of temperature increase over the ambient.



This temperature has an impact in two areas, firstly how do you get rid of the unwanted heat the second is a factor that a lot of people ignore temperature increases above the ambient of 21C leads to higher attenuation (Insertion Loss), higher attenuation means shorter transmission distances. Therefore in simple terms a device that is at the end of a 90m permanent link may stop working once the cables heat up.

The second major factor is the design of Secondary Equipment Rooms/Floor Distributors (SER/FD). Most Architects and Building Service Consultants are making no provision within these spaces for the higher power and heating load that PoE is generating in these spaces.

To give a simple example, this can be seen if a Cisco Catalyst is deployed, just looking at the following table and working back the numbers; if 250 devices require UPoE then there will be a power and cooling requirement of 12Kw, standard none PoE switches supporting a similar number of devices would typically have a requirement of less than 3Kw

	Standard 802.3af Classes 0 and 3 (15.4W per Port)	Standard 802.3at Class 4 (30W per Port)	Cisco UPOE (60W per Port)
4200WAC	374	192	96
6000WAC	384	269	134



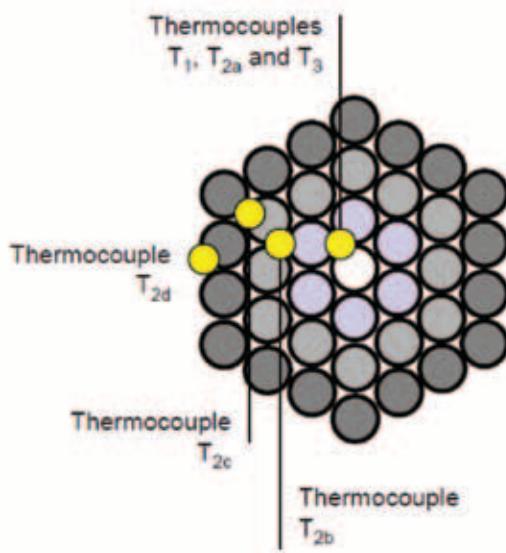
So is the power and cooling going into the SERs to support this level of load? The evidence suggests not.

## Testing the Impact

There is light at the end of the tunnel in truly understanding the extent of the problems and how to mitigate the impact of PoE. In 2010 ISO/IEC published a Technical Report TR 29125 which looked at mitigating the heat created by PoE. Whilst a lot of the content was very useful and good recommendations made, unfortunately the testing methodology used was badly flawed, with too many assumptions made. The main flaw being that cables were only tested in 'Free Space' and no form of containment was ever tested.

Cenelec on the other hand have started with a very robust testing methodology of the impact and will then base its recommendations upon the findings. The testing methodology published under WD TR EN50174-99-1 has set out all the separate environments as well as methodologies. It will also cover all the separate power levels that the cable may be subject to, from PoE, PoE+ and UPoE etc. On knowing the true impact we will then be able to effectively mitigate the problem.

This Technical Report has detailed the size of the optimum bundle size for testing purposes (a bundle of 37 cables produces the best results) along with where the temperature is measured.



The results of this testing will provide far more accurate data to base mitigation strategies on.

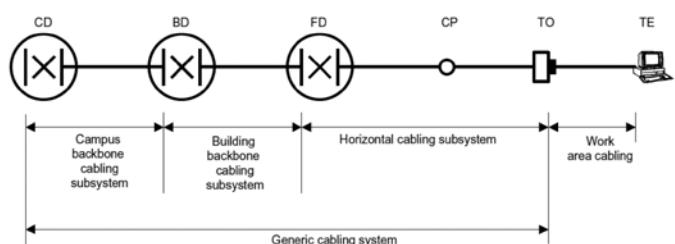
Finally there is one impact of PoE that may not be easy to overcome and that is the physical effects of constantly mating and de-mating connectors that are energised. Research has shown that unplugging an RJ45 patch cord from a socket whilst under load causes a minor electrical arc between the pins on plug and socket, whilst that arc occurs at the initial point of contact rather than the fully mated position, it does cause the gold plating of the contacts to become eroded. If this is a repeated action this erosion 'creeps' along the pins/contacts to such an extent that the overall performance is affected, therefore the standards bodies are considering reducing the minimum number of mating cycles, when energised with PoE, from 750 to 100. The TR will also look to address ways of minimising this impact.

## A New Design approach to the problem

Along with the above testing method from the proposed TR producing a way of mitigating the issues of PoE, a new standard has been published that provides a design methodology of reducing the impact of PoE enabled IP devices.

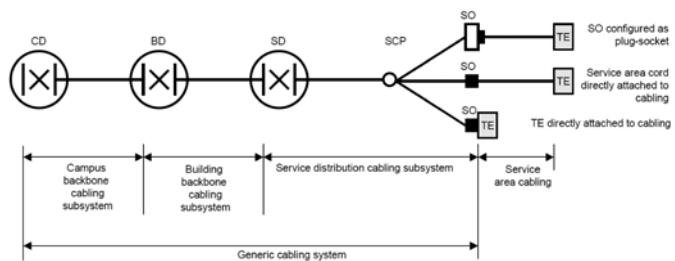
EN50173-6, Distributed Building Services, provides a set of guidelines that could further reduce the impact of PoE by moving some of the issues discussed to the edge.

It is in the same family as the rest of the series EN50173 therefore the principles remain the same the minor change being the meaning of the acronyms used, the items themselves are used in almost exactly the same way. The following images show hierarchy used in EN50173-1 and the similarities are obvious.



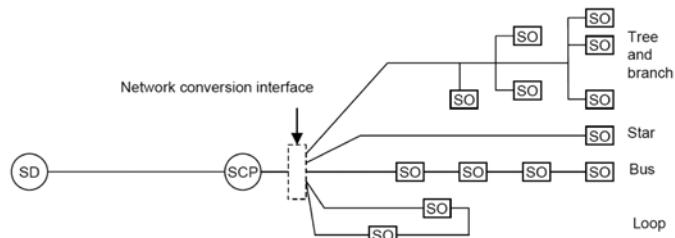
**EN50173-2 – Office Premises**

We have become comfortable with the above model it has been in use for many years, the following model from EN50173-6 only differs in the terms used, rather than Floor Distributor we now have a Service Distributor and rather than Consolidation Point we have a Service Concentration Point.



**EN50173-6 – Distributed Building Services**

The big difference happens at the SCP and beyond within the new Standard we have the ability to install an active device such as a Network Conversion Interface (NCI) to provide a point where the topology of the Infrastructure can change to adapt to the legacy systems of the Building Service Environment.



To accommodate not just the Star topology of IP Networks but also the BUS, LOOP and Tree and Branch found in BacNet, Echelon and LONworks networks that are used for Building Service applications such as access control, Building Management Systems (BMS) etc.

The inclusion of the NCI at the SCP also allows us to start implementing PoE Mid-Span devices at this point. The pros and cons of this approach are quite straightforward.

**Pros:**

- Moving the power and cooling requirement to the edge.
  - Far less density of energised cables, leading to less heat build up on major routes
  - The cables will run smaller bundles if not single cables on diverse routes leading to less heat build up
  - The smaller requirement for power at the edge is easier to accommodate
  - Less power means less cooling, which can be typically handled by ambient cooling
  - Shorter cable runs means less power required for transmission, less heat build up
- Existing SERs can handle the power and heat requirements without major costly redesigns and dedicated cooling solutions

**Cons:**

- Power required at the SCP or Consolidation Point
- An extra set of connectors required in the Channel Model (however this can be covered within the 6 connector channel model)
- Requires an acceptance by the Building Services Consultants designing other elements of the infrastructure

## Conclusions

PoE is a technology that is here to stay and the levels of power involved will continue to increase. With this comes the need to act responsibly when deploying it, unfortunately this is where a major problem exists. There remains a great deal of ignorance about PoE along with its benefits and pitfalls, which has only been made worse by overinflated claims made by some vendors.

The major issue is PoE is being sold as a retrofit application i.e. it is being installed onto existing structured cabling installations that may have been in use for a number of years, the design of which was carried out without a minutes thought about the use and implications of PoE. Unfortunately the effects will not be encountered on day one of use, it may even be some weeks or months before the problem comes to light when the heat builds up sufficiently to cause a problem.

This White Paper has been developed to provide an insight into the current state of play and provide some guidelines on how to come up with a Network design that can deploy PoE effectively and avoid some of the major pitfalls that have been discussed.

*This Technical Note has been produced by Paul Cave, Technical Manager, on behalf of Excel.*



# White Paper

## NVP, what is it for?

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In this paper, Simon Robinson, Excel Product Manager, explains the term NVP and how it is used in infrastructure data cabling.

### NVP, what is it for?

NVP, yet another acronym to understand in infrastructure cabling... NVP is a property of copper data cabling that is, hopefully, stated on specification sheets and required to carry out testing, but why?

Firstly, NVP stands for Nominal Velocity of Propagation. It is the speed at which the data signals travel down the cable expressed as a percentage of the speed of light in a vacuum. So a typical NVP for an unscreened cable may be 69% (sometimes expressed as 0.69). The speed of light in a vacuum (designated by the letter  $c$ ) is a constant and is  $299\,792\,458\text{ ms}^{-1}$  (metres per second) – far easier to quote the percentage than use the value.

### What is NVP used for?

Part of the requirement of testing is to record the length of a copper data cable. This can be done manually by reading the cable sheath, and hoping that the metre marks are reasonably accurate and then recording it. This is not very easy once the cable is installed and would also require manual input in the test results. So by knowing the speed that the signal is transmitted down the cable it is a simple matter of the test equipment using:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

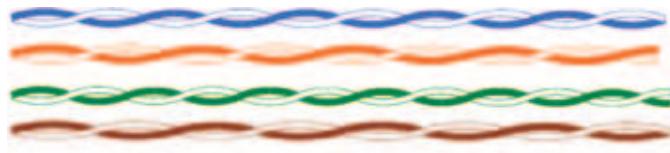
The testers measure the delay in the signal (time) and use the speed (NVP  $\times c$ ).

### Which length is used?

There are in fact different lengths when looking at a twisted pair cable.

- Sheath Length
- Copper Length

The Sheath Length is the physical length and most cables, including Excel, have metre marks to aid this measurement. Copper Length is the actual length of the copper conductors. Data cables are constructed of twisted pair cables. Each of the four pairs has a different twist rate, and so is of different length.



**4 Pairs of different twist rates**

Different twist rates are used on the pairs to improve the performance and reduce cross talk issues. These different lengths account for the delay skew (see below). When the length of the cable is referred to in cable or installation design it is the sheath length that is the measurement.

Attenuation (Insertion Loss) is directly proportional to the length of the installed cable. The longer the cable the more the signal is attenuated or lost.

### Why is the length important?

Attenuation (Insertion Loss) is directly proportional to the length of the installed cable. The longer the cable the more the signal is attenuated or lost. The components for infrastructure cabling systems up to and including Class FA are designed to ensure that the insertion loss does not exceed certain values when the channel length is at a maximum of 100 m. By specifying these limits, applications can be developed knowing that they will work on compliant Generic Cabling systems. As mentioned above, the twist rates of each pair, is different within the sheath. The different lengths of the pairs means that the delay (the time taken for the signal to be carried down the cable) will be different across the pairs. The difference in delay between the longest and shortest pair is the delay skew. It is important that the delay skew is within limits to ensure that the applications, that use multiple pairs, will function correctly.

### How is NVP calculated?

The standards use the delay measured at 10 MHz of the shortest pair on 100 m (sheath length) of the cable.

#### Example – Excel Category 6 Unscreened Cable – LSOH

Delay measured at 10 MHz of shortest pair (lowest value)  
 = 497.075 ns (nanoseconds)  
 =  $497.075 \times 10^{-9}$  seconds

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Speed} = \frac{100 \text{ m}}{482.675 \times 10^{-9}}$$

$$\text{Speed} = 207\,178\,743 \text{ ms}^{-1}$$

Therefore

$$NVP = \frac{\text{Speed}}{c}$$

$$NVP = \frac{207\,178\,743 \text{ ms}^{-1}}{299\,792\,458 \text{ ms}^{-1}}$$

$$NVP = 0.69 = 69\%$$

### Finding the NVP

The NVP of data cables are stated on specification sheets and often stored in the test equipment as well under the manufacturers name – for example Excel. These are, as the name implies, are nominal values and may vary between batches. For improved accuracy the actual batch of cable being used on a given installation can be checked. The NVP can be measured using field test equipment such as the Fluke DTX-1800. A known length (using cable sheath length measurement) permanent link is connected to the field tester. The field testers have a function to calculate the specific NVP without going through the above calculation.

### In summary

NVP, Nominal Velocity of Propagation, is the fraction or percentage of the speed of light that is used to express the equivalent speed that signals travel down the length of the constructed cable. This speed is used to measure the length of the cable. Knowing the length of the installed cable is important to ensure that it meets the specification and therefore will support the stated applications.

*This White Paper has been produced by Simon Robinson, Product Manager, on behalf of Excel*



# White Paper

## BS EN 50174-1 AND BS EN 50174-2:2008



The 2008 revision of EN 50174-1 and EN 50174-2 has been approved by the European national standards bodies and was published in all EEA countries in early 2009. In the UK they are designated BS EN 50174-1:2008 and BS EN 50174-2:2008 and replace the existing versions of the documents, published in 2000. These standards have major significance for the telecommunications cabling industry, covering "installation specification and quality assurance" and "installation planning and practices inside buildings" respectively.

Telecommunications cabling infrastructures have been subject to an increasing level of contractual disputes resulting from a lack of relevant information being provided to the installers in combination with poor installation practices. In a court of law, judgement is often based on what a reasonable person would be expected to do - and this is normally based on the available standards. The UK national standard for the "installation, operation and maintenance of telecommunications equipment and telecommunications cabling" is BS 6701:2004 - which mandates compliance with the BS EN 50174 standards.

The work undertaken by the British and European standards committees over the last five years has been targeted to simplify the use of standards in an installation contract - removing the need for the customer and their consultants to include multiple, sometimes conflicting, often obsolete, standards where only one or two are really needed.

A simple reference to BS 6701 is all that is needed to define the installation requirements - independent of the design of the infrastructure.

However, many customers, consultants and installers alike do not realise that the presence of other standards in a contract already mandates compliance with these "installation" standards. For example, any client wishing the cabling to be designed in accordance with any of the structured cabling standards in the BS EN 50173 series, has automatically stated that the installations shall conform to both BS 6701 and the BS EN 50174 series. That being said, it should be remembered that BS 6701 and BS EN 50174 series of standards apply to all telecommunications and information technology cabling - not just structured cabling. Moreover, they can be applied to cabling systems that are designed with non-UK standards including the latest US standards in the ANSI/TIA-568-C series.

The 2008 versions of BS EN 50174-1 and BS EN 50174-2 are based on the format of BS 6701:2004 and not only introduce substantive changes to the existing requirements and recommendations but also present them in a more structured

way. This makes it much easier to define the separate responsibilities for installers and their clients - independent of whether those clients are the end-users or their consultants.

BS EN 50174-1:2008 effectively creates a "tick-list" of issues to be addressed in an Installation Specification - allowing clients to monitor what their consultants have produced on their behalf while letting the installers identify weaknesses or lack of clarity in what they are being asked to do. To balance the contractual see-saw, the standard details the requirements for the Quality Plan, produced by the installer, which explains how the specification is to be met. The very words "Quality Plan" send some installers into an apoplectic fit but there really is no need for such a reaction. A Quality Plan in the eyes of BS EN 50174-1 is just a list of Method Statements - and if installers do not already have basic Method Statements then maybe they are not suitable candidates for the project anyway. One of the more subtle changes in BS EN 50174-1 is the development of a concept of infrastructure complexity as a means of defining the scale or coverage of specific activities for smaller installations such as domestic premises.

EN 50174-2 has received a massive makeover. Often criticised, even by the standards-makers themselves, for a lack of clear requirements and apparent technical inconsistencies, the structure and content of EN 50174-2:2000 has been totally re-worked and re-engineered. BS EN 50174-2:2008 now contains three principle clauses against which conformance is assessed. The first is entitled "Requirements for planning installations....", the second: "Requirements for installation...." and the third: "Segregation of metallic information technology cabling and mains power cabling". These three sections represent the general requirements for all installations but have additional clauses for "offices", "industrial premises", "homes" and "data centres" which contain any modified requirements that are applicable to the particular premise type. The 2008 edition of BS EN 50174-2 contains the "offices" and "industrial premises" clauses and a further amendment in 2009 contains the clauses for "homes" and "data centres".

The new requirements for the segregation of metallic information technology cabling and mains power cabling, in relation to electrical interference, are now recognised to be much more logical and are being reflected in future changes to the UK Wiring Regulations.

This White Paper opened by referring to a growth of contractual disputes surrounding installations of telecommunications cabling. Many large enterprise installations remain problem free since customers tend to define their own needs for the IT infrastructure and only use the services of specialist consultants to identify potential installers. Installers are generally free to discuss the small, but critical, details of the installation requirements directly with the customer - identifying incompatibilities and information shortfalls.

The real concerns exist in the domain of smaller installations (such as universities and hospitals) where the infrastructure specifications are handled by non-specialist consultants and are exacerbated by the fact that telecommunications cabling installation lies at the bottom of a multi-disciplinary sub-contract chain. In many cases, requirements that have been clearly defined and documented by customers are not included, or are incorrectly translated or modified, in the tender document and the use of extended sub-contracting chains frequently fails to provide the correct tender documentation to those undertaking the work. This is a "double-whammy" which often results in cabling systems that meet the required transmission requirements but are rendered non-functional, non-maintainable or irreparable due to non-agreed installation decisions.

However, both problems are symptoms of a more fundamental disease - a lack of direct communication between the end-user and the installer. So how can the new standards help to reduce installation disputes? BS 6701 and the BS EN 50174 series of standards offer customers the opportunity to stem the growth of poor installations - by defining the minimum content of installation specifications and mandating installers to produce quality plans which explain how those specifications are to be met - encouraging dialogue by insisting that both the installation specifications and the quality plans have to be agreed between the customer (or their representatives) and the installer - before the installation commences.

While no customer likes to be hounded by competing potential suppliers, the situation following contract award should be completely different. Consultants should enable direct communication between those paying for the installation and those performing it. Two fundamental questions must be answered by all customers - firstly, do the specifications produced on their behalf meet the requirements of the applicable standards and, secondly, do they wish to have technical oversight of installers appointment and proposals within the sub-contracting chain. The use of the available UK standards enable to the answers to the both questions to be a resounding "yes" - and the adoption of the standards is strongly endorsed by Excel.

## Bibliography

BS 6701:2004	Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance
BS EN 50174-1:2008	Information technology - Cabling installation - Part 1: Specification and quality assurance
BS EN 50174-2:2008	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings
BS EN 50174-3:2003	Information technology - Cabling installation - Part 3: Installation planning and practices

*This White Paper has been produced by Mike Gilmore, e-Ready Building Limited, on behalf of Excel.*



# White Paper

## Demystifying PoE

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It's a welcome bonus of Ethernet and structured cabling, but as the demands for Power over Ethernet (PoE) grow, is this once preferred solution about to run out of control? This white paper investigates some of the realities of PoE and looks at how we can use it wisely.

### The Standards

We can't look in depth at PoE at all without understanding the standards. These are the strict guidelines of how it should be used and must be abided by.

802.3af PoE or what we now call Standard POE was published in 2003. This document set out the method of delivering power to end Powered Devices (PD) from Power Sourcing Equipment (PSE), such as a new breed of PoE enabled Ethernet Switches or in the case of legacy installations, Mid-Span Power Injectors. They were designed to provide 15.4 watts, however given the distances and potential losses over the cable and connectors, the end powered devices expected a total of 12.95 watts.

In 2009 we saw 802.3at published which answered the demands of some manufacturers of the end devices, who had been asking for more power to exploit their full features. As in the case of CCTV manufacturers with PTZ (pan, tilt and zoom) capability, it was struggling with standard POE. This new standard dramatically increased the limits, in effect doubling the power levels involved to 34.2 watts powering and 25.5 watts powered.

### Doubling the Power?

Exactly what power you can get from PoE has been debated and has caused much confusion, but the answers can be found quite simply by looking at the standards.

PoE runs over two pairs, however although the load can be received over all four pairs, as in Figure 33-5 from the standard, it does not mean using all four pairs doubles the power.

At any one time only 2 of the pairs can deliver the power, even if 4 pairs are used, so the power can never be doubled in this instance.

The following statement from the 802.3at standard should clarify this point. Please remember to bear in mind that in standards parlance "SHALL" is mandatory and "SHOULD" is recommended.

"PSE shall implement Alternative A, Alternative B, or both. While a PSE may be capable of both Alternative A and Alternative B, PSEs shall not operate both Alternative A and

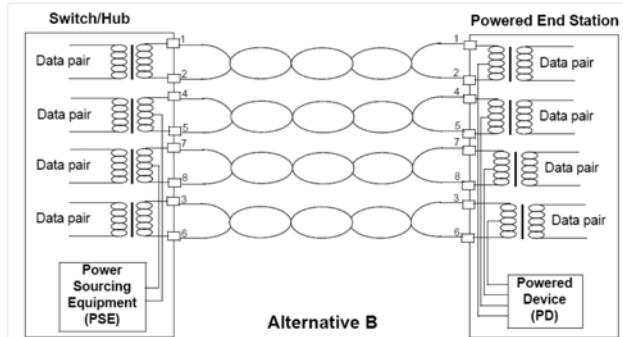


Figure 33-5—1000BASE-T Endpoint PSE location overview

Alternative B on the same link segment simultaneously."

Figure 33-7 gives the same Alternative model but this time using Mid-Span Power Sourcing.

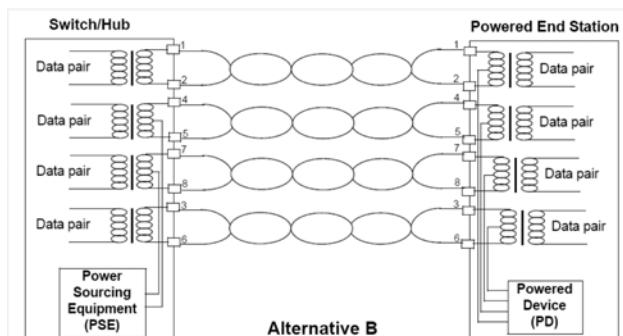


Figure 33-5—1000BASE-T Endpoint PSE location overview

### With Power comes Heat

Some people still believe it's possible to increase the wattage of power used. As a standalone argument maybe it is, but it does not come without consequences.

I remember doing some experiments in school with a battery, some wire and a light bulb. The basic demonstration showed that when you connected up the circuit and the current started to flow, the light bulb sprang into life and produced light. This was caused by a fine element heating up to a point so it glowed brightly.

This shows, quite simply, that when you run a current you are going to produce heat. So put power down a copper wire and it is going to heat up.

With the increase in the level of power with POE+ we are now facing greater challenges concerning heat dissipation. This reality has lead to ISO/IEC producing a Technical Report on the heat dissipation titled 'Telecommunications cabling requirements for remote powering of terminal equipment' TR29125.

This document outlines the impact of putting power over structured cabling as well as how to mitigate the effects. Table 1 gives examples of the level of heat that can be produced in a bundle of cables.

Cable bundle size (number of cables)	Temperature rise <sup>a</sup> °C				
	Category 5	Category 6	Category 6 <sub>A</sub>	Category 7	Category 7 <sub>A</sub>
1	0,8	0,6	0,6	0,6	0,6
7	1,4	1,1	1,0	1,0	0,9
19	2,6	2,1	1,8	1,8	1,6
37	4,7	3,7	3,2	3,2	2,9
61	6,9	5,5	4,8	4,8	4,4
91	9,7	7,7	6,7	6,7	6,2
127	13,1	10,4	9,0	9,0	8,3
169	16,9	13,5	11,7	11,7	10,8

<sup>a</sup> Calculated values for worst case

NOTE 1 The temperature rise (°C) is based upon a current of 600 mA per pair, for all pairs in all cables in the bundle.

NOTE 2 The values in this table are based on the implicit DC resistance derived from the insertion loss of the various categories of cable. Manufacturers'/suppliers' specifications should be consulted for the information relating to a specific cable

NOTE 3 The current per pair for each category is dependent on the cable construction

Table 1

The document goes on to outline a number of methods of mitigating this heat. These include powering all the cables in the bundle, as well as:

- Using a Higher Category Cable – (minimum 24AWG Cat5e)
- Selecting a larger conductor size decreases per unit length dc resistance
- Choose pathways and spaces with good air circulation
- Selection of applications and devices that use lower current

All the heat calculations are based on the standards, which are the only facts we have to go on.

There is one other reason why the understanding of heat is so important and that is, that increased operating temperatures may reduce the length over which an application can be supported. EN 50173 series provides information with regards to reference implementations at temperatures above 20°C.

## Reduced Lifespan

TR29125 highlights a further consideration, and this is the impact of the current on the connecting hardware. Each time the RJ45 plug is mated and unmated there is an arcing effect between the two contact points. As you disengage the pins, there may be a point where the load could run over just one pin. This will cause damage over time which will reduce the overall life of the product. The number of matings allowed within the component standards are being reduced from 750 to just 200 for connectors under load conditions of 600mA.

TR29125 does advise that the power should be disabled every time the connections are mated and unmated, however in the real world it's hard to believe that anyone would go to that level of effort each time they have to move and re-patch a device.

## What's to Come?

As people are starting to want more power for more devices, the expectations of PoE are growing.

Any increase in power has to go somewhere. In the main it will be utilised by the end device, but we have already established that a percentage will be lost in transmission and that loss is reflected by an increase in heat within the cable.

We have illustrated what Standards compliant PoE and PoE+ equate to but there are a few vendors of PSE devices that are claiming over 100watts.

This worries me. If, as in the example shown from TR29125, a bundle of 170 Cat5e cables will increase in temperature by 16.9°C, what is the impact if the power is trebled? Could we see a doubling in temperature? If so then there will be an impact on the data carrying capabilities. The simple calculation is that for every degree above 20°C the performance has to be de-rated by 0.2%. Therefore, 20 degrees above the distance is reduced by at least 4%.

Here is the second problem: how is that heat increase going to be managed within the environment? Will it need additional cooling and ventilation within raised floor spaces?

The IEEE is already looking at the next level of PoE but it's at very early stages still. However there is a group of Manufacturers that have come forward and called themselves the HDBase-T Alliance. Their aim and ambition is to provide IP TV within the home by providing remote powering to LCD screens throughout the property up to 100mtrs. As the International Standards bodies haven't provided them with enough scope they have now released their own standard for providing 100watts up to 100mtrs over Cat5e cable.

My main concern with all of this is that the cable will be run behind walls, that contain various cavity wall insulating products meaning any heat generated will continue increasing as it has no way of dissipating.

What is possible is one thing, but the consequences must be considered. The standards are there to help us all.

## Conclusion

PoE is a welcome technology and will promote the growth of Converged IP enabled systems. Designed and installed correctly it can be simple 'Plug and Play' but as power increases and the size of installations increase the problems start to appear.

My advice is use it, but make sure you understand it and don't get carried away.



# White Paper

## The importance of cleanliness when handling fibre

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One of the most basic and important procedures for the maintenance of fibre optic systems is to clean the fibre optic equipment.

One of the most basic and important procedures for the maintenance of fibre optic systems is to clean the fibre optic equipment.

Any contamination in the fibre connection can cause failure of the component or failure of the whole system. Even microscopic dust particles can cause a variety of problems for optical connections. In a survey carried out by Fluke Networks they claim that 85% of the failing links can be attributed to 'end-face contamination'.

To illustrate this it can be compared to a typical human hair which is between 50 and 75 micron. A dust particle can be as little as 9 micron and is pretty much impossible to see without a microscope. Despite this it could completely block a single mode fibre core, and if trapped between two fibre faces it can even scratch the glass, damaging the end-face. If this happens then at best it will require the careful and time consuming process of being polished out and, at worst, it will have to be replaced.

Furthermore, with high power lasers now in use, if the contamination remains in place when the laser is turned on it can actually be burned into the end-face to such an extent that it cannot be polished out.

Whilst this may seem extreme consequences, each time you disconnect and re-connect a fibre, connector problems can be re-introduced; a statement backed by a study carried out by NEMI (National Electronics Manufacturing Initiative).

The study showed that mating caused loose contaminants to spread. Through connection, a significant amount of the particles were transferred from the contaminated connector to the clean reference connector in a pattern similar to that seen on the contaminated connector below.



Even the use of 'dirty' dust caps can have a significant impact on the 'cleanliness' of the fibre installation. The oil from human skin can also have a dramatic effect when viewed under a microscope.

A recent incident was reported claiming that fibre cable was failing after less than 10 years of use, when it shouldn't degrade at all over this period of time. The first clue to the culprit of the problem was that the building and cabling infrastructure had transferred ownership on two separate occasions during this time. Each time, there was a massive opportunity to introduce contamination, which in reality is what had occurred.

**Visual requirements for PC polished connectors, single mode fibre, RL ≥ 45 dB**

Zone name	Scratches	Defects
A: core	None	None
B: cladding	No limit ≤ 3 µm None > 3 µm	No limit < 2 µm 5 from 2 µm to 5 µm None > 5 µm
C: adhesive	No limit	No limit
D: contact	No limit	None => 10 µm

NOTE 1 For scratches, the requirement refers to width.

NOTE 2 No visible subsurface cracks are allowed in the core or cladding zones.

NOTE 3 All loose particles should be removed. If defect(s) are non-removable, it should be within the criteria above to be acceptable for use.

NOTE 4 There are no requirements for the area outside the contact zone since defects in this area have no influence on the performance. Cleaning loose debris beyond this region is recommended good practice.

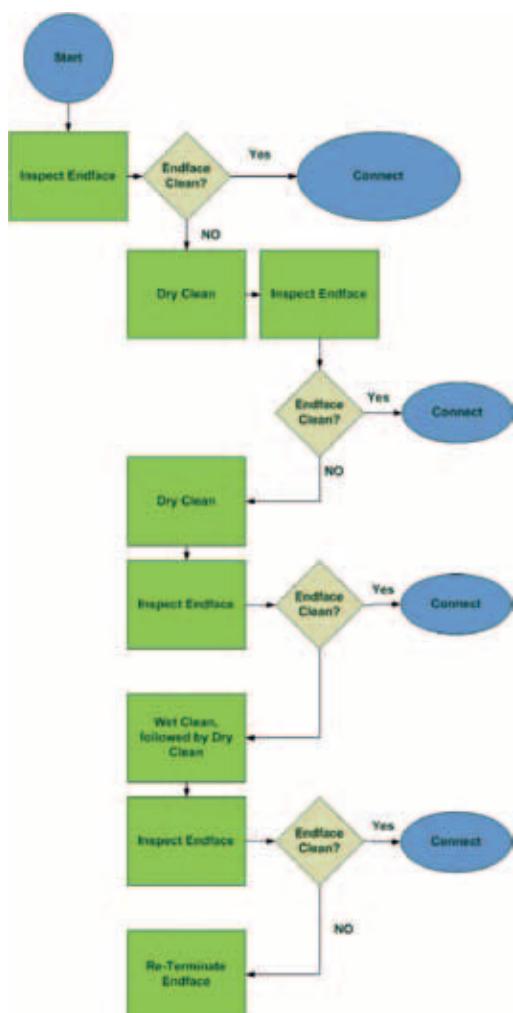
NOTE 5 Structural features that are part of the functional design of the optical fibre, such as microstructures, are not considered defects.

There are many excellent documents which cover the correct procedure for cleaning and inspecting fibre optic end-faces, however we should always refer to the standards if they are available. In February 2010 the British Standards Institute published BS EN 61300-3-35 Examinations and Measurements-Fibre optic connector end-face visual and automated inspection. This document outlines the criteria for the number and details of the scratches and defects that can appear on the end-face, both in the core and cladding areas. The table on the previous page is taken from the document that outlines the limits for single mode with a return loss of  $\geq 45\text{dB}$ .

### Cleaning Methods

There are a range of cleaning products on the market and it is almost a case of you pay your money and make your choice. The two most popular are the cassette type cleaners such as Cletops or the Pen/Swab type. Whatever the choice, it is important to follow the correct procedure/instruction. Failure to do so could lead to even more contamination being introduced.

The following is a flow chart outlining the suggested process for cleaning fibre connectors.



### Conclusion

Cleaning fibre is not a mystery it just requires some common sense and a little thought before the cleaning process starts. There are, of course, some warnings that must be noted.

Here are just a few of the dos and don'ts:

- Never touch the end-face of the fibre connectors - natural body oil can be a major cause of contamination
- Always keep a protective cap on unplugged fibre connectors – protection from both damage and contamination
- Do not clean bulkhead connectors without a way of inspecting them – how else will you know whether the cleaning is successful?
- Always store unused protective caps in a sealed container - they can also be a major source of contamination if not stored in a clean environment.
- Never re-use any tissue, swab or cleaning cassette reel
- Never touch any portion of tissue or swab where alcohol was applied – you could be introducing both dirt and body oil
- Never use a wet cleaning method without a way of dry cleaning immediately afterwards - the wet process can leave a harmful residue that is hard to remove when it dries



# White Paper

## Blown Fibre - A Tube of Benefit



Blown fibre sounds like a tricky alternative to the conventional method of installing fibre optic cable and something that would require a lot of expertise. It is a rarely understood technique and so is often avoided. But if someone had all the facts to hand, would they still choose the conventional method? With the many benefits to using blown fibre, it's definitely something that should be explored.

### Blown Fibre: A Tube of Benefit

At its simplest, blown fibre uses a series of fitted tubes to install fibre between locations. It is a far easier method of installation than the conventional process, which requires the integrator to literally pull the cable along its route, but despite the many advantages, it is still rarely utilised.

Using air, fibre can be blown through a tube at approximately 30 metres a minute, and this offers a huge time saving. The time saving alone is a great reason to use blown fibre, but this, in fact, comes second to the cost effectiveness of it. That's not to say that the actual start up costs are a lot cheaper; they're not. In fact both blowing fibre and pulling it costs pretty much the same at the initial stage of installation. To look at the true cost savings the whole lifecycle needs to be taken into consideration with the key benefits coming from the ease of reconfiguration and expansion.

The foundation of blown fibre is the installation of tube cable (available in various tube counts) between required locations. The aim is to 'over install' the relatively low cost tubing meaning that the actual fibre that is installed is then only done so in the core count and grade required for the immediate to short term. This is where the real saving of blown fibre can be seen, as the costs can be deferred. Only what is needed is installed initially. Then, when a network requires expanding, the new fibre units are blown in quickly and without physical disruption to the fabric of the building or campus. Money is not tied up in having the fibre cores installed for a number of years that are not being used and redundant fibre units can be very quickly removed using the same blowing equipment, making the tubes available for the future. As and when new grades of fibre are developed this can be quickly and easily deployed.

With blown fibre providing a return on investment as quickly as this, it not only strengthens the argument for using it over the conventional method, but it also helps IT and Network Managers justify the costs of the whole infrastructure in the first place. If the project budget can be spread out on a user basis, then it's much easier for it to be approved.

The fact that the cable can be installed as required indicates that the maintenance of the fibre should also be easy to manage. And this certainly is the case. Whether it's replacing a cable at fault or upgrading the infrastructure, it couldn't be easier. The existing fibre is simply blown out and binned and the new fibre is blown into its place. That's it.

In an industry where Moves, Adds and Changes (MACs) are inevitable, contingency planning is vital. Installing infrastructure that is virtually impossible to modify should always be avoided, and integrators and designers are, instead, looking to install products that can be easily adjusted, thereby expanding their lifecycle, increasing the longevity and cost effectiveness of them.

The need for maintenance is greatly reduced in itself by using blown fibre, adding a further benefit to the list. Blown fibre is a smooth process, and the cable travels effortlessly down a tube, with no interference. In comparison, the use of the more traditional pulling method can cause damage to the cable just through the actual installation process, and whether it's just light stress or more severe strain, the life of the cable will be shortened. The stress it faces means that the need for maintenance becomes far more likely and, worse still, the 25 year warranty that it may carry will become vulnerable.

The stress and strain are inflicted to the cable through the transportation of it in the pulling method. By manually pulling it, it becomes impossible to not, somehow, put pressure on the cable and, unavoidably, the installer will have inadvertently damaged the cable to some degree. This problem is eliminated when the blown technique is used. Air, by its very nature, is frictionless and it is the air alone that transports the cable through its tube in this technique. This means that with blown fibre an installer can confidently guarantee its life for the full warranty, which is a huge advantage for both the installer and end user alike. The stress and strain that pulled cable will, unavoidably, have to sustain will lessen the life of it and therefore the 25 year life span cannot be guaranteed.

Diversity, a key requirement for cabling infrastructure, is also much easier with blown fibre. A competent network should have more than one path for cable, ensuring that if

one path goes down, a second can pick up the feed. This can be achieved with any installation method, but blown fibre provides far greater advantages. With blown fibre only one tube is needed and this one tube can install cable in up to four multiple points by using 'ring topology'. Ring topology is a process whereby devices are attached along the same signal path to other devices, forming a path in the shape of a ring. The diversity that blown fibre creates offers greater flexibility and at a much lower expense, whilst at the same time still ensuring a resilient network. If something goes wrong in this instance, only the part that needs fixing has to be touched, leaving the rest of the infrastructure unscathed.

Using conventional cabling methods, this is achieved with much greater difficulty and much greater expense. In this case, two separate cables must be used and, if something goes wrong and the cable needs to be replaced or repaired, the whole network must go offline. The cable then has to be ripped out and replaced in a far lengthier, more expensive process. Blown fibre is not only faster and cheaper to maintain, but with a shorter and more accurate repair and replace process, the impact to the network users is minimised and less of the network is affected at any one time.

Blown fibre truly is a more cost effective, easier and more flexible approach. Fundamentally, the fact that only the tubes are fixed, meaning the cable can be manipulated as needed, offers numerous advantages. Using conventional methods the cable is fixed in place so the flexibility is non-existent and, should a MAC be required, the time and cost implications could be huge.

The difference blown fibre can make is vast and lasts throughout the lifetime of the infrastructure, which can be up to a quarter of a century. This, combined with the fact that the costs can be spread, provides an easy solution for installers and a very attractive offering to Network and IT Managers.

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*Written in conjunction with Excel & Prysmian*



# White Paper

## Best practices for fibre optic installation start with inspection & cleaning

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For centuries, optics have been inspected and cleaned to ensure the proper passage of light. The advent of fibre optic cabling systems resulted in one more application where optical care and cleanliness are important. While inspecting and cleaning fibre connectors is not new, it is growing in importance as links with increasingly higher data rates are driving decreasingly small loss budgets. With less tolerance for overall light loss, the attenuation through adapters must get lower and lower. This is achieved by properly inspecting and cleaning when necessary. Yet there is no reason to feel intimidated by these tighter loss budgets because inspecting and cleaning connections is straightforward and easy.

## What's the problem

### Fibre basics

Fibre optic cabling carries pulses of light between transmitters and receivers. These pulses represent the data being sent across the cable. In order for the data to be transmitted successfully, the light must arrive at the far end of the cable with enough power to be measured. Light loss between the ends of a fibre link comes from multiple sources such as the attenuation of the fibre itself, fusion splices, macrobends and loss through adapter couplings where end-faces meet.

In lower data rate networks with shorter lengths, loss budgets may be generous enough to allow for significant attenuation throughout the link and still the link will function properly. However, there is one perpetual trend in structured cabling: the constant push for greater bandwidth. As fibre links are pushed to carry higher data rates, loss budgets get correspondingly smaller, requiring all loss events to be minimised.



### Enemy #1 — a dirty face

Among key sources of loss that can bring a fibre network down, dirty and damaged end-faces are the threat most underestimated. In a survey commissioned by Fluke Networks, dirty end-faces were found to be the #1 cause of fibre link failure for both installers and private network owners. Contaminated end-faces were the cause of fibre links failing 85% of the time. It's astounding and yet easy to prevent. Nevertheless, there continues to be a lack of appreciation for this crucial issue and lots of misinformation about proper techniques.

### What to look for and when

Network professionals need to know what to look for when evaluating end-face conditions. There are two types of problems that will cause loss as light leaves one end-face and enters another inside an adapter: contamination and damage.

### Contamination

Contamination comes in many forms from dust to oils to buffer gel. Simply touching the ferrule will immediately deposit an unacceptable amount of body oil on the end-face. Dust and small static-charged particles float through the air and can land on any exposed termination. This can be especially true in facilities undergoing construction or renovation. In new installations, buffer gel and pulling lube can easily find its way onto an end-face.

Ironically, protective caps – also called “dust caps” – are one of the most common contributors to contamination. These caps are made in high-speed production processes that use a mold release compound that will contaminate end-faces on contact. Further, as the plastic cap ages the plasticisers deteriorate resulting in an outgas residue. Last, airborne dust itself will find its way into the protective cap and will move to the end-face when the cap is pushed onto a ferrule. It's a very common

mistake to assume that end-faces are clean when patch cords or pre-terminated pigtails are removed from a sealed bag with protective caps in place.

Inspection of the end-face should verify that no contaminants are within the field of view. The most crucial area to ensure is clean is the core of the fibre, followed by the cladding. Yet contamination on the ferrule – outside of the end-face – could slide towards to core as the fibre is mated or handled. Therefore, all visible contamination should be removed if possible.

### Damage

Deciding to mate every connection first and then inspecting only those that fail is a dangerous approach as the physical contact of mated contaminants can cause permanent damage. This permanent damage would require more costly and time consuming re-termination or replacement of pre-terminated links.

Damage will appear as scratches, pits, cracks or chips. These end-face surface defects could be the result of poor termination or mated contamination. Regardless of the cause, damage must be evaluated to determine if action is required as some of it can be ignored or remedied. Up to 5% of the outer edge of fibre cladding generally may be chipped as this is a common result of the polishing process. Any chips on the core are unacceptable. If scratches or excess epoxy bleed is found, repolishing with fine lapping paper can eliminate the problem. If the end-face is cracked or shattered, then the fibre must always be re-terminated.

In every instance, all end-faces should always be inspected before insertion. If a connector is being mated to a port, then the port should be inspected as well. Inspecting one side of a connection is ineffective as contamination inside a port can not only cause damage but also migrate to the connector being inserted. Too often equipment ports are overlooked not only as contaminated themselves but also as a source of contamination for test cords.

## How to inspect

### Fibre microscope choices

From the first days of fibre optic cabling, microscopes were used to inspect end-faces. Initially stereo bench top microscopes were modified to handle the task in manufacturing environments. Over time new microscopes were designed specifically for the task, resulting in smaller units that could be taken down the hall to the cabling closet or outside into the field.

Microscopes can be divided into two basic groupings: optical and video. Optical microscopes incorporate an objective lens and an eyepiece lens to allow you to view the end-face directly through the device. Today, the barrel shaped microscopes are ubiquitous in termination kits and used to inspect patch cords during troubleshooting. The best feature of these microscopes is their price as they are the least expensive way to see end-face details. Their drawback is that they are unable to view end-faces through bulkheads or inside equipment. As a result, you will sometimes hear these microscopes referred to as “patch cord scopes.”

Video microscopes incorporate both an optical probe and a display for viewing the probe's image. Probes are designed



to be small so that they can reach ports in hard-to-access places. The screens allow images to be expanded for easier identification of contaminants and damage. Because the end-face is viewed on a screen instead of directly, probes eliminate any chance of harmful laser light from reaching a person's eye.

### Microscope evaluation

What matters most about a microscope is what it shows the user. In the case of fibre optic inspection, the goal is to identify all contaminants and damage of a minimum size and within a critical area. Users must first identify the appropriate minimum size contaminant or defect that will affect their system. The smallest-sized item that a microscope can detect is referred to as its detection capability. Next, look for the microscope that has the largest field of view while also maintaining the necessary detection capability. It is preferable to see as much of the surface area as possible while maintaining requisite detection capability. Detection capability and field of view require a trade-off as improving on one dimension tends to require a detriment to the other.

If detection capability and field of view are the most appropriate measurements of a microscope, then why is magnification the prevalent metric. Magnification is perfectly applicable to optical microscopes as their performance is a direct function of the objective and eyepiece lens inside the device. Where magnification becomes less applicable is in video microscopes where the size of the image is a function of both the magnification of the lens as well as the size of the screen. Complicating matters further is the effect of contrast on the ultimate goal of detection capability. Magnification specifications for video microscopes are a vestige of the historical prevalence of optical microscopes. Though magnification is directly related to detection capability, it is a less precise measure of a fibre microscope's capabilities than detection capability and field of view.



# How to clean

## Beware of bad habits

Because cleaning has been part of fibre maintenance for years, most people have their own approaches for cleaning end-faces. However, beware of bad habits as many have developed in the industry over time. With an evolving base of knowledge, the industry has moved recently towards new best practices. One common approach to cleaning end-faces is to blast them with canned air, either on a connector or inside a port. Canned air is only effective on one type of contaminant: large dust particles. Canned air is ineffective not only on oils and residues but also on smaller, charged dust particles. Moreover, canned air will tend to blow large particles around inside ports rather than carefully remove them.

## Use of solvent

Another suboptimal approach is to clean without use of a solvent. Solvents provide multiple benefits, the most being their ability to dissolve contaminants that have dried or adhered onto the end-face. In addition, solvents will envelop particles and debris to effectively lift them from the ferrule surface so that they can be carried away without damaging the end-face. Last, solvents will prevent a static charge from developing during cleaning with a dry wipe or reel. There are many stories of end-faces becoming statically charged during solvent-free cleanings such that they were strongly attracting static-charged dust floating in the air. The developed charge can be so strong that static dust accumulates on the end-face during the short move from a microscope into port.

## Solvent selection

Isopropyl alcohol (IPA) has been used for years in the fibre cabling industry to successfully clean end-face and continues to find broad use today. But there are solvents now available specially formulated for fibre end-face cleaning that are far superior to IPA in every way. These new solvents are more effective at dissolving virtually every contaminant than IPA. Further, these custom solvents will dissolve non-ionic compounds such as pulling lube and buffer gel that IPA will not. With a specified lower surface tension, the specialised solvents will do a better job of enveloping debris for removal than IPA. When cleaning inside ports, evaporation rates become important as lingering solvents can become trapped during mating, resulting in a harmful residue. Fibre-specific solvents have tailored evaporation rates that give them time to work yet disappear before mating. Last, IPA is highly hygroscopic which means it will draw water moisture from the air and onto the end-face. This water mixes with the IPA and leaves a residue if it dries on the end-face. To be safe, leave the IPA in the medicine cabinet.

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## Cleaning tools

There are a wide variety of tools available to clean end-faces. The most basic tools are wipes and swabs used to clean patch cords and inside ports, respectively. More involved approaches include mechanical, hand-held contraptions designed to make easier work of cleaning. The most complex devices incorporate blasted solvents or ultrasound in water to achieve the best result. While the more complex systems may achieve better results, they cost far more money. Individuals should determine the best approach for their application and budget. The one key criterion for wiping materials is that they be lint-free. Shirtsleeves are unacceptable!

## Best practices

Whatever approach is selected, certain truisms apply to fibre optic end-face inspection and cleaning. First, inspection must occur not only before but also after cleaning to ensure a good result. If a post-cleaning inspection shows remaining contamination, then a second cleaning must follow. Second, both sides of any connection need to be inspected as every mating involves two surfaces coming into contact. And last, it is almost always easier and cheaper to inspect and clean as a preventative measure than as reactive response. Consistent inspection and cleaning up front will avoid unexpected and costly downtime in the future.



# Technical Note

## Bonding of Screened Cabling



This technical note covers the basic rules and guidelines for bonding a screened cabling system.

### Bonding of cabinets, frames and racks

Cabinets, frames and racks and their contents containing, or intended to contain, telecommunications equipment or metallic telecommunications cabling shall be bonded in accordance with BS EN 50310. The following additional requirements shall apply.

Each cabinet, frame or rack shall be connected to the Common Bonding Network (CBN) using a separate bonding conductor:

- Having a cross-sectional area in accordance with HD 60364-5-54:2007, Section 543 and not less than:
- 4 mm<sup>2</sup> for a cabinet ≤21U;
- 16 mm<sup>2</sup> for a cabinet >21U;
- That is neither coiled nor doubled back on itself.

Whilst some may think this subject is complex it is actually very simple and straightforward and will take no longer to complete than an unscreened system.

### The basic points to remember are:

- Bonding of the cabling infrastructure is only required at the Cabinet end.
- The Patch Panels are individually bonded to a grounding busbar within the Cabinet using the bonding lead supplied, which in turn is bonded to the cabinet.
- With Excel screened products by inserting the toolless Jack into the patch panel frame it has metal to metal clean contact.
- It is also important to note that Grounding Continuity is provided by the Drain Wire within the screen cable not the foil screen it should therefore be terminated in accordance to the product instructions.
- The Cabinet is then bonded to the Common Bonding Network or Main Grounding Busbar by the use of the appropriate size conductor as outlined in the above standards, following the Manufacturers Installation Guidelines.

### Recommendations:

- Multiple bonding conductors should not be attached to a single connection point (e.g. screw, bolt) due to the risk of interruption of all connections during maintenance or repair.
- The conductor (independent of cross-sectional area or shape) should be no greater than 0.5 m long where possible.



# Technical Note

## Channel Configurations – 3rd Party Verification Testing

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Excel Networking currently has a valid 3rd Party Certification from Delta Labs from Denmark for a Screened Channel, Class E<sub>A</sub>, 4 Connector Model. This technical note is a simple explanation of the configuration for that test.

The Channel was constructed using the following components:

Horizontal Cable:

100-196 Excel Category 6<sub>A</sub> Screened F/FTP 'S' Foil Cable, LS0H

Equipment/ User Cord (A) & Patch Cord (D):

100-154 Excel Category 6<sub>A</sub> Screened F/FTP LS0H Patch Lead, Booted, 5m Grey

100-148 Excel Category 6<sub>A</sub> Screened F/FTP LS0H Patch Lead, Booted, 1m Grey

Consolidation Point Cable (B) & Equipment Cord (E):

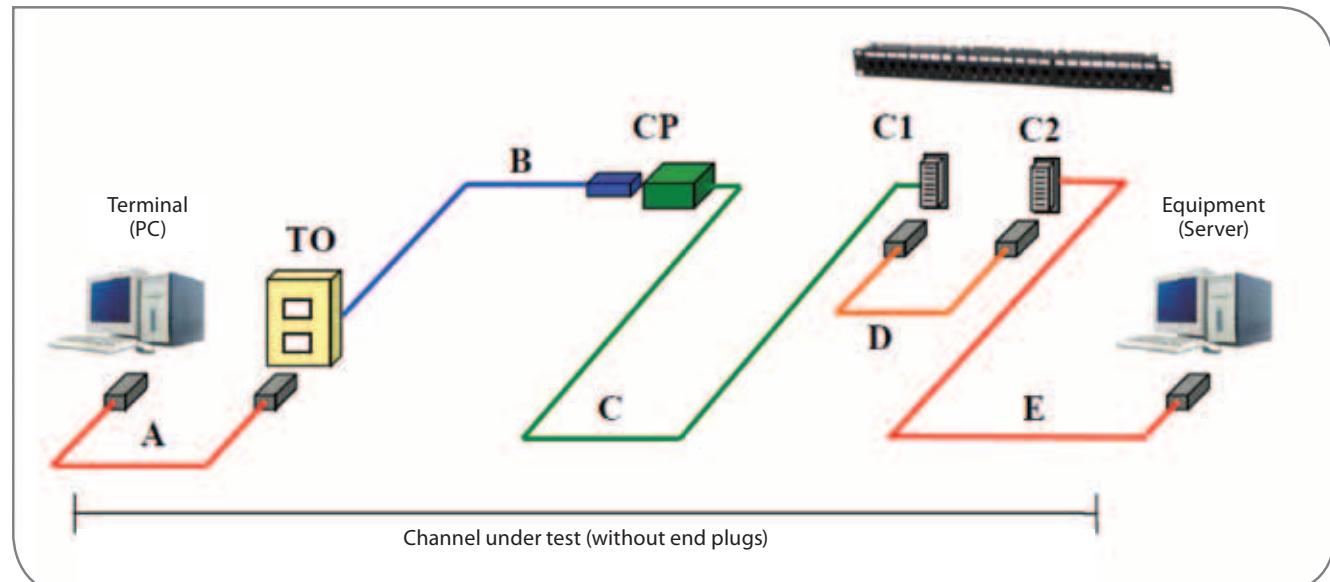
100-133 Excel Category 6<sub>A</sub> Solid Core (F/FTP) Screened Harness/Switch Links Leads – 30m

(Cut to length and outlet jacks added)

Telecommunications Outlet and Patch Panel Jacks:

100-181 Excel Category 6<sub>A</sub> Low Profile Screened Keystone Jack - Toolless

The configuration of the specific channel tested is as follows



The detailed legend to the diagram on the previous page is as follows:

Item	Name	Cable type	Length	Connecting hardware
A	Terminal cord	Flexible cable	5 m	1 plug
B	Consolidation point cable	Flexible or Horizontal cable	5 m	1 socket 1 plug
C	Horizontal cable	Horizontal cable	85 m	2 sockets
D	Patch cord	Flexible cable	1 m	2 plugs
E	Equipment cord	Flexible cable	4 m	1 socket
TO	Telecommunications Outlet / Wall Outlet			
CP	Consolidation Point connector (Sockets)			
C1, C2	Horizontal cross-connector / Floor Distributor / Patch panel			

This document should be read in conjunction with the relevant certificate, 2014-333 that can be found on the Excel Networking website.

[http://www.excel-networking.com/\\_assets/downloads/2014-333%20Excel.pdf](http://www.excel-networking.com/_assets/downloads/2014-333%20Excel.pdf)



# Technical Note

## Channel Configurations – Minimum Distances



For the purposes of the Excel Encyclopaedia the configurations and rules are based on the EN 50173 series of standards. The particular section is Clause 6.2.2.2 Dimensions of EN 50173-2:2007+A1:2010 The copper channel comprises of the Equipment Cord through to the Work Area Cord up to, but **excluding**, the end connection (Plug from the Work Area Cord & Jack in the Terminating Equipment.

The maximum channel length supported by the standard is 100 m. There are four recognised channel models ranging from a two connector to four connector configurations. A “connector” in terms of the channel is a plug/jack mated pair. As the channel does not include the connector in the equipment at each end, this is not included in the number of connectors. The maximum length of the Horizontal Cable is calculated based on the Class of the system and the lengths of the attached cords and links. The following general restrictions apply:

- The physical length of the channel shall not exceed 100 m
- The physical length of the horizontal cable shall not exceed 90 m. This may need reducing depending on the length of the attached cords
- Where a MUTO (Multi User Telecommunications Outlet) is used the length of the work area cord shall not exceed 20 m
- Where a CP (consolidation point) is used the horizontal cable length shall be at least 15 m in length. This is to reduce the effect of multiple connections in close proximity. **This minimum length is often misquoted.** The minimum length only applies where a CP is used. See sections c) & d) below.
- The length of individual patch cords or jumpers shall not exceed 5 m

The minimum distances discussed above do not apply to Switch or Harness links, these lengths are governed by the manufacturer's discretion and in the case of Excel Networking we have successfully tested solid core Harness/Switch Links at less than 5 m.

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**Please note:** it is difficult to test short links if in doubt advice should be sought. For example on a short link, the Insertion Loss may never reach 3.0 dB. If that were to happen, then the entire measurement would be ignored, or as the cabling standards phrase it; “recorded for information only”. If this were to happen with your DTX CableAnalyzer, you would see an “i” appear next to the summary result for that test parameter. In LinkWare software, the result would be recorded with “N/A” at the same time the link can still be recorded as a PASS.

## Technical Note

### Category 6<sub>A</sub> U/FTP in a Box - Set up Rig

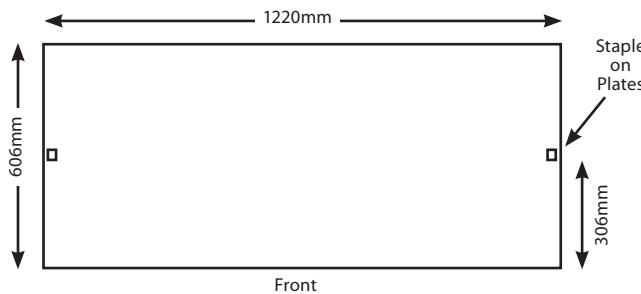


This simple cost effective solution allows one man to prepare 12 boxes of cable for pulling, in less than 10 minutes.

#### Materials Required

Two sheets of Plywood – 1220mm x 606 mm (these are available already cut to size at B&Q)  
 2 x Staple on Plates  
 1 x Ratchet Tie Down – 5m x 25mm

#### Construction



Take the 2 x Staple on Plates and attach them at the very edge of either end (1200mm apart) of one of the sheets this will be the base section. The staple on plates should be located 306mm from the front on each side (the short length).

**N.B.** We would also recommend that you round the corners and sand down the edges of the plywood to avoid the chance of splinters.

#### Operation

Stack 12 boxes of 100-191-305m, 4 wide by 3 high along the base section, with the cables facing in the direction you intend to pull. **N.B.** Please ensure all boxes are facing in the same direction.

Then lay the second sheet of plywood across the top and pass the ratchet strap over the top connecting the hooks on the ends to the staple on plates. Finally tighten the ratchet until all the boxes are secure between the two boards and they cannot move. **N.B.** the top board is intended to stop the strap digging into the cardboard boxes.

You are then ready to start pulling.

**This simple and cheap method will allow a 1 man set up and will enable them to pull the cables within approx. 10 minutes.**





## Technical Note

### Fibre Identification



From time to time a question arises, 'Is it possible to identify the grade of the installed fibre backbone cable?' This is particularly relevant where a company moves into a building that has been previously occupied and are keen to take advantage of the existing installed cabling system.

This is relatively straightforward with regards to copper cabling, where a tester can be used to see what standard it passes.

With fibre it is not as straightforward as there is no field tester that can actually tell the difference between grades of fibre, the operator is required to input this information.

Furthermore there is a misconception that a colour coding system introduced a number of years ago would provide sufficient information for identification. The coding scheme has its limitations as it only really covers the connectors and patch cords along with the actual cores within a multi-core cable. It is also reliant on all manufacturers following the same scheme, which is not always the case. To give an example of the problem, TIA have at least 3 methods of fibre array colour coding and EN 50174 has one, the manufacturer could have used any one of them.

Many manufacturers haven't incorporated the above to the outer sheath of multi-core fibres which still tend to have a black outer jacket with a legend printed on it, even this may not be visible with legacy installations.

There are ways to make an educated assessment.

Listed below are some different scenarios that can be used on a site to try and differentiate a fibre type.

1. If there are no markings on the cable, check the core size with a microscope and identify it as 50/125 or 62.5/125. Then test it to see what attenuation is in the fibre and the length of the cable, to decide what data speeds can be run on it.
2. Read the sheath of the cable for a part number or type description. If there are markings on the cable you should be able to identify the cable type by the part number and then run the same tests as above to check the attenuation and length.
3. The Fluke DTX will do an application test, i.e. Ethernet 1G or 10G but this is only after the size and type of the fibre has been established.

In conclusion, if there is any doubt, a NEW quality grade of fibre cable should be installed to support future applications. The simple reason for this is that OM3 fibre will support 10G Ethernet over a distance of 300m, OM2 can only support 10G up to 82m - both cables appear identical to the naked eye.

The full details of fibre construction types and application lengths can be found in the Fibre Section of the Excel Encyclopaedia.

# Technical Note

## The Danger of Overstating Mating Cycles



### Overview

Structured Cabling is all about numbers. Some vendors believe that a bigger number is better and that quoting a larger number than their competitors will give them the edge. Unfortunately this practice can be misleading for end-users who may not possess all of the relevant facts to make an informed decision.

One such practice is to quote the number of mating cycles (insertions and withdrawals) for modular plugs and jacks that is higher than the requirements of the Standards.

Excel has carried out aged life testing on all our products, including mating cycles, well in excess of the required number in the current standard, without any significant degradation of performance. We do not overstate our performance unnecessarily for a number of reasons as discussed below.

### Standards Requirements

EN 50173-1:2011 refers to EN60603-7 as the standard for free and fixed connectors (modular plugs and jacks) however it goes on in Clause D to outline the expected life-cycle of these components. The following text and table is quite clear in its understanding

*'The number of mating cycles (insertions and withdrawals) for free and fixed connectors (modular plugs and jacks), and the number of conductor re-terminations per solderless connection shall comply with the specifications in Table D.34.'*

Table D.34 - Free and fixed connectors (modular plugs and jacks) operations matrix

Connecting hardware type	Insertion and withdrawal, and conductor re-termination, operations	Minimum number of operations
Free connector (modular plug)	Insertion/withdrawal with fixed connector (modular socket)	750
	Cable re-termination	0
Fixed connector (modular jack)	Insertion/withdrawal with free connector (modular plug)	750
	Cable re-termination	20 <sup>a b</sup>

<sup>a</sup> Unless not intended for re-termination; in which case this value equals 0.

<sup>b</sup> The range of conductor size and type shall be in accordance with the manufacturer's instructions.

For clarification of the table above, Cable re-termination relates to how many times a plug or a jack can be re-terminated. Point 'a' means if you get it wrong throw it away, Point 'b' means use in accordance with the Manufacturer guidelines.

From this the current standard stipulates a minimum of 750 operations.

Some vendors are now stating far higher numbers than the 750, however we believe this to be quite misleading.

ALL Standards bodies are actually looking to REDUCE the number of mating cycles and the majority of leading manufacturers are currently part of this initiative

The main reason for this is POE and the higher power POE+. A series of recent studies have shown that if POE+ is not disabled prior to a plug being de-mated then 600mA per pair will create a small electric surge/arc across just one of the pins. Each time this occurs it causes a small amount of damage in the 'wiping area' (the point of contact prior to full mating) over time this damage will spread and potentially affect the whole contact area.

The current discussions are quoting numbers as low as 200 if POE+ is energised, therefore telling an end-user they could have over 1,000 mating cycles could be very misleading indeed.

The second major reason, relates to the compatibility. To be able to quote an increased number of mating cycles in this way, then that Manufacturer, MUST be in control of all the components in the Channel and even with the best efforts this is not always possible.

With the best will in the world it will prove almost impossible to keep the installation 'Sterile'. During the life of the installation, if not on day-one, a Patch / Equipment Lead not made by the manufacturer of the jack/outlet will be introduced, as soon as that happens the mating cycles can only be calculated by using the Standards.

### Conclusion

We trust this clarifies the situation. Excel Networking is a contributor to the development of a number of the Standards discussed in this document. We are very proud of the extent of our Independent Component Compliance Testing, which means our products meet or exceed both the Channel and Component Standards.

We do not believe in overstating the performance of any component in a way that could be misconstrued by a user.



## Technical Note

# Clarification of the cabling requirements of IEEE 802.3af and IEEE 802.3at (Power over Ethernet)



## Overview

Since the launch of Power over Ethernet in 2003 and then the further development of Enhanced POE in 2009, there has been some confusion about what Class or Category of cabling that is required.

This confusion has been caused or exploited by a small number of structured cabling vendors who have implied that by having independent testing carried out specifically related to POE, that their system is better than anyone else's.

This note sets out to clarify the requirements as outlined within IEEE 802.3at. and prove that this form of testing is not only misguided, it is also unnecessary.

## Standards Requirements

It is actually very simple; to gain general and wide spread acceptance regarding Power over Ethernet. The IEEE has developed the above standard to utilise 'Standards Compliant' structured cabling and not have any special requirements that would limit its adoption.

This can be fully understood by reading the cabling requirements section of the standard. For information 'Type 2' relates to the higher Power Enhanced POE or POE+

### '33.1.4.1 Type 2 cabling requirement

Type 2 operation requires Class D, or better, cabling as specified in ISO/IEC 11801:1995 with the additional requirement that channel DC loop resistance shall be  $25\Omega$  or less. These requirements are also met by Category 5e or better cable and components as specified in ANSI/TIA/EIA-568-B.2, ANSI/TIA/EIA-568-B.2-1, and ANSI/TIA/EIA-568-B.2-10; or Category 5 cable and components as specified in ANSI/TIA/EIA-568-A-1995.'

There is one sentence in this requirement that could have caused the confusion which some may have tried to exploit.

This is the line which states: 'with the additional requirement that channel DC loop resistance shall be  $25\Omega$  or less' which was written in 1995. With the amendments made to the 2002 edition of ISO 11801 this is not an additional requirement, it is part of the stated limits for a Class D channel as can be seen in the following table from the 2002 edition of this Standard.

### '6.4.7 Direct current (d.c.) loop resistance

The d.c. loop resistance of each pair of a channel shall meet the requirements in Table 16.

When required, the d.c. loop resistance shall be measured according to IEC 61935-1.'

Table 16 - Direct Current (d.c) loop resistance for channel

Maximum d.c. loop resistance $\Omega$					
Class A	Class B	Class C	Class D	Class E	Class F
560	170	40	25	25	25

This table has been further updated in subsequent editions of ISO 11801 and All Classes of Channel above Class D have a limit of  $25\Omega$

## Conclusions

With the IEEE writing the standard in the way they have, they have looked to exploit Generic, Standards Compliant Structured cabling systems to support Power over Ethernet. This ensures there are no limitations to the adoption or use of this important technology. Having any special requirements is totally against the purpose of 802.3at.

If certain vendors wish to carry out additional testing to prove their product can support POE it is their prerogative, but it is not necessary as the standard demonstrates the suitability of the products.

If the system has been independently tested to meet or exceed ISO 11801 Ed 2.2: 2010 that is all the IEEE require.

# Technical Note

## The Use of Cable Ties



This item covers the use of cable ties for securing data cables to both horizontal and vertical pathways. Crushing of 4 pair data cables can seriously inhibit the performance of the installed structured cabling installation.

It has become common practice over the years to dress cables into bundles relating to the panels they have originated from using cable ties. However there is nothing within any of the standards that actually calls for this practice and the only reference is in EN 50174-1 A2 2011 which states.

*'Instructions for the storage, installation and operation of the cabling components shall be obtained from manufacturers or suppliers including:'*

This statement therefore clearly puts the emphasis on the Manufacturers Installation Guidelines which can be found on the Excel Networking website, by downloading the latest Excel Installation Guide.

<http://www.excel-networking.com/downloads/>

This states the following conditions:

- Hook and eye cable fixings are preferred.
- If nylon type zip ties are used, excess lengths must be cut-off flush to avoid leaving sharp edges.
- Do not over tighten.
- No deformation, marking or compression of cable jacket is allowed.

### Note:

In the case of long vertical backbone runs it is sometimes advisable to use a combination of Hook & Loop as well as Metal Cable ties at regular intervals to provide sufficient support of the cables.



## Technical Note

### The use of E-Glass Strength Member within Tight Buffered Fibre Cables



Excel recently made the decision to move to the use of E-Glass as a strength member in the construction of its Tight Buffered Multimode Cables.

The key reasons for this are as follows:

- It is deemed to be 'swellable' which means that it expands at the first sign of moisture and forms an effective water blocking barrier, providing Longitudinal Water Tightness not achievable with Aramid yarn
- Being a form of glass it provides a 'Standard' Rodent Protection, which is not present with Aramid yarn

E-Glass achieves these additional benefits whilst providing comparable strength member properties without incurring additional cost.

## Technical Note

### Loose Lay Cabling



This item covers loose laying data cables within horizontal pathways. It has become common practice over the years to dress cables into bundles relating to the panels they have originated from. However there is nothing within any of the standards that actually calls for this practice and the only reference is to follow the manufacturer's installation guidelines.

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With the increased density of cables within pathways it is now becoming more common to loose lay the cables on horizontal pathways without pulling them into tight uniform bundles along the entire length.

This is seen as acceptable for a number of reasons, with one clear caveat:

- It allows a better fill ratio within the basket, whilst ensuring that no one cable is subject to all the pressure of the other cables above, over a major proportion of its length.
- It ensures that no two cables run directly alongside each other for extended distances and therefore avoids the likelihood of spurious signals leeching between cables at higher frequencies, otherwise known as Alien Crosstalk.
- Furthermore, with the advent of PoE (Power over Ethernet) it is important to consider the dissipation of the heat that can possibly build up within bundles a fact that will only get worse when companies start to deploy PoE Plus, which has the possibility to deliver twice the power to end devices.

The Draft ISO/IEC - TR29125 - Telecommunications cabling requirements for remote powering of terminal equipment states one option to mitigate the potential heat build up is to loosen and separate the cable bundles.

**Caveat:**

This is not a licence for an untidy installation and care should be taken over the appearance of the cable. Where cables are run in trays or on cable matting, laid directly upon the floor slab, measures must be taken to ensure the cables remain neat and in place throughout their length, the recommended approach is to use hook & loop ties.

# Technical Note

## Specific Separation Distances



This Technical Note has been written to offer guidance with respect to separation distances for specific Electromagnetic Interference (EMI) sources.

The information to compile this technical note is from

**BS EN 50174-2:2009** - Information technology- cabling installation

– Part 2: Installation planning and practices inside buildings.

The following are specific items of equipment and the respective minimum separation distances from copper data cabling. These distances are to ensure compliance with Electromagnetic Compatibility (EMC)

Source of disturbance	Minimum separation	Note
Fluorescent lamps	130 mm	a
Neon lamps	130 mm	a
Mercury vapour lamps	130 mm	a
High-intensity discharge lamps	130 mm	a
Arc welders	800 mm	a
Frequency induction heating	1000 mm	a
Hospital equipment	b	b
Radio transmitter	b	b
Television transmitter	b	b
Radar	b	b

*This list is not exhaustive.*

Notes:

- a The minimum separations may be reduced provided that appropriate cable management systems are used or product suppliers guarantees are provided.
- b Where product suppliers guarantees do not exist, analysis shall be performed regarding possible disturbances. e.g. frequency range, harmonics, transients, bursts, transmitted power, etc.



## Technical Note

### Class D / Category 5e Extended Distances



This technical note offers guidance with respect to installed channels over 100m and links over 90m using Excel Class D / Category 5e cabling systems.

The Excel warranty is standards based to ensure that all of the protocols and applications will run on an installed system. Included within the International Standards cabling channels have a maximum length as one of the parameters to ensure compliance.

In the case of Class D / Category 5e the maximum Channel length is 100m. Where the installation exceeds this parameter, and therefore fails the test, this will result in the exclusion from the warranty for that specific Link/Channel.

However, Excel accepts that on a specific Link/Channel basis there are occasions where these lengths are exceeded. Excel has carried out testing to determine the maximum length that can be achieved for a given application.

Our configuration testing has shown that correctly installed product from the above will pass the above criteria to the following lengths:

Application	Permanent Link Length	Channel Link Length (consisting of 5+5m Patch Cord)
10BASE-T	170m	180m
100BASE-TX	120m	130m

1000BASE-TX is only supported with a fully compliant installation, including length of a 100m channel maximum.

To determine whether a specific Link will support the desired application Excel recommend that the test is carried out with the Application Specific Test using the Fluke DTX-1800 Cable Analyzer. As these links are over length a further Channel test should be carried out with the specific configuration required. This will give the best indication for the specific channel of the likelihood of the desired application working.

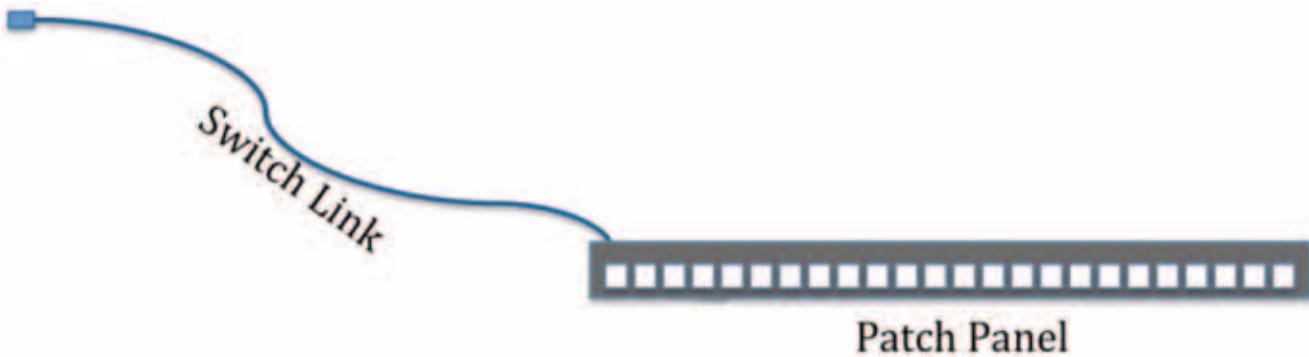
These distances are offered in good faith and subject to continuing development and improvement. The Excel Warranty excludes the specific links, and therefore channels, that are over length (90m and 100m respectively).

## Technical Note

### Switch / Harness Links



This technical note offers guidance with respect to installing switch / harness links for Class E<sub>A</sub> / Cat 6<sub>A</sub> Channels. The item in question is the cord which has an RJ45 on the end for connection to active equipment such as Switches etc. The other end of the cable is terminated with a Jack housed in a patch panel frame.



The Jacks used in the Patch Panel shall be:

100-180      Excel Category 6<sub>A</sub> Screened Toolless Jacks

The switch link shall be constructed from the following leads (remove one RJ-45 or cut in half):

Excel Category 6<sub>A</sub> F/FTP Patch Lead

- various lengths and colours available – contact Excel supplier

Conditions:

The Jack has to be a new and not previously terminated with solid core cable.

Channel length has to be determined to take into account that the leads are stranded cable. Refer to Table 3 of BS EN 50173-2:2007.

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## Technical Note

### Class E<sub>A</sub> / Category 6<sub>A</sub> Extended Distances



This technical note offers guidance with respect to installed channels over 100m and links over 90m using Excel Screened Class E<sub>A</sub> / Category 6<sub>A</sub> cabling systems.

The Excel warranty is standards based to ensure that all of the protocols and applications will run on an installed system. Included within the International Standards cabling channels have a maximum length as one of the parameters to ensure compliance.

In the case of Class E<sub>A</sub> / Category 6<sub>A</sub> the maximum Channel length is 100m. Where the installation exceeds this parameter, and therefore fails the test, this will result in the exclusion from the warranty for that specific Link/Channel.

However, Excel accepts that on a specific Link/Channel basis there are occasions where these lengths are exceeded. Excel has carried out testing to determine the maximum length that can be achieved for a given application. The testing has been based on the following Excel Products:

- 100-150      Excel Cat 6<sub>A</sub> LSOH F/FTP Cable
- 100-180      Excel Cat 6<sub>A</sub> Screened Tool-less Jack
- 100-160      Excel Cat 6<sub>A</sub> Screened LSOH Patch Cord – Blue – 5m

The test carried out shall be the Application Specific Test using the Fluke DTX-1800 Cable Analyzer with the appropriate Permanent Link Adapters. The results show a pass in all parameters with the exception being length.

Our configuration testing has shown that correctly installed product from the above will pass the above criteria to the following lengths:

Application	Permanent Link Length	Channel Link Length (consisting of 5+5m Patch Cord)
10BASE-T	170m	180m
100BASE-TX	120m	130m

1000BASE-TX is only supported with a fully compliant installation, including length of a 100m channel maximum.

These distances are offered in good faith and subject to continuing development and improvement.

# Technical Note

## Excel Cable – Liquid Contamination



This document covers the interaction of liquids (including water) with indoor Excel Copper and Fibre cable and connecting hardware. This document excludes product that is designed for external use.

### Connecting Hardware

The connecting hardware consists of

- copper jacks & patch panels
- fibre optic pigtauls, connectors and patch panels

These connecting hardware products are designed for indoor use as defined by ISO standards. This means that they are to be used in dry environments. Therefore if any of the mentioned Excel product has been in contact with any liquid they shall be replaced. This is because of the unknown composition of the liquid. Even water may contain impurities, for example from the salts that emanate from a concrete slab. These contaminates may have affects on the mechanical and/or the electrical/optical performance. In the case of the performance the effect of the connector 'drying out' may lead to altering performance during the process. The long term effects of the contaminate will also be unknown.

### Cable

The cable consists of

- copper – LSOH & PVC cable
- fibre optic – LSOH & PVC cable

These indoor cables are also designed to be stored, installed and operated in an indoor environment. This excludes the immersion in liquids or having liquids in contact with the sheath. If any liquid comes into contact with the cable it shall be replaced. The jacket sheath is designed to ensure that the cable is mechanically secure and stable. Even in the case of water this can have a negative effect on the sheath due to the composite of the jacket material. For example the construction of LSOH indoor sheathed cable can absorb liquid over time. This is a factor of the compound manufacture and will be common with many manufacturers. Any liquid absorption will change the geometry of the cable therefore having an effect on the electrical or optical performance. Probably the worst case would be to get liquid in the end of a copper cable. The capillary action will draw the liquid a fair distance along the inside of the sheath. The liquid will have an effect on the Return Loss of the cable which will vary as the cable 'dries out' over a much extended timescale.

### Mitigating Actions

Excel recommends that to mitigate the possibility of liquid contamination that installations are only undertaken once the building is 'water tight' and liquid systems (e.g. sprinklers, water, etc.) are installed and tested. Cables can be protected by containing them in basket or tray that is off the floor slab. In the case of spillages this will reduce the risk from indirect contamination.

On a pragmatic note If a cable is in constant contact with water for less than four hours it may be possible to lift and dry it completely and as long as it passes all subsequent testing we will accept these cables for warranty purposes with the following conditions:

- The total period of time involved is less than, i.e. either one period of 4 hours or a cumulative 4 hours following multiple instances.
- This is only acceptable if can be proved the period of time involved is less than 4 hours e.g. recorded time for a burst main or sprinkler etc. If the period of time is unknown, then it can only be assumed to be more than 4 hours. The onus is on the installer to provide evidence.
- At no point should the water have come in contact with the un-terminated end or the outlet of a terminated end. Any incident of this nature and the cables shall be replaced.

### Summary

Liquid contamination of any kind requires the product that has come in contact to be replaced. After any change the affected link shall be re-tested.



## Technical Note

### Class E / Category 6 Extended Distances



This technical note offers guidance with respect to installed channels over 100m and links over 90m using Excel Class E / Category 6 cabling systems.

The Excel warranty is standards based to ensure that all of the protocols and applications will run on an installed system. Included within the International Standards cabling channels have a maximum length as one of the parameters to ensure compliance.

In the case of Class E / Category 6 the maximum Channel length is 100m. Where the installation exceeds this parameter, and therefore fails the test, this will result in the exclusion from the warranty for that specific Link/Channel.

However, Excel accepts that on a specific Link/Channel basis there are occasions where these lengths are exceeded. Excel has carried out testing to determine the maximum length that can be achieved for a given application.

Our configuration testing has shown that correctly installed product from the above will pass the above criteria to the following lengths:

Application	Permanent Link Length	Channel Link Length (consisting of 5+5m Patch Cord)
10BASE-T	170m	180m
100BASE-TX	120m	130m

1000BASE-TX is only supported with a fully compliant installation, including length of a 100m channel maximum.

To determine whether a specific Link will support the desired application Excel recommend that the test is carried out with the Application Specific Test using the Fluke DTX-1800 Cable Analyzer. As these links are over length a further Channel test should be carried out with the specific configuration required. This will give the best indication for the specific channel of the likelihood of the desired application working.

These distances are offered in good faith and subject to continuing development and improvement. The Excel Warranty excludes the specific links, and therefore channels, that are over length (90m and 100m respectively).

# Technical Note

## Segregation Distances



This technical note offers guidance for the general segregation distances required between copper data cabling and mains power to mitigate the effects of Electromagnetic Interference (EMI). The responsibility for assuring compliance with required standards and legislation lies with the designer and installer. The information in this Technical Note is provided in good faith. Local and national safety regulations may require different segregation requirements and distances. Safety requirements are the priority. The more stringent requirement shall take the precedence.

The information to compile this technical note is from

BS EN 50174-2:2009 - Information technology- Cabling installation – Part 2: Installation planning and practices inside buildings.

The minimum segregation distance depends on:

- Electromagnetic immunity of the data cabling – Segregation Classification
  - Coupling attenuation for screened balanced cables
  - Transverse Conversion Loss (TCL) for unshielded balanced cables
  - Screening attenuation for unbalanced (coaxial) and twin axial cables
- Construction of mains cable
- Quantity and type of electrical circuit
- The divider between the data and power cabling

$$A = S \times P$$

Final separation distance (A) = Basic Separation Distance (S) x Power Cabling Factor (P)

The requirements of the parameters determining the segregation classification is detailed in the above referenced standard and should be used if reviewing a specific cable that is not covered below. The cables are detailed in parentheses () below the Segregation Classification generally comply.

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Cable Management System					
Segregation Classification	Cable Performance	None (or Non-metallic)	Open metallic containment	Perforated metallic containment	Solid metallic containment
d	Class F <sub>A</sub>	10 mm	8 mm	5 mm	0 mm
c	Class D or E or E <sub>A</sub> U/FTP	50 mm	38 mm	25 mm	0 mm
b	Class D or E or E <sub>A</sub> U/UTP	100 mm	75 mm	50 mm	0 mm
a	Coaxial	300 mm	225 mm	150 mm	0 mm
Notes	Applicable to plastic containment	Screen performance (0 to 100 MHz) equivalent to weld mesh 50 mm x 100 mm and steel tray of less than 1 mm thickness (and trunking without lid).	Screen performance (0 to 100 MHz) equivalent to steel tray of 1 mm thickness (and trunking without lid). Cables to be installed at least 10 mm below top of barrier.	Screen performance (0 to 100 MHz) equivalent to steel conduit 1.5mm wall thickness.	



## P - Power Cabling Factor

The Power Cabling Factor is based on 20 Amp, 230 Volt, 1-Phase. 3-Phase treat as 3 off 1-Phase. More than 20A treat as multiples of 20A. Lower voltage AC or DC power cables shall be treated on the current rating. E.g. a 100A 50V DC cable is equivalent to 5 off 20A cables.

Quantity of Circuits	P – Power cabling factor
1 to 3	0.2
4 to 6	0.4
7 to 9	0.6
10 to 12	0.8
13 to 15	1.0
16 to 30	2
31 to 45	3
46 to 60	4
61 to 75	5
> 75	6

## Conditional Relaxation of Requirement

Where the requirements in specific EMI conditions do not apply, no segregation distance is required between power and data where:

Power - Single Phase, Total power  $\leq$  32A, Power conductors contained in overall sheath or twisted, taped, bundled together

Data Cable - Segregation Classification is "b", "c" or "d" & E1 environment classification of EN 50173:2007

# Excel Partner Programme

## Section 12

### In this Section:

- [Excel Accredited Partners](#)
- [Benefits and Requirements](#)
- [Excel Partner Services](#)

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## Excel Accredited Partners

The [Excel Partner Programme](#) offers three levels of accreditation,



**Excel Cabling Partner (ECP)** – These organisations are experienced providers of design, installation and testing services for the entire range of Excel passive copper, conventional and pre-terminated high density MPO optical fibre solutions.



**Excel Solutions Partner (ESP)** – These organisations offer turnkey integrated solutions, including conventional Excel copper and optical fibre solutions, pre-terminated high density MPO optical fibre solutions and also blown fibre cabling systems. These infrastructure systems can be integrated with IP solutions such as wired and wireless Ethernet, electronic security, and building management systems. The ESP status is only available in the UK.



**Excel Distribution Partner (EDP)** – These organisations operate outside of the UK as local support and service centres for the Excel Partners in their territories, they offer sales, and technical assistance and hold stocks of key product lines to service demand in a fast and efficient manner.

A pre-requisite of installation partner status is training, the understanding of which is verified through an exam process to demonstrate knowledge of the Excel system and how to design, install and test in accordance with Excel guidelines, best practice and above all standards compliance. The online course and test is run by Excel. The design and installation two day training course is run by our independent training partner, CNet Training.

Once partner status is awarded, both ECP's and ESP's are able to provide the comprehensive 25 year warranty for, copper, fibre, voice and rack installations.

This section details the features and benefits available through participation in the partner programmes, together with the level of commitment required to achieve and maintain a particular level of partner accreditation.

In the UK and UAE Excel is distributed exclusively by the Mayflex Group, elsewhere in EMEA Excel Distribution Partners are strategically located to service local ECP's and ESP's.



Partner Benefits	Excel Cabling Partner (ECP)	Excel Solutions Partner (ESP)	Excel Distribution Partner (EDP)
Access to the partner area of the Excel corporate website	X	X	X
Excellence Initiative training credits	X	X	
Access to the Excel Encyclopaedia	X	X	X
Pre and post sales phone and email technical support	X	X	X
Pre sales tender response support	X	X	
Complimentary Excel branded literature available on line	X	X	X
Complimentary printed Excel positioning brochures	X	X	X
Access to Excel demonstration facilities in Birmingham, City of London and Dubai	X	X	X
Project Registration Programme	X	X	X
25 Year Warranty Programme – product and application only *	X		
25 Year Warranty Programme – product, application and labour *		X	
Warranty certification issued within 5 working days **	X	X	
Market Development Funds (MDF)	On Application	X	On Application
Toolbox On Site Training ***		X	
Excel Site Audit ***		X	

\* Please refer to the Excel warranty terms and conditions document for full details

\*\* Subject to application for warranty meeting published terms and conditions

\*\*\* Tool box training and Excel site audits are available in the UK only, and with prior arrangement via the Excel technical support team, terms and conditions apply. For further details please contact your local sales representative, or the technical support team on +44 (0)121 326 7557

Partner Requirements	Excel Cabling Partner (ECP)	Excel Solutions Partner (ESP)	Excel Distribution Partner (EDP)
Complete the Excel Partner application form	X	X	X
Annual revenue commitment (measured January to December)	>£50,000	>£250,000	On Application
Complete a 12 month business plan to be reviewed quarterly		X	X
Share project pipeline opportunities		X	
Attend a 2 day Installation Training Course (Min 2 engineers) *	X	X	
Attend one complimentary Excel Partner Briefing event per annum (Held at three or four venues across the UK)	X	X	X
Retain qualified Excel engineers via bi-annual online certification +	X	X	
Offer complementary IP Converged Solutions, for example wired or wireless Ethernet, electronic security, etc		X	
Hold agreed levels and breadth of stock at all times			X
Allow Excel staff access to sales and marketing personnel		X	X
Promote the Excel brand via, business development staff, corporate web site and marcoms activities		X	X

\* Engineers successfully completing this course will be awarded 10 BICSI Cec's towards RCDD, RITP & ITS designations.

+ Engineers successfully completing this course will be awarded 6 BICSI Cec's towards RCDD, RITP & ITS designations.



# Excel Partner Services

Excel offers a suite of optional support services to its partners, and in turn to its end user customers. These services are currently available as standard in the UK and are available free of charge to ESPs and are chargeable to ECPs – details on application.

The purpose of these services is to ensure that the required level of best industry practice, together with system specific Excel design, installation, termination and testing practices are adhered to when installing Excel Category 6<sub>A</sub> and 6 structured cabling systems.

These services are not a replacement for class based or online training programmes offered as part of the Excel Partner Programme, the services available can be beneficial to installers who are new to the Excel range, or to changes in cable and connector design, for example installing screened Category 6<sub>A</sub> solutions. They also offer specifiers of Excel and end user customers an assurance of vendor support throughout the install programme.

# Excel Toolbox Training

The Excel toolbox training service is offered subject to terms and conditions and to customers and sites which meet the qualification criteria. The training will be delivered by a qualified and experienced member of the Excel technical support team and will provide hands on guidance and advice on best practice for preparation, installation, termination and testing of the Excel product set being used.

As stated above, this is an optional service, installers and end users of Excel will receive full post sales support, including warranty programmes, with or without use of the tool box training.

For further information please email [toolbox@excel-networking.com](mailto:toolbox@excel-networking.com)

# Excel Audit Service

The Excel Audit service is offered subject to terms and conditions and to customers and sites which meet the qualification criteria. The audit will be completed by a qualified and experienced member of the Excel technical support team, and will consist of a visual and performance inspection of the installed cabling. Visual inspection will include a review of cable routing and management, use of containment and cable ties, termination and labelling practice. Using calibrated and Excel approved test equipment a range of sample performance tests will be completed against the standards requirements for the installed grade of cabling.

As stated above, this is an optional service, installers and end users of Excel will receive full post sales support, including warranty programmes, with or without use of the site audit service.

For further information please email [audits@excel-networking.com](mailto:audits@excel-networking.com)

# Excel System Warranty Terms & Conditions

## Section 13

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## Excel System Warranty - Terms & Conditions

This document covers:

- Excel Category 5e



- Excel Category 6



- Excel Category 6A



- Excel Fibre Optic



- Excel Voice Cabling



# ENVIRON

The purpose of this document is to outline the terms and conditions of the Excel Structured Cabling System Warranty.

### Excel Partner Programme

The Excel partner programme offers installers two levels of accreditation, Excel Cabling Partner (ECP) and an Excel Solutions Partner (ESP).

Acceptance to either programme follows an application process based around technical and commercial capability, and commitment to undergo extensive training and sit an exam to demonstrate a full understanding of the Excel Structured Cabling System and how to design, install and test systems in accordance with the Excel guidelines, best practice and above all standards compliance.



### Excel System Warranty

The Excel System Warranty provides a 25-year product and applications assurance of compliance with the industry performance standard appropriate to the class of cabling installed. The Excel System Warranty is only available when the said system is designed, supplied and installed by an accredited Excel Partner.

If the accredited Excel Partner does not pay in full for the goods supplied under the warranty in accordance with terms, the warranty will become null and void. In the event that this occurs the end user will be notified immediately by Excel.

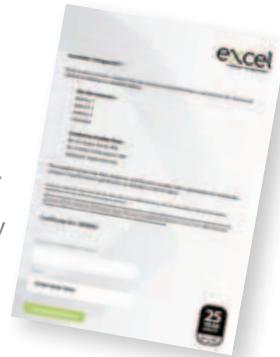
It is the accredited Excel Partner's responsibility to ensure that the end user is fully aware of the terms and conditions on which the warranty is supplied.



## How does it work?

Once site testing has been completed, the Excel Partner visits the Excel Partner Area at [www.excel-networking.com](http://www.excel-networking.com) to apply for a warranty via the online system within 60 days of the final test result date. When this information has been evaluated and accepted by our Excel Warranty team, certification will be issued. Until the certificate is issued the installation is not covered by the warranty.

Upon receipt of the application, and the required information in the correct format, the Excel Warranty team will complete the above process within a maximum of five working days, 90% of correctly applied for applications are processed and approved within 48 hours of application. Once a warranty has been approved a notification will be sent to you by email to advise you that the warranty has been issued and you will be able to visit the warranty area to download your certificate or to send a link directly to your end user client.



To qualify for the warranty the installation **must** be made up entirely of Excel or approved strategic partner products, which must be new at the time of installation.

## What is covered by the warranty?

The Excel system warranty provides assurance of fibre and/or copper link performance, covering patch panel to outlet and/or patch panel to patch panel links. The warranty covers components and applications. This means that if a component in any link fails, or the structured cabling fails to support an application that it has been tested to carry (such as 10 Gigabit Ethernet), then a claim can be made on the warranty.

All links must be installed and tested to Excel and industry guidelines to qualify for the warranty. (refer to 'Warranty procedure' and Installation Guidelines section).

The following, if tested and included in the warranty registration form are covered:

### Copper and Fibre versions of

- Horizontal links (Patch Panel to Outlet)
- Rack links (Patch Panel to Patch Panel)
- Backbone links (Patch Panel to Patch Panel between communications room or area)
- MTP Optical Fibre installations (test in accordance with the details of the Fibre Optic Links section below)
- Copper harness or Switch Links (comprising of patch panel and solid or stranded patch leads)
- Patch leads (must be Excel and detailed on the application)
- Consolidation Points and Cables when installed and tested in accordance with Installation Guidelines
- Environ Racks (when installed as part of a complete Excel solution)
- Intelligent, Modular and Standard PDUs (the warranty is for 3 years on PDUs included in the registration)

### Strategic Partners

Excel is proud to include Prysmian Sirocco blown fibre systems in the Excel Warranty when purchased with Excel Product from an authorised distributor.

- Installations using any combination of Excel Fibre Optic and Prysmian Sirocco Blown Fibre are covered by the Excel 25 Year Warranty. The Prysmian Sirocco Blown Fibre system, including, but not limited to, Prysmian Tube Cable and the blowing of the Prysmian Enhanced Performance Fibre Unit (EPFU), shall be installed by personnel trained and certified by Prysmian.

## What isn't covered by the warranty?

All information supplied to Excel from the Excel Partner pertaining to the warranty must be an accurate and true representation of the installation work undertaken. Should it become known that deliberately falsified information has been tendered to Excel, the warranty shall be rendered null and void.

- The warranty does not cover accidental or malicious damage to the installed links outside of Excel's control.
- The warranty does not cover damage caused by external circumstances beyond our control.
- The warranty does not cover links for which compliant test results were not supplied at the time of application. If subsequent work is carried out on the network or surrounding services (electrical, water, etc) that may have an effect on the performance of the cabling, the cabling must be retested. If the cabling is not retested, this may invalidate the warranty. For further detail please refer to our full terms and conditions of sale.

## What if there is a problem?

In the event of a problem with the installation, the user should contact the Excel Partner who installed the system. They will undertake a site survey to establish the extent of the problem and the actual cause. The Excel Partner shall contact the Excel Warranty team to notify them of a potential problem. Excel reserve the right to detail specific testing that shall be carried out by the installer, conduct a site visit, request samples, have suspected faulty product returned to Excel. Failure to comply with these requirements may, at the sole discretion of Excel, invalidate the claim. If it is found that installed Excel product covered by a valid warranty is at fault, then the Excel Partner will supply replacement product to resolve the problem at no cost to the customer.

- Excel Cabling Partners are eligible to claim the value of Excel product back from Excel.
- Excel Solutions Partners are eligible to claim the value of the Excel product, and the cost of labour to rectify the problem, back from Excel. Labour costs are covered at the rate agreed in the Excel Partner agreement.

If the Excel Partner is no longer in business, the customer should contact Excel's post-sales department, providing full details, in writing, of the installation and problem. Excel or an alternative Excel Partner will provide support, and where necessary replace/repair the products, to ensure the certified levels of performance are achieved. If a warranty was not applied for and/or not issued Excel does not accept any liability.

If an engineer is despatched to the site and it is found that the cabling system or workmanship is not at fault, then the customer will be charged at the standard rate for the engineer's time and travelling expenses.

## Warranty Application Process

Applying for an Excel 25 Year Product and Application Warranty couldn't be easier. The whole process is now undertaken via the 'Partner Area' located on the Excel website [www.excel-networking.com](http://www.excel-networking.com)

Once you have completely read these Terms and Conditions, please follow these simple steps to ensure that your warranty application is processed quickly and efficiently.

### Step One

Visit [www.excel-networking.com](http://www.excel-networking.com)

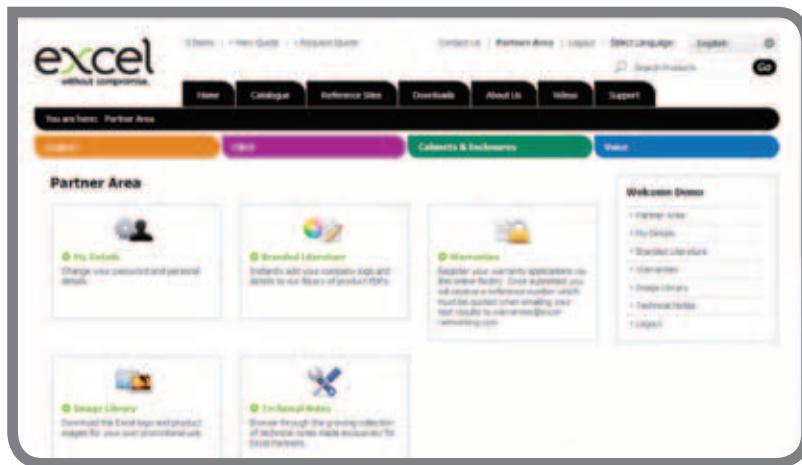
Click on the 'Partner Area' – you will be required to enter your email and password to enter this area. The link to the 'Partner Area' is at the very top of the webpage.

If you are an accredited Excel Partner and you haven't yet registered for the 'Partner Area' please email [admin@excel-networking.com](mailto:admin@excel-networking.com) and a user name and password will be set up and sent to you within 24 working hours.

**Note:** To ensure only the authorised people at your company can view the Excel Partner Area, we will set up the requestor as an 'Administrator' level so that they are the only ones that can then add and remove users to the site.

## Step Two

Click on Warranties

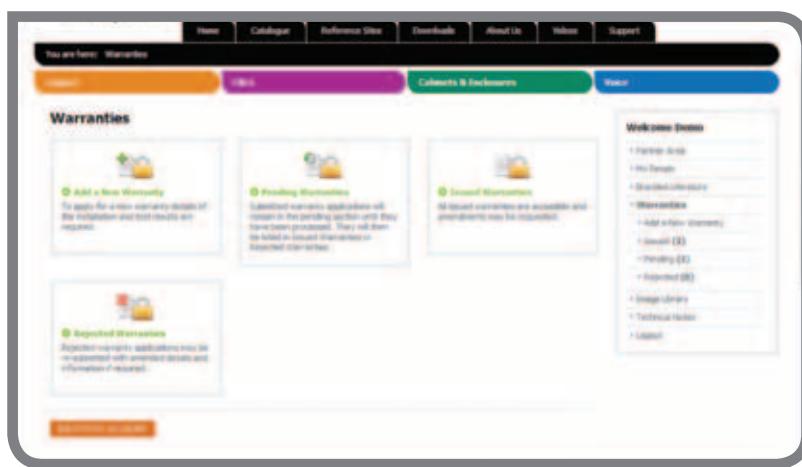


## Step Three

From here you have four choices:

- You can add a new warranty
- You can check any pending warranties
- You can view issued warranties
- You can view rejected warranties and change/add information to progress the application

Click on 'Add a new warranty'

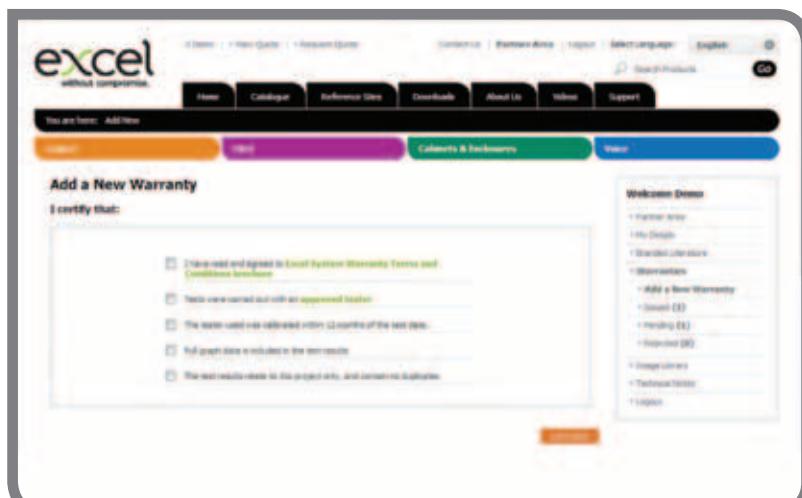


## Step Four

Before you start the process you will be asked to confirm compliance with certain conditions, including:

- I have read and agreed to the Excel System Warranty Terms and Conditions brochure
- Tests carried out with an approved tester
- The tester used was calibrated within the last 12 months.
- Full graph data included in test results
- The test results relate to this project only, and contain no duplicates

Once you confirm these points it will take you through to the next screen.



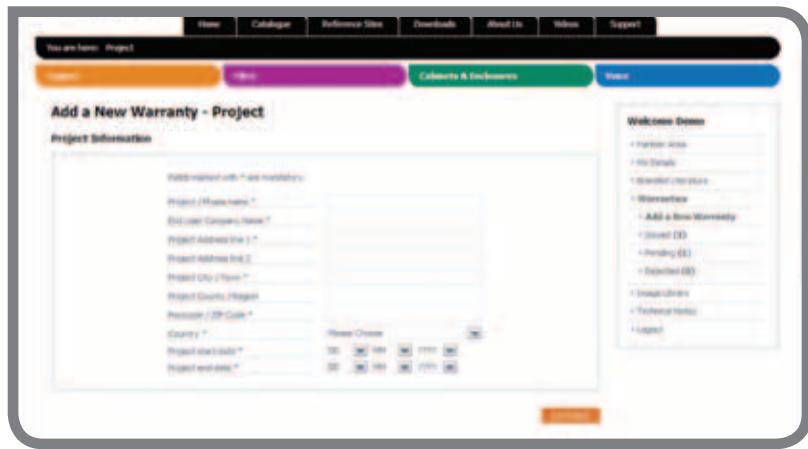
## Step Five

The database will automatically populate your company details – please check the information and should you need to make any changes these can only be carried out by an ‘Administrator’ level user (this is for security purposes). Please tick to confirm that you are happy with the details.



## Step Six

Add the full details of the project that you are requesting a warranty for.



## Step Seven

Add the technical information relating to the warranty application.

Please take care to include correct and accurate information as these details will be checked against the test results and inconsistencies in the information will result in your application being rejected.

These details will also be listed on the Warranty Certificate that is produced at the end of the process.

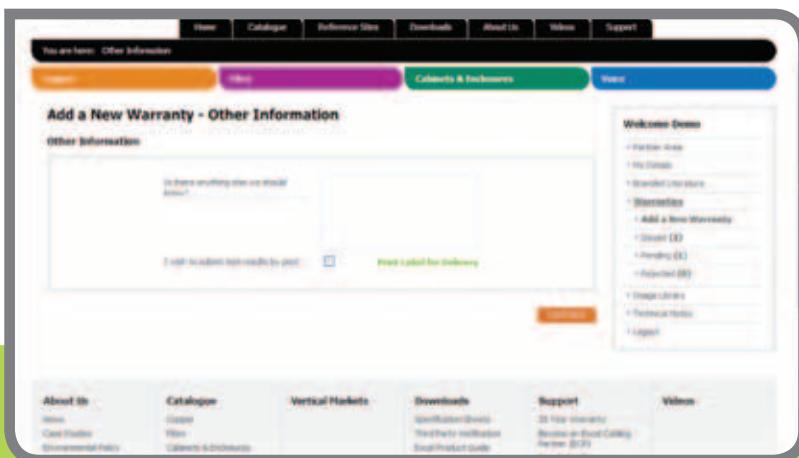
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## Step Eight

At this stage you can add in any further information that is relevant to the site and then submit your test results.

**N.B.** If you are submitting more than one file via the website, please ensure that you zip these documents together first.



### IMPORTANT Submitting Test Results

- Please make sure that your test results are submitted from an up-to-date calibrated tester – failure to do so will mean that your results will not be accepted and the 25 year warranty will not be provided.
- The tester shall be calibrated annually, preferably by the test equipment manufacturer. If a third party is used a PDF copy of the calibration certificate shall be submitted with every warranty application.  
Excel reserves the right not to accept third party calibration should the details not meet the required standards.
- The test equipment must support the standard for which the warranty is being sought.
- The test results must be submitted in the tester manufacturer format (eg.:flw' FlukeLinkWare).
- PDF test results are NOT accepted.
- The test results must be sorted within the results file by Building, Floor, Communications Room, Rack, Panel for easy analysis
- Only submit results that apply for this warranty application

### Submitting Results via the Post

You have a choice to submit the results by post or via the web. If you choose to send the results by post please click on the 'Print Label for Delivery' and it will produce a label with all the relevant information that you need to include when sending the test results.

The reference number will also be confirmed in an email and this must be included with the results that are posted to ensure that the details are matched to the right project. Write this reference number on the CD/DVD/Memory Stick that you are submitting the results on. Failure to include the reference number will mean that the results will not be accepted and we will be unable to process your warranty application.

Please ensure that the results are submitted straight away, if we don't receive them within 30 days your warranty application will automatically be removed from the system and you will need to re-apply.

**Note:** The results (CD/DVD/Memory Stick) will NOT be returned.

Alternatively upload the test results by following the instructions shown on the screen.

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### Verification

Once the results have been uploaded or you've printed off a label and sent the results by post, these will be sent through to our technical team.

They will check the online application and compare and verify the test results (please ensure that the test results are provided in the relevant format as stated above). Applications will be processed within 5 working days from the receipt of the test data being supplied in the correct format.

Once a warranty has been approved a notification will be sent to you by email to advise you that the warranty has been issued and you will be able to visit the warranty area to download your certificate or to send a link directly to your end user client.



## Pending Warranties

Any submitted warranty applications can be viewed by clicking on the 'Pending Warranties' folder.

## Approved Warranties

You can view any of your approved warranty applications (submitted from March 2012) by visiting the 'Approved Warranties' folder in the partner area. These details are held in a completely secure area that is only accessible by those members of your staff that have been given access to the Excel Partner area, and the Excel technical team. However, it is possible for you to copy and paste the link to the pdf of the warranty certificate to email directly to your customer if you wish.

## Rejected Warranties

If the warranty application is rejected it will be listed in the 'Rejected Warranties' area and a notification will be sent to you by email advising you of the reason(s) for rejection. You will then have the ability to update the information and progress the warranty through to completion.

**Please note that all rejected warranties will automatically be removed from the system after 60 days.**

For any questions or queries relating to the warranty application process please email these through to [warranties@excel-networking.com](mailto:warranties@excel-networking.com)

## Copper (Horizontal 4 pair)

100% testing shall be carried out on:

- Horizontal links (patch panel to outlet) – test as permanent link.
- Horizontal Links with Consolidation Points (CP) – test from Patch Panel to CP.
- Patch Panel to Patch Panel links are to be tested as Permanent Links.
- Switch Links (Patch Panel to RJ45 plug) – test continuity, no need to record the test. Document switch links on the application. Switch links shall be made from Excel patch leads (solid or stranded) and patch panel ports. The warranty does not cover installer terminated RJ45 plugs
- Full results must be submitted for each link.
- Results to be submitted in the original tester format (see previous page).

## Copper (Vertical Category 3/CW Multipair)

Links that are submitted for warranty must include:

- Length
- Continuity report
- Cable construction type and pair data.

## Fibre Optic Link

- Tier 1 certification must be completed and submitted for each fibre link. Each fibre core shall be tested in each direction and the results combined if stored electronically.
- Test equipment that stores the results electronically shall be presented in the manufacturers format.
- Where test equipment tests against a specific standard, care shall be taken to ensure that the correct one is selected.
- Details of the construction and core count of the fibre cable are needed.
- The fibre loss results should be submitted in the testers native format.
- Manual report shall include – test equipment make and model, calibration date, date of test, standard being tested against, calculated loss budget, loss A to B, Loss B – A, Pass or Fail.

Tier 1 certification refers to the use of a light source and power meter to perform continuity and loss testing of the installed links. The length of the fibre is also measured.

## Class E<sub>A</sub>/Category 6<sub>A</sub> warranty

An installation must be tested to Category 6<sub>A</sub> performance and 100% link tests must be performed using Level III test equipment as a minimum. Either a permanent link adapter or approved manufacturer's test head must also be used. The approved testers for submission of an Excel Warranty application are available at

<http://www.excel-networking.com/support/25-year-warranty/>



### Requirements for Class E<sub>A</sub>/Category 6<sub>A</sub> warranty

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class E<sub>A</sub> or EN50173 Class E<sub>A</sub>

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class E<sub>A</sub> protocols.
- Guaranteed backward compatibility.

For a full list of protocols supported by the Excel Category 6<sub>A</sub> warranty, please refer to appendix A.

## Class E/Category 6 warranty



An installation must be tested to Category 6 performance and 100% link tests must be performed using Level III test equipment as a minimum. Either a permanent link adapter or approved manufacturer's test head must also be used.

The approved testers for submission of an Excel Warranty application are available at

<http://www.excel-networking.com/support/25-year-warranty/>

### Requirements for Class E/Category 6 warranty

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class E or EN50173 Class E

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class E protocols.
- Guaranteed backward compatibility.

For a full list of protocols supported by the Excel Category 6 warranty, please refer to appendix B.

## Category 5e warranty



An installation must be tested to Class D/Category 5e performance and 100% link tests must be performed using Level III test equipment as a minimum. Either a permanent link adapter or approved manufacturer's test head must also be used.

The approved testers for submission of an Excel Warranty application are available at

<http://www.excel-networking.com/support/25-year-warranty/>

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class D or EN50173 Class D

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class D protocols.
- Guaranteed backward compatibility.

For a full list of protocols supported by the Excel Category 5e warranty, please refer to appendix C.

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## Fibre optic warranty

Tier 1 testing must be completed for each link (in both directions) that requires a warranty. The fibre loss results should be submitted in the testers native format. The maximum loss allowed can be worked out using the table below.



Class	Optical Fibre Type	Maximum Channel Attenuation dB			
		Multi Mode		Single Mode	
		850nm	1300nm	1310nm	1550nm
OF-300	OM1, OM2, OM3, OM4, OS1, OS2	2.55	1.95	1.8	1.8
OF-500	OM1, OM2, OM3, OM4, OS1, OS2	3.25	2.25	2	2
OF-2000	OM1, OM2, OM3, OM4, OS1, OS2	8.5	4.5	3.5	3.5
OF-5000	OS1, OS2			4	4
OF-10000	OS1, OS2			6	6

## Multipair warranty

Links that are submitted for warranty must include:



## Conditions of Warranty

The products, and where appropriate the labour, are covered by the warranty from the point of acceptance by Excel and not before. The warranty covers the products and installation as detailed above. The warranty excludes any form of consequential loss of any kind. The warranty is subject to the Mayflex Group Limited Conditions of Sale. The warranty is in addition to statutory rights. This warranty is governed by and interpreted in accordance with English law and the parties agree to submit to the non-exclusive jurisdiction of the English courts.

# Appendix A

## Excel Protocols List – Category 6<sub>A</sub>/Class E<sub>A</sub> – defined 500 MHz

Data systems supported include, but are not limited to:

Name	Application	Specification
10 Gigabit Ethernet	10GBASE-T	IEEE 802.3an
Gigabit Ethernet, IEEE 802.3ab	CSMA/CD 1000BASE-T b	IEEE 802.3 clause 40
Fast Ethernet IEEE 802.3u	CSMA/CD 100BASE-TX b	IEEE 802.3 clause 25
Ethernet: IEEE 802.3i	CSMA/CD 10BASE-T a	IEEE 802.3
Power over Ethernet Plus	PoE-plus	IEEE 802.3at Type 2
Power over Ethernet	PoE	IEEE 802.3at Type 1
Twisted pair Fibre Channel 1G	Fibre Channel 1Gb/s	INCITS 435
ATM-1200/Category 6	ATM LAN 1,2 Gbit/s	IP/MPLS Forum af-phy-0162.000
ATM-155/Category 5	ATM LAN 155,52 Mbit/s	IP/MPLS Forum af-phy-0015.000
ATM-52/Category 3	ATM LAN 51,84 Mbit/s	IP/MPLS Forum af-phy-0018.000
ATM-25/Category 3	ATM LAN 25,60 Mbit/s	IP/MPLS Forum af-phy-0040.000
Firewire/Category 5	Firewire 100 Mbit/s	IEEE 1394b
High Speed Token Ring	Token Ring 100 Mbit/s	IEEE 802.5t
Token Ring	Token Ring 16 Mbit/s	IEEE 802.5
Token Ring	Token Ring 4 Mbit/s	IEEE 802.5
ISDN Primary Access (Physical Layer)	S <sub>1</sub> /S <sub>2</sub>	ITU-T I.431
ISDN	S <sub>0</sub> Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S <sub>0</sub> Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S <sub>0</sub> -Bus (extended)	ITU-T I.430
Voice	X.21	ITU-T X.21
Voice	V.11	ITU-T V.11
Voice	PBX	National Requirements



## Appendix B

### Excel Protocols List – Category 6/Class E – defined 250 MHz

Data systems supported include, but are not limited to:

Name	Application	Specification
Gigabit Ethernet, IEEE 802.3ab	CSMA/CD 1000BASE-T b	IEEE 802.3 clause 40
Fast Ethernet IEEE 802.3u	CSMA/CD 100BASE-TX b	IEEE 802.3 clause 25
Ethernet: IEEE 802.3i	CSMA/CD 10BASE-T a	IEEE 802.3
Power over Ethernet Plus	PoE-plus	IEEE 802.3at Type 2
Power over Ethernet	PoE	IEEE 802.3at Type 1
Twisted pair Fibre Channel 1G	Fibre Channel 1Gb/s	INCITS 435
ATM-1200/Category 6	ATM LAN 1,2 Gbit/s	IP/MPLS Forum af-phy-0162.000
ATM-155/Category 5	ATM LAN 155,52 Mbit/s	IP/MPLS Forum af-phy-0015.000
ATM-52/Category 3	ATM LAN 51,84 Mbit/s	IP/MPLS Forum af-phy-0018.000
ATM-25/Category 3	ATM LAN 25,60 Mbit/s	IP/MPLS Forum af-phy-0040.000
Firewire/Category 5	Firewire 100 Mbit/s	IEEE 1394b
High Speed Token Ring	Token Ring 100 Mbit/s	IEEE 802.5t
Token Ring	Token Ring 16 Mbit/s	IEEE 802.5
Token Ring	Token Ring 4 Mbit/s	IEEE 802.5
ISDN Primary Access (Physical Layer)	S <sub>1</sub> /S <sub>2</sub>	ITU-T I.431
ISDN	S <sub>0</sub> Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S <sub>0</sub> Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S <sub>0</sub> -Bus (extended)	ITU-T I.430
Voice	X.21	ITU-T X.21
Voice	V.11	ITU-T V.11
Voice	PBX	National Requirements
Voice	PBX	National Requirements

## Appendix C

### Excel Protocols List – Category 5e/Class D – defined 100 MHz

Data systems supported include, but are not limited to:

Name	Application	Specification
Gigabit Ethernet, IEEE 802.3ab	CSMA/CD 1000BASE-T b	IEEE 802.3 clause 40
Fast Ethernet IEEE 802.3u	CSMA/CD 100BASE-TX b	IEEE 802.3 clause 25
Ethernet: IEEE 802.3i	CSMA/CD 10BASE-T a	IEEE 802.3
Power over Ethernet Plus	PoE-plus	IEEE 802.3at Type 2
Power over Ethernet	PoE	IEEE 802.3at Type 1
Twisted pair Fibre Channel 1G	Fibre Channel 1Gb/s	INCITS 435
ATM-155/Category 5	ATM LAN 155,52 Mbit/s	IP/MPLS Forum af-phy-0015.000
ATM-52/Category 3	ATM LAN 51,84 Mbit/s	IP/MPLS Forum af-phy-0018.000
ATM-25/Category 3	ATM LAN 25,60 Mbit/s	IP/MPLS Forum af-phy-0040.000
Firewire/Category 5	Firewire 100 Mbit/s	IEEE 1394b
High Speed Token Ring	Token Ring 100 Mbit/s	IEEE 802.5t
Token Ring	Token Ring 16 Mbit/s	IEEE 802.5
Token Ring	Token Ring 4 Mbit/s	IEEE 802.5
ISDN Primary Access (Physical Layer)	S <sub>1</sub> /S <sub>2</sub>	ITU-T I.431
ISDN	S <sub>0</sub> Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S <sub>0</sub> Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S <sub>0</sub> -Bus (extended)	ITU-T I.430
Voice	X.21	ITU-T X.21
Voice	V.11	ITU-T V.11
Voice	PBX	National Requirements
Voice	PBX	National Requirements
Voice	PBX	National Requirements



## Site & Installation Inspection Report

This form has been developed to be used for audits during or on completion of an Excel installation. Using our traffic light system you can see at a glance where any additional focus or work is required, to the standard required to receive a system warranty.

**Green - Fully compliant no further work required**

**Amber - Needs work to reach completion**

**Red - Major work or replacement required**

Name: ..... Date: .....

### Details

<b>End User Client</b>	
Project:	
Company:	
Address:	
Contact:	Tel No.:
<b>Excel Partner</b>	
Company:	
Address;	
Contact:	
Phase of Project	Initial <input type="checkbox"/> Termination <input type="checkbox"/> Testing <input type="checkbox"/> Handover <input type="checkbox"/>
Has previously highlighted remedial work been actioned?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> n/a

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### Installed Cabling

Copper System	Cat 5e <input type="checkbox"/> Cat 6 <input type="checkbox"/> Cat 6 <sub>A</sub> <input type="checkbox"/> Cat 6 <sub>A</sub> (with 7 <sub>A</sub> Cable) <input type="checkbox"/> Unscreened <input type="checkbox"/> Screened <input type="checkbox"/>	No. of outlets:
Fibre System	OM 1 <input type="checkbox"/> OM 2 <input type="checkbox"/> OM 3 <input type="checkbox"/> OM4 <input type="checkbox"/> OS1 <input type="checkbox"/> OS2 <input type="checkbox"/>	No. of terminated ends:
Brief overview i.e. Office/Hotel/ Industrial/Trading Floor		

## Cabling

Cable tie type	Hook & Loop <input type="checkbox"/> Nylon <input type="checkbox"/> Other <input type="checkbox"/>			
	Green	Amber	Red	Notes
Cable stored and protected before installation				
Adequate bundles presented				
Horizontal				
Vertical				
Cable ties fastened correctly				
Defined cable routes used				
Protected from sharp edges and damage				
Adequate containment used				
Minimum bend radii observed				
Power and Data separated				
Firestopping in place				

## Copper Terminations

	Green	Amber	Red	Notes
Pair twist intact				
Patch Panel Outlet				
Cable sheath stripped back - kept to minimum				
Cable dressed into outlet correctly				
Cables anchored to Jacks				
Conductors damage free				
Terminated correctly				
Shutters operating correctly				
Patch cord - Unscreened/ Screened used correctly				
Screens terminated				
Jacks				
Patch Panels				
Patch leads installed	Cat 6 <sub>A</sub> <input type="checkbox"/>	Cat 6 <input type="checkbox"/>	Cat 5e <input type="checkbox"/>	



## Fibre Terminations

Termination type	Cold/Hot Melt Connectors <input type="checkbox"/> Pigtails <input type="checkbox"/> Mechanical <input type="checkbox"/> Pre-terminated (inc. MTP) <input type="checkbox"/>			
Type	Fibre		Multimode <input type="checkbox"/> Singlemode <input type="checkbox"/>	
	Connector		LC <input type="checkbox"/> SC <input type="checkbox"/> ST <input type="checkbox"/> FC <input type="checkbox"/> MTP <input type="checkbox"/>	
	Other - please specify			
	Bulkhead adapter		Multimode <input type="checkbox"/> Singlemode <input type="checkbox"/>	
	Green	Amber	Red	Notes
Sufficient slack available Patch Panel Outlet				
Fibre supported to gland				
Gland used to secure to patch panel				
Continuity of fibre type				
Dust caps fitted where appropriate: Connectors Bulkhead adapters Blown fibre tubing				
Warning labels fitted				
Contamination free				

## Racks

Type	Environ CR <input type="checkbox"/> Environ ER <input type="checkbox"/> Environ SR <input type="checkbox"/> Environ OR <input type="checkbox"/> Environ WR <input type="checkbox"/>			
	Other (specify)			
	Green	Amber	Red	Notes
Rack grounded				
Patch Panel individually bonded to rack				
Cables dressed correctly and neatly in racks				
Sufficient management bars used				

## System Labelling

	Green	Amber	Red	Notes
Racks				
Patch Panel				
Cable at Patch Panel				
Telecommunications Outlet				
Cable at Telecommunications Outlet				
Labelling legible & permanent				
Clear, presentable and legible				
Labels match at both ends				
Consistent format				
No hand written labels and marker pen removed				

## System Testing

<b>Copper</b>	
Tester used	
Configuration	Permanent Link <input type="checkbox"/> Channel <input type="checkbox"/>
Standard	EN <input type="checkbox"/> TIA <input type="checkbox"/> ISO <input type="checkbox"/>
Correct NVP	
Test adapters used	
Firmware/Software version	
<b>Fibre</b>	
Equipment used	VFL <input type="checkbox"/> Light source & power meter <input type="checkbox"/> OTDR <input type="checkbox"/>
Fibre type	Multimode <input type="checkbox"/> Singlemode <input type="checkbox"/>
	850 nm <input type="checkbox"/> 1300nm <input type="checkbox"/> 1310nm <input type="checkbox"/> 1550 nm <input type="checkbox"/>



## Testing *(Continued)*

	Green	Amber	Red	Notes
Fully tested				
Tester within calibration				
Results saved electronically				
Appropriate manufacturer tester software used				
Full information included (Site details, company name, operator, cable ID, etc.)				
Test Operator	Name			
	Position			

## Containment

Type	Tray <input type="checkbox"/>	Basket <input type="checkbox"/>	Matting <input type="checkbox"/>	Dado <input type="checkbox"/>	None used <input type="checkbox"/>
	Green	Amber	Red	Notes	
Fit for purpose					
Condition					
Adequate for the install					
Lids fitted securely					
Securely fixed in place					
Aesthetically pleasing					
Loading					
Right Depth					
Future expansion					

## Notes

## Actions Required

Task	Completion Date	Task Owner

Audit Completed by:

Name: ..... Company: ..... Date: .....

Audit Received by:

Name: ..... Company: ..... Date: .....

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# Excel Reference Sites and Case Studies

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## Excel Reference Sites

Excel has been installed in thousands of different sites across the world. When installed by a qualified Excel Partner the Excel 25 Year Product and Applications Warranty is also available to the end user client. With installers experienced in a wide range of vertical markets, Excel is the perfect solution, whatever the industry.

Listed below are examples of projects across various vertical markets and countries.



### Banking and Finance

Admiral UK, Newport, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre, Cabinets	
ARC International, United Arab Emirates	Excel Category 6	
Banco Alcala, Madrid, Spain	Excel Category 6 UTP	
Bank of Ireland, United Kingdom	Excel Category 6	
banque Rhone-Alpes, (Different cities in RA region), France	Excel Category 6 F/UTP	
CBI Bank, Rak, United Arab Emirates	Excel Category 6	
Bridge Point, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM4 Fibre, OM4 MTP, Cabinets	
Capital One, Various Sites, United Kingdom	Excel Category 6 U/UTP, OM4 Fibre, Wall Mounted Cabinets	
Citibank, Madrid, Spain	Excel Category 6 UTP	
Creston Insurance	Excel Category 6 UTP LOSH	
Dealogic, London, United Kingdom	Excel Category 6 <sub>A</sub> , Category 6 U/FTP, Category 6 <sub>A</sub> F/FTP, OM3 Fibre	
Delurac, Paris, France	Excel Fibre, MTP Fibre	
Edificio Camoes-Porto CGD, Oporto, Portugal	Excel Category 6 UTP	
European Capital Finance, United Kingdom	Excel Category 6	
Faber Maunsell, United Kingdom	Excel Category 6, Category 5e	
Fournié Grospraud, Albi, France	Excel Category 6 <sub>A</sub> , Cabinets	
FTI Consulting, London, United Kingdom	Excel Category 6 U/UTP, Category 6 <sub>A</sub> U/UTP, Fibre	
Gras Savoye, Grenoble, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre	
Industrial & Commercial Bank of China, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP	
Jefferies Bank, United Kingdom	Excel Category 6	
JLT Scotland, Scotland	Excel Category 6 UTP	
Kauphins Singer, United Kingdom	Excel Category 5e	
Kirsh, London, United Kingdom	Excel Category 6 <sub>A</sub> UTP, OM2 Fibre	
Leadenhall Building, London, United Kingdom	Excel Voice, Cabinets	
Mako, Kent, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP	
National Bank of Greece, United Kingdom	Excel Category 6, Fibre	
Quilter, London, United Kingdom	Excel Category 6 UTP, MTP Fibre, Fibre	
RSA, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets, PDUs	
Schnider Trading, United Kingdom	Excel Category 6	
Stanbic Bank, Accra, Ghana	Excel Category 6, OM3 Fibre, Cabinets	
Sunguard St Matthews House Office Refurb, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets	
Swiss Finance Corporation, United Kingdom	Excel Category 6	
Walbrook St, London, United Kingdom	Excel OS2 Fibre	
Wonga, London, United Kingdom	Excel Category 6 UTP, MTP Fibre, Cabinets	
Yorkshire Building Society, Yorkshire, United Kingdom	Excel Category 6 and Category 6 UTP	

### Central Government

ADH Military, Abu Dhabi, United Arab Emirates	Excel Category 6 FTP	
Ajman Municipality Licensing Department, United Arab Emirates	Excel Category 6	
Anti-Corruption Bureau	Excel Category 6 + Excel Category 5e	
Anti-Corruption Bureau, Baku, Azerbaijan	Excel Category 5e, Cabinets	
Belgrade Police HQ	Excel Category 6 UTP	
Border Guard, Saudi Arabia	Excel Fibre	
Central Statistics Agency Ministry, Addis Ababa, Ethiopia	Excel Category 6 UTP, OM2 Armoured Fibre, Server Cabinets	
CMW 11023	Excel Category 6 F/UTP	
CMW-10093-10257, Abu Dhabi, United Arab Emirates	Excel Category 6 FTP	

DEFRA, United Kingdom	Excel Category 5e
Department of Culture, Media & Sport, United Kingdom	Excel Category 6, Fibre
Department of Transport, United Kingdom	Excel Category 6
Dubai Military, Dubai, UAE	Excel Category 6 FTP
DVLA, United Kingdom	Excel Category 6
Environment Agency, Leeds, United Kingdom	Excel Category 6 U/UTP, Floor Standing Cabinets
Ethiopian Press Agency Ministry, Addis Ababa, Ethiopia	Excel Category 6 UTP, OM2 Armoured Fibre, Server Cabinets
Ethiopian Revenue & Customs Authority, Addis Ababa, Ethiopia	Excel Category 6 UTP, OM2 Armoured Fibre, Server Cabinets
Ethiopian Road Authority, Addis Ababa, Ethiopia	Excel Category 6 UTP, OM2 Armoured Fibre, Server Cabinets
General Medical Council, United Kingdom	Excel Category 6
General Prosecutor	Excel Category 5e
General Prosecutor, Baku, Azerbaijan	Excel Category 6 U/UTP, Cabinets
GHQ Armed Forces HQ, Abudhabi, United Arab Emirates	Excel Category 6 <sub>A</sub> UTP, Fibre, Server Cabinets
HMRC Ralli Quays, Manchester, United Kingdom	Excel Category 6
HMRC, United Kingdom	Excel Category 5e, Fibre
Inland Revenue (NAV), Hungary	Excel Category 5e U/UTP
Mersey Police - Millenium House, Liverpool, United Kingdom	Excel Category 6 UTP, Environ® Cabinets
Meteo, France	Excel Category 6 <sub>A</sub> U/FTP, Cabinets
Military Accommodation Roll Out, Various Sites, United Kingdom	Excel Category 5e U/UTP, OS2 Fibre
Ministry of Defence - Moral Guidance Project, Safat, Kuwait	Excel Category 6
Ministry of Defence, Various, Netherlands	Excel Category 5e U/UTP, Fibre, Cabinets
Ministry of Justice, Muscat, Oman	Excel Category 6 <sub>A</sub>
MOD Building 988, Hereford, United Kingdom	Excel PDUs
MOI, Doha, Qatar	Excel CST Fibre
Oman Border Control, Oman	Excel Fibre
Parliamentary & Health Service Ombudsman, United Kingdom	Excel Category 6
President's Delivery Bureau	Excel Category 6
Qatar Government, Qatar	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre
Ramses IV, Laval, France	Excel MTP Fibre
Reg Oman Electricity & Transmission Comp head office (OETC) Project	Excel Category 6 <sub>A</sub>
Register of Scotland, Scotland, United Kingdom	Excel Category 6 U/UTP, Category 6 UTP, OM4 Fibre
Survey of Land Registration Bureau(SLRB), Manama, Bahrain	Excel Category 6, OM3 Fibre
Thales Security	MTP solution
The Combined Justice Centre, United Kingdom	Excel Category 6
Turkish Highways, Ankara , Turkey	Excel Category 6 <sub>A</sub> F/FTP, OM4 Fibre, OS2 Fibre, Cabinets
Wataya Music School ROP, Muscat, Oman	Excel Category 6, Cabinets

## Charities

LHASA, Leeds, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP	
Princes Trust	Excel Category 5e UTP	
Thames Valley Housing Assoc, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP	

## Commercial

Akers Project, Various Sites, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP	
Al Arab News Channel, Bahrain	Excel Category 6 <sub>A</sub> F/FTP	
Al Khor Villas	Excel Category 6	
Bain & Co, United Kingdom	Excel Category 6 U/UTP, Fibre	
Belven Pumps and Valves	Excel Category 6 U/UTP	
Bon Preu, Barcelona, Spain	Excel Category 6 UTP	
Bouygues, France	Excel Category 6 <sub>A</sub> F/FTP, Fibre	
BPM, Denmark	Excel Category 6 <sub>A</sub> F/FTP	
Bravida, Sweden	Excel Category 6 <sub>A</sub> U/FTP	
C.C. Atrium Bengela, Angola	Excel Category 6 FTP, UTP, Cabinets	
Call Center Promotec	Excel Category 6 UTP	
Cap Gemini Project, United Kingdom	Excel Category 5e, Category 6, Cabinets	
Capita Moorfoot, Sheffield, United Kingdom	Excel Category UTP, Cabinets	



## Excel Reference Sites and Case Studies

Centre Commercial, La Defense, France	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre, Cabinets
Chantier Iter, Sant Paul Les Durance, France	Excel Category 6 FTP and Voice
CIRTL, Lyon, France	Excel OM3 Fibre
Commercial Complex	Excel Category 6 U/UTP
Conexdata, Paris, France	Excel Category 6 <sub>A</sub> F/FTP
Countrywide, Various Sites, United Kingdom	Excel Category 5e U/UTP
Eastleigh and Wessex House, Southampton, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets
General Electric (GE) Manchester, Cheshire, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre
Goodrich, Banbury, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre, Floor Standing Cabinets
GRDS Irisium Office, Douai, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets
Grimaldi	Excel Category 6 U/UTP
Havas, Paris, France	Excel OM3 Fibre
Hill Dickinson	Excel Category 6 UTP LSOH
Ilva	Excel Category 6 U/FTP
Itron Contigea	Excel Category 6 U/UTP
Lanvin, Paris, France	Excel Category 6 <sub>A</sub> Fibre
LAPF Project	Excel Category 6 U/UTP
Lunch Garden	Excel Category 6 U/UTP
Micrent	Excel Category 6 UTP
Mwanza Commercial Complex, Dar Es Salaam, Tanzania	Excel Category 6 UTP, OM2 Fibre, Cabinets
Norfin, Lisboa, Portugal	Excel Category 6 U/UTP
Northampton Germany Co Project, Northamptonshire, United Kingdom	Excel Category 7, SWA OM3 Fibre, Cabinets
Novi 8	Excel Category 6 <sub>A</sub>
Oficinas Calle Orense, Madrid, Spain	Excel Category 6 FTP
Oficinas Reparalia, Madrid, Spain	Excel Category 6 UTP
Oficinas SPEE Leon	Excel Category 6 UTP
Onyx Towers	Excel Category 6, OS2 & OM3 Fibre
Oxilan (decathlon), Lille, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets
Project Everest	Excel Category 6 <sub>A</sub> U/FTP S/FOIL
Project Galaxy, Liverpool, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, Fibre
Project Pentrak, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Proyecto IPN- Edificio Tecbis	Excel Category 6 UTP
Real Insurance HQ Building, Nairobi, Kenya	Excel Category 6, OM3 Fibre, Cabinets
Renault, Paris, France	Excel Fibre
Renesainse PPF, Croydon, United Kingdom	Excel Category 6 UTP
Salon de l'automobile	Excel Category 6 UTP
SCC Contract Phase 2, United Kingdom	Excel Category 5e, Category 6, Category 6 <sub>A</sub>
Sephora	Excel Category 6 <sub>A</sub> F/FTP
Spie St Nazaire	Excel Category 6 UTP
T8, Paris, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre
Tabacalera, Malaga, Spain	Excel Category 6 UTP
Zemsania, Barcelona, Spain	Excel Category 6 UTP
France television	Excel Category 6 FTP
Messe Congress Graz	Excel Category 6 <sub>A</sub> F/FTP

### Construction

375 Kensington, London, United Kingdom	Excel Category 5e U/UTP
55 Villas	Excel Category 6
Adnoc - AlKayatt Tower, Abudhabi, United Arab Emirates	Excel Category 6 <sub>A</sub> F/FTP
Arabtec HQ, Abudhabi, United Arab Emirates	Excel Category 6 <sub>A</sub> F/FTP
Bam Construction	Excel Category 6
Bovis Homes, United Kingdom	Excel Category 6, Category 5e
Broadgate Leeds, Leeds, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Chelsea Harbour Design Centre, United Kingdom	Excel Category 5e
Cushman & Wakefield	Excel Category 6 UTP
Fabrica en Bilbao	Excel Category 6 <sub>A</sub> F/FTP
Ferrovial	Excel Category 6 UTP
Gleeson Homes, United Kingdom	Excel Category 6



Goodmans Field, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP
HealthCare Centre De Pastorij	Excel Category 6 U/UTP
Housing Complex in Wadi, Oman	Excel Category 6
ISG, United Kingdom	Excel Category 6
Kier, United Kingdom	Excel Category 6
Mackinnon & Co, United Kingdom	Excel Category 6
Morgan Sindall, Various Sites, United Kingdom	Excel Category 5e, Category 6, Category 6 <sub>A</sub>
Morris Homes, United Kingdom	Excel Category 6
Nuzal Labour Village, United Arab Emirates	Excel Category 6
Shard of Glass, London, United Kingdom	Excel Fibre, Blown Fibre, Cabinets
Town Hall	Excel Category 6 U/UTP
Trinity Square Development Gateshead, Newcastle, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre, Cabinets
Wasl Buildings	Excel Category 6
Your Homes, Newcastle, United Kingdom	Excel Category 6, Cabinets

## Education

Applied Science Phase 2, Manama, Bahrain	Excel Category 6, Category 6 <sub>A</sub>
Aylward Academy	Excel Category 6 UTP LSOH
Bangor Uni	Excel Category 6 <sub>A</sub> U/UTP
Barcelona Languages School, Spain	Excel Category 6
Billericay School, United Kingdom	Excel Category 6, Cabinets
Bishop of Winchester, Bournemouth, United Kingdom	Excel Category UTP, OM3 Fibre, Cabinets
Bow School, London, United Kingdom	Excel Category 6 U/UTP, Cabinets
Bradford College, Bradford, United Kingdom	Excel Category 6 UTP
Brompton Academy, Gillingham , United Kingdom	Excel Category 6 U/UTP, OM3 Fibre
Burntwood School, United Kingdom	Excel Category 6
BWS	Excel Category 6 <sub>A</sub> U/FTP
Cardiff School	Excel Category 6 UTP
Carillion Schools	Excel Category 6 UTP
Central Foundation School, London, United Kingdom	Excel Category 6, Fibre, Cabinets
Cetic, Granada, Spain	Excel Category 6 <sub>A</sub> U/FTP, Fibre, Cabinets
City Heights Academy, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
City Of Leicester	Excel Category 6 <sub>A</sub> U/FTP
City of Sunderland College, United Kingdom	Excel Category 6 <sub>A</sub> Fibre
Colegio de aparejadores en Granada, Granada, Spain	Excel Category 6 UTP
College Jean Mace, France	Excel Category 6 <sub>A</sub> F/FTP
COUFIGNAL, STRASBOURG, France	Excel Category 6 <sub>A</sub> U/UTP, Cabinets
Crest Academy, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre
Crous, France	Excel Category 6 <sub>A</sub> U/UTP
East Ham CSC, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, F/FTP, Category 7 <sub>A</sub> + S/FTP, OM3 Fibre
Elstree, Hertfordshire, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Foxfield Primary School, London, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP, OM3 Fibre, Cabinets
Furness College Barrow, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
George Elliott School, United Kingdom	Excel Category 6 U/UTP, Fibre, Cabinets
Gloucester Academy	Excel Category 6 UTP
Grace Academy Darlaston	Excel Category 6 UTP
Habberley Learning Campus, Kidderminster, United Kingdom	Excel Category 6 UTP
Hamilton & Netherhall College, Leicester, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, 6 <sub>A</sub> U/FTP, OM3 Fibre
Hampton Academy, Middlesex, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Hans price Academy, Weston-Super-Mare, United Kingdom	Excel Category 6 UTP, OM3 Fibre
Holden Lane School, United Kingdom	Excel Category 6, Cabinets
Ille d'Abeau, France	Excel Category 6
James Hornby School, Essex, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
KCL Kings Way, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets
Kearsley Academy, Bolton, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Kings College, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, FFTP, OM4 Fibre, Cabinets
Kirklees Engineering College, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP
Knowledge Modern School	Excel Category 6





## Excel Reference Sites and Case Studies

LAPF	Excel Category 6
Leeds East Academy, Leeds, United Kingdom	Excel Category 6 U/UTP
Lincoln College, Lincoln, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, Cabinets
Lisboa School, Lisboa, Portugal	Excel Category 6 UTP, Cabinets
London Borough Of Hillingdon Schools	Excel Category 5e & Category 6, OM3
London BSF Schools, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre
LOR 3 Project, Oldham / Stoke, United Kingdom	Excel Category 6 UTP
Loxford School, Essex, United Kingdom	Excel Category 6, Cabinets
Lycée Victor Hugo, Rennes, France	Excel Category 6 <sub>A</sub> Dual, Cabinets
Maltby Academy	Excel Category 6 UTP
Marriotts School Stevenage, United Kingdom	Excel Category 6, Fibre, Cabinets
Maura & Nordkisa schools, Nr Oslo, Norway	Excel Category 6 <sub>A</sub> U/FTP
Mearns Academy, Aberdeen, United Kingdom	Excel Category 5e, OM3 Fibre, Cabinets
MOE - 6 Schools, Sohar, Oman	Excel Category 6 <sub>A</sub> U/UTP, OS2 Fibre, Cabinets
Mosely Park School -Wolves BSF, Wolverhampton, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Newcastle College 6th Form Academy, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre, Cabinets
Nizwa College, Oman	Excel Category 6
North Portugal School, Oporto, Portugal	Excel Category 6 U/UTP
North Wales Education Project, North Wales, United Kingdom	Excel Category 6 UTP, OM3 Fibre
North West Schools, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre
NTU UPP, Nottingham, United Kingdom	Excel Category 6 U/UTP
NWRC-Fort William	Excel Category 6 U/UTP
Ormiston Sandwell Community College, Oldbury, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Our Lady and St John College	Excel Category 6 UTP
Oxford University Institute	Excel Category 6 <sub>A</sub> U/UTP
Park Community School, Portsmouth, United Kingdom	Excel Category 6 UTP, OM4 Fibre, Cabinets
Parklands Bolton, Bolton, United Kingdom	Excel Category 6 UTP
PDCP	Excel Category 6
Phoenix School, United Kingdom	Excel Category 6 U/UTP, Fibre, Cabinets
Port Glasgow	Excel Category 6 UTP LSOH
Portslade Academy, Brighton, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Portsmouth School 2, Portsmouth, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Priory Ruskin Academy, Grantham, United Kingdom	Excel Category 6 UTP
Quest Academy	Excel Category 6 UTP, OM3 Fibre
RGC - Wireless	Excel Category 6 <sub>A</sub> U/FTP
Riverbank & Barclay Primary Schools Waltham	Excel Category 6 U/UTP
School of Geography Leeds Uni	Excel Category 5
Schools Project, United Kingdom	Excel Category 6
Sheldon Academy	Excel Category 6 UTP
Shirebrook Academy, United Kingdom	Excel Category 6
Silverstone UTC, Northamptonshire, United Kingdom	Excel Category 6 <sub>A</sub> UTP
South Wales Schools, South Wales, United Kingdom	Excel Category 6 UTP
Southwark School Project, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
St Bede Blackburn	Excel Category 6 UTP
St Chads & Our Ladys School, Wolverhampton, United Kingdom	Excel Category 6
St Columbus High School, Strathclyde, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
St Leonards/Hastings Academy, Hastings, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
St Mary's College Hull	Excel Category 6 UTP LSOH
Sutton Academy, Merseyside, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Tauheedul Islam Girls' High School	Excel Category 6 UTP LSOH
Teie School, Norway	Excel Category 6 <sub>A</sub> F/FTP
Temple Grove School	Excel Category 6 <sub>A</sub> UFTP, OM3
Three Academy, Colchester, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Trinity Academy, Halifax, United Kingdom	Excel Category 6, Fibre, Cabinets
Twickenham Academy, Middlesex, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Unite Student Accommodation, Various Sites, United Kingdom	Excel Category 5e U/UTP, OM3 Fibre, Cabinets
University of Bahrain	Excel Category 6
Waterhead Academy, Oldham, United Kingdom	Excel Category 6, Fibre, Cabinets

Waverley School - Bham BSF, Birmingham, United Kingdom  
Winterbourne Academy, Bristol, United Kingdom

Excel Category 6, OM3 Fibre, Cabinets  
Excel Category 6 UTP, OM3 Fibre, Cabinets

### Emergency Services

Cumbria Police Durranhill BCU, United Kingdom	Excel Category 6, Fibre
KSA Municipality, Saudi Arabia	Excel Category 6 <sub>A</sub> F/FTP
Lothian & Borders Police, United Kingdom	Excel Category 6
Metropolitan Police, London, United Kingdom	Excel Category 5e
New Scotland Yard, London, United Kingdom	Excel Category 5e
Royal Oman Police, Muscat, Oman	Excel Category 3 External, Fibre
Serbian Police, Belgrade, Serbia	Excel Category 6 U/UTP
Serious Fraud Office, United Kingdom	Excel Category 6
Strathclyde Police, United Kingdom	Excel Category 6
West Yorkshire Police Scientific Support Unit, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP



### Enterprise

ADP	Excel Category 6 <sub>A</sub> UTP
Bain & Co, London, United Kingdom	Excel Category 6, OM3 Fibre, OM4 Fibre
Biopharma Laboratories, Granada, Spain	Excel Category 6 <sub>A</sub> U/UTP, Fibre
Bouygues, Paris, France	Excel Category 6 <sub>A</sub> F/FTP
Brookfield, 99 Bishopsgate, London, United Kingdom	Excel Category 6 UTP, Fibre
Building F, Sunbury, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OS2 Fibre
Burberry, Various Sites, United Kingdom	Excel Category 6 U/UTP, Cabinets
Camden 6023, United Kingdom	Excel Category 6, Cabinets
Chanel, Various Sites, United Kingdom	Excel Category 6 U/UTP, Cabinets
Co-Operative Head Office, Manchester, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP
Coca Cola, London, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre
Cofidis	Excel Category 6 <sub>A</sub> UTP
Edificio ONCE Cartuja, Sevilla, Spain	Excel Category 6 FTP
EON Green, Nottingham, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, Cabinets
Euro Clear, United Kingdom	Excel Category 6, Fibre
FDM IT Services, London, United Kingdom	Excel Category 6 UTP, Category 6 <sub>A'</sub> U/FTP, Category 6 <sub>A</sub> UTP, Cabinets
Fourtech Angola, Angola	Excel Category 6 UTP, Fibre, Cabinets
Francisc Lefevre Offices, Spain	Excel Category 6
GE new office, Budapest, Hungary	Excel Category 6 U/UTP, Cabinets
GE Office Building, Spain	Excel Category 6
HOGAN LOWELLS	Excel Category 6 <sub>A</sub> UTP
Infinity Data Centre 2013, Various Sites, United Kingdom	Excel Category 6, Category 6 <sub>A'</sub> Fibre
K23 Business Park	Excel Category 7 <sub>A</sub>
Kelvin Hughes, United Kingdom	Excel Category 5e
MOOG Inc, Wolverhampton, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP
Mostoles Industrial, S.A. (Moinsa), Madrid, Spain	Excel Category 6 FTP
NEC Headquarters, Birmingham, United Kingdom	Excel Category 6 U/UTP, Cabinets
Nokia, United Kingdom	Excel Category 6, Category 6 <sub>A'</sub> Fibre
NTTE, Various Sites, United Kingdom	Excel Category 6, Category 6 <sub>A'</sub> Fibre
Odgers Berndston, United Kingdom	Excel Category 6 U/UTP, OM3 Fibre
Open Space Offices, Spain	Excel Category 6 U/UTP
Plusnet - Leeds, Leeds, United Kingdom	Excel Category 5e U/UTP
Project Mercury, Warrington, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP / FFTP, OM3 Fibre
PTS, Granada, Spain	Excel Category 6 <sub>A</sub> UTP, Category 6 UTP, Fibre, Cabinets
Real Free Zone Warehouse, Dubai, United Arab Emirates	Excel Category 6
Red.Es, Valladolid, Spain	Excel Category 5e UTP
SGAE	Excel Category 6 UTP
Tracerco, Billingham, Cleveland, United Kingdom	Excel Category 6 UTP, Category 6 <sub>A</sub> U/FTP, Fibre, Cabinets
UGT, Spain	Excel Category 6
Ultra Electronics, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP
Unruly Media, United Kingdom	Excel Category 6, Cabinets





## Excel Reference Sites and Case Studies

Volvo, Madrid, Spain  
Weightmans, United Kingdom  
West Notts College Phase 2, Nottingham, United Kingdom

Excel Category 7, Category 6<sub>A</sub> FTP, OS2 Fibre  
Excel Category 6  
Excel Category 6 U/UTP, Cabinets

### Health

5 Hospitals, Ankara, Turkey	Excel Category 6 U/UTP, OM3 Fibre
Al Basheer Hospital, Jordan	Excel Category 6 <sub>A</sub>
Alderhay Children's Hospital	Excel Category 6 <sub>A</sub> FFTP
Ayrshire & Arran Health Board, United Kingdom	Excel Category 6
Berretyóújfalu Hospital	Excel Category 6 <sub>A</sub> FTP
Birmingham & Solihull Mental Health Trust, United Kingdom	Excel Category 6
Bolton Hospital, Bolton, United Kingdom	Excel OS2 Fibre, Cabinets
Brighton Hospital, United Kingdom	Excel Fibre
BUPA-HQ - Leeds	Excel Category 5e
CHU de Lille, France	Excel Category 6 <sub>A</sub> F/FTP
Cli.St-PierreOttigni, Brussels, Belgium	Excel Category A F/FTP
Clinica Fiac, Spain	Excel Category 6 <sub>A</sub> U/UTP
Department of Health, United Kingdom	Excel Category 6
EBI / PH2, Cambridge, United Kingdom	Excel Category A FTP, OM3, OS2 Fibre
EPHAD CARVIN, France	Excel Category 6 <sub>A</sub> F/FTP
EPHAD LINSELLES, France	Excel Category 6 <sub>A</sub> F/FTP
Galla Hospital, Muscat, Oman	Excel Category 6, Category 5e, OS2 Fibre
Glan Clwyd Hospital	Excel Category 6 UTP LSOH
Guys & St Thomas, London, United Kingdom	Excel Category 6 <sub>A</sub> UTP, Category 6UTP
Hamad Medical Center	Excel Category 6 <sub>A</sub>
Heartlands Hospital, Birmingham, United Kingdom	Excel Category 6 U/UTP, OM1 Fibre, Floor Standing Cabinets
Hopital de Pontoise, Paris, France	Excel Category 6 F/UTP, OM3 Fibre
Hopital Erstein, Mulhouse, France	Excel Category 6 <sub>A</sub> OM3 Fibre, Cabinets
Hospital de Valencia (CCTV Instalation), Valencia, Spain	Excel Category 6 UTP, Cabinets
Hospital La Paz, Madrid, Spain	Excel Category 6 <sub>A</sub> UTP
Hospital Lamego, Portugal	Excel Category 6 <sub>A</sub> U/UTP
Laboratory of Molecular Biology, United Kingdom	Excel Category 6
London NHS, London, United Kingdom	Excel Category 5e, OM3 Fibre
Lordswood Medical Centre, United Kingdom	Excel Category 6
Macmillan, London, United Kingdom	Excel Category 6, Category 6 <sub>A</sub> FFTP, Fibre
National Neuroscience Centre, Cuba	Excel Category 6 <sub>A</sub> F/FTP
NHS Framework Project, Various Sites, United Kingdom	Excel Category 5e, Category 6 <sub>A</sub> U/UTP, 6 <sub>A</sub> F/FTP
NHS, Various Sites, United Kingdom	Excel Category 6, Category 5e, Cabinets
Nyt Hospital, Norway	Excel Category 6 <sub>A</sub> F/FTP
Pabellon Hospital Pau, Barcelona, Spain	Excel Category 6 <sub>A</sub> U/UTP, Cabinets
Pathology New X Hospital, Wolverhampton, United Kingdom	Excel Category 6 <sub>A</sub> FTP
Project Care Homes, Various Sites, United Kingdom	Excel Category 6 UTP
QE Hospital Pathology Building, Gateshead, United Kingdom	Excel Category 6, OM3 Fibre, Cabinets
Queen Elizabeth Hospital - ECC Building	Excel Category UTP, OS2
Royal Society of Radiologists	Excel Category 6 <sub>A</sub> U/FTP
Ryhope Hospital Tyne & Wear, Newcastle, United Kingdom	Excel Category 6 UTP, OS2 Fibre, Cabinets
Shelton Hospital, United Kingdom	Excel Category 6, Fibre, Cabinets
Sigems Toulouse, Angers/Toulouse, France	Excel MTP Fibre
Simply Health, Bristol, United Kingdom	Excel Category 6 UTP
Sports England, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, Fibre, Cabinets
Trafford Hospital	Excel OM3 & OM4 Fibre
University College London Hospital, United Kingdom	Excel Category 6
Yardley Green Hospital, United Kingdom	Excel Category 6, Fibre, Cabinets



## Higher Education

Aga Khan University	Excel Category 6	
Anglia Ruskin University	Excel Category 6	
Aston University Student Village Phase 2, Birmingham, United Kingdom	Excel Category 6	
Birmingham City University, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre	
Buckinghamshire Chilterns University College, United Kingdom	Excel Category 6	
Canterbury Christ Church University - Augustine, United Kingdom	Excel Category 6	
BNU, Strasbourg, France	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre, Floor Standing Cabinets	
Espace Clement Ader	Excel Category 7 <sub>A</sub> + Excel Category 6 <sub>A</sub>	
Exeter Student Accommodation, Exeter, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre, Floor Standing Cabinets	
Facultad Universidad de Leon	Excel Category 6 UTP	
Gonder University, Gonder, Ethiopia	Excel Category 6, Cabinets	
ISAE, Toulouse, France	Excel Category 7 <sub>A</sub> + Excel Category 6 <sub>A</sub>	
KNUST University, Accra, Ghana	Excel Fibre	
Liverpool John Moore University, Liverpool, United Kingdom	Excel Category 6	
MIA2, France	Excel Category 6 <sub>A</sub> U/FTP	
Northumbria University, Northumbria, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets	
Oporto University	Excel Category 6 UTP	
Romax Building Nottingham University, Nottingham, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP	
Sohar University extension, Oman	Excel Category 6 <sub>A</sub>	
Student Accommodation, Leeds and Newcastle, United Kingdom	Excel Category 5e, Cabinets	
Tallinna Technical University, Tallinn, Estonia	Excel Category 6 U/UTP	
Tartu University, Estonia	Excel Category 6	
UG Gent, Gent, Belgium	Excel Category 6 UTP, Fibre	
Universidad Autónoma de Madrid, Spain	Excel Category 6	
Universidad de Granada, Spain	Excel Category 6 <sub>A</sub> U/UTP	
University College Birmingham - Phase 1, Birmingham, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets	
University of Bahrain, Manama, Bahrain	Excel Category 6, OM3 Fibre, Floor Standing & Equipment Series Cabinets	
University of Bangor - Pontio, Bangor, Wales, United Kingdom	Excel Category 6 U/FTP, OM4 Fibre	
University of Bedfordshire, Luton, United Kingdom	Excel Category 6	
University of Dodoma, Tanzania, United Republic Of	Excel Category 6	
University of East London, United Kingdom	Excel Category 6	
University of Liverpool - Crown Place, Liverpool, United Kingdom	Excel Category 6 UTP, OS2 Fibre, Cabinets	
University of Nottingham IMH Building, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP	
University Wireless Rollout, United Kingdom	Excel Category 5e	
Zona Acceso Universidad Autonoma, Madrid, Spain	Excel Category 6 <sub>A</sub> U/UTP	

## Local Government

Albi theatre, Albi, France	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre, Cabinets	
Amber Valley Council, Derbyshire, United Kingdom	Excel Category 6 UTP, Cabinets	
Bexley Civic Centre, London, United Kingdom	Excel Category 6 UTP, OM3 Fibre	
Cargate Police Station - West Yorkshire Police, Leeds, United Kingdom	Excel Category 6	
Caserne Senarmont	Excel Category 6 <sub>A</sub> U/FTP	
CCIP Champerret, France	Excel Category 6 <sub>A</sub> F/FTP	
Centro Cultural Ayuntamiento del Prat, Barcelona, Spain	Excel Category 6 <sub>A</sub> UTP	
Centro de Transferencia Tecnologica (Gran Via 48), Granada, Spain	Excel Category 6 UTP, Cabinets	
Cherwell District Council	Excel Category 6	
CIRTL, Lyon, France	Excel OM3 Fibre	
City of York Council, West Offices, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP	
Clemessy, Strasbourg, France	Excel OM3 Fibre	
Comunidad de Castilla La Mancha, Spain	Excel Category 5e U/UTP	
Conseil Général Isere, Grenoble, France	Excel Category 7 <sub>A</sub> S/FTP	
Derby Civic, United Kingdom	Excel Category 6	
DGA Toulon, Toulon, France	Excel Category 6 <sub>A</sub> , OM3 Fibre, Cabinets	
Eastleigh and Wessex House, Southampton, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre	
Girona Library, Spain	Excel Category 6	
Glasgow Council, Glasgow, United Kingdom	Excel Category 6 U/UTP, F/UTP, Cabinets	



## Excel Reference Sites and Case Studies

Hackney Borough Council, United Kingdom	Excel Category 6
Hampshire County Council, United Kingdom	Excel Category 6, Fibre
HMRC Cumbernauld (AOC), Strathclyde, United Kingdom	Excel Category 6 U/UTP
HMRC Leicester, Leicester, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
IMEM i Autopistas, Barcelona, Spain	Excel Category 6 UTP, Wall Cabinets
Improveus, Paris, France	Excel Category 7 <sub>A</sub>
Leeds Police Headquarters, Leeds, United Kingdom	Excel Category 6 UTP
Leicester City Council, Leicester, United Kingdom	Excel Category 6, Category 5e, OM3 Fibre
Lens Prison, Lens, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Server Plus Cabinets
Liverpool Central Library, Liverpool, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
London Legacy Security Project, London, United Kingdom	Blown Fibre
Mairie De Paris, Paris, France	Excel Category FTP, Cabinets
Mairie du 11ieme, Paris, France	Excel Category 6 F/UTP, Cabinets
Mairie, Paris, France	Excel Category 6 FTP
Melton Mowbray Council, United Kingdom	Excel Category 6
Military Works	Excel Category 6 FTP
Northampton County Council, United Kingdom	Excel Category 6
Pabellon de La Merce, Barcelona, Spain	Excel Category 6 <sub>A</sub> U/FTP
Paris Town Hall	Excel Category 6 <sub>A</sub>
Police Stations Rollout, London, United Kingdom	Excel Category 6, Cabinets
Prison de Lens, Lille, France	Excel Category 6 <sub>A</sub> U/FTP, OM3 Fibre, Cabinets
RAF Wyton, Wyton, United Kingdom	Excel OS2 Fibre
Rochdale M.B.C, United Kingdom	Excel Category 6
SEPA - Central Facility	Excel Category 6 UTP
Theatre Des Cordeliers, Toulouse, France	Excel Category 6 <sub>A</sub> OM3 Fibre
Trafford Council, Manchester, United Kingdom	Excel Category 6 <sub>A</sub> FTP
Ville de Lille, Lille, France	Excel Category 6 <sub>A</sub> F/FTP
Ville de Paris, Paris 13ieme, France	Excel Category 6 FTP
Wakefield Police HQ, Wakefield, United Kingdom	Excel Category 6
Worcester Library & History Centre, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
Wyre Forrest Council, United Kingdom	Excel Category 6

### Manufacturing

Boeing Milton Keynes, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP
Damm Brewery, Spain	Excel Category 6
Hale Products Europe Ltd, United Kingdom	Excel Category 6
Heineken Breweries	Excel Category 6
Hitachi Europe Ltd, United Kingdom	Excel Category 5e
Imperial Tobacco Phase 2, Bristol, United Kingdom	Excel Category 6 U/UTP, OM4 Fibre
Imperial Tobacco, Bristol, United Kingdom	Excel Category 6, OM4 Fibre, Cabinets
Lyons Seafoods, United Kingdom	Excel Category 6
Oficinas Fundacion Museo Dali, Barcelona, Spain	Excel Category 6 <sub>A</sub> U/FTP
Rolls Royce	Excel Category 6 <sub>A</sub> FFTP, OS2
Rolls Royce Derby	Excel OM3 Fibre
Turner Virr Garforth, United Kingdom	Excel Category 5e
UBE Europa, Spain	Excel Category 6
Viglen Computers, United Kingdom	Excel Category 5e



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### Media

Ajman Independant Studios, Khartoum, Sudan	Excel Category 7 + Category 6 FTP Components
Anuntis, Barcelona, Spain	Excel Category 6 UTP
Arqiva Roll Out, Various Sites, United Kingdom	Excel Category 6 UTP, Cabinets
Editorial Planeta, Barcelona, Spain	Excel Category 6 UTP
EMAP, London, United Kingdom	Excel Category 6 U/UTP
FRANCE 5 (french channel)	Excel Category 6 <sub>A</sub>
ITV Orange Building, Manchester, United Kingdom	Excel Category 6
ITV Trafford Wharf, Manchester, United Kingdom	Excel Category 6 UTP, OS1 Fibre
News UK, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM4 Fibre



Beacon Barracks	Excel Category 5e, OS2
BT 2014 Contract	Excel Category 6 <sub>A'</sub> , Category 5e, OM3 Fibre
Commercial	Excel Category 7 + Category 6 <sub>A</sub> FTP
ACI Project - Clydebank, Wick, Inverness & Edinburgh	Excel Category 6 UTP, OM3
Beckenham	Excel Category 6 <sub>A</sub> UTP, OM3 Fibre
Bowcliffe Hall Wetherby	Excel Category 6 <sub>A</sub> U/FTP
Bristol Water	Excel Category 6 <sub>A</sub> UTP, OM3 Fibre
Building F Sunbury Phase 2	Excel Category 6 <sub>A</sub> U/FTP
Cheil	Excel Category 6 UTP, OM3 Fibre
Cornwall	Excel Category 6 <sub>A</sub> UFTP, OM3 Fibre
DS Smith	Excel Category 6 UTP
Harmon House	Excel Category 6 U/UTP
Hilton Foods	Excel Category 6
Invesco	Excel Category 6 <sub>A</sub> U/FTP, OM4 Fibre
Nexen Petroleum	Excel Category 6 <sub>A</sub> UFTP, OM3 Fibre
Strata (Kings Reach)	Excel Category 6 UTP, OM3
The Harbour	Excel Category 6 UTP, OM3, Fibre
We Works	Excel Category 6
Workspace	Excel Category 5e

### Petro Chemical

BP Antonine House, Falkirk , United Kingdom	Excel Category 6 <sub>A</sub> U/UTP
BP Bedfont Lakes, Feltham , United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OS2 Fibre
C M Leeds, United Kingdom	Excel Category 6 UTP, OM3 Fibre, Cabinets
Drengsrudbekken	Excel Category 7 <sub>A</sub>
EDF	Excel Category 6 <sub>A</sub>
Ghana Energy Commission, Accra, Ghana	Excel Category 5e
BP MTP Project, Middlesex, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM3 MTP and OS2 Fibre, Cabinets
Maersk Oil Rig, Dubai, United Arab Emirates	Excel Category 6 <sub>A'</sub> Fibre
Planta Termosolar Arenales, Sevilla, Spain	Excel Category 6 UTP
Statoil, London, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP, OM3 Fibre, Cabinets
Suncor	Excel Category 6
Total, Bauvais, France	Excel Category 6 <sub>A</sub> F/FTP, OM3 Fibre
Total, France	Excel Category 6 <sub>A</sub> F/FTP
Urenco, Almelo, Netherlands	Excel Cabinets
Vilma Oil, Madrid, Spain	Excel Category 6 <sub>A</sub> U/UTP



### Retail, Leisure & Hospitality

ACCOR	Excel Category 5e UTP LSOH
Amazon, Scotland, United Kingdom	Excel Category 5e, OM2 Fibre, Cabinets
Arcadia, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, FFTP, OM3 Fibre
Asda Click and Collect, Various Sites, United Kingdom	Excel Category 6 UTP
Asda Depots, Various Sites, United Kingdom	Excel Category 6 UTP, Category 5e UTP, Fibre
Asda Rollout, Various Sites, United Kingdom	Excel Voice
Asda Scales, Various Sites, United Kingdom and Ireland	Excel Category 6 UTP, Category 5e UTP
Aspers Casino, Milton Keynes, United Kingdom	Excel Category 6 UTP, Cabinets
Ato Ayele Medhin Hotel	Excel Category 6
Barron McCann	Excel Category 5e
Beaumont Hotel, London, United Kingdom	Excel Category 6 <sub>A</sub>
BHAFC Traing Academy, Brighton and Hove, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, Fibre, Cabinets
Bright Start Beach Resort	Excel Category 6 LSOH
Burberry - 1 Page Street, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP, OM4 Fibre
Burberry - Regent Street, London, United Kingdom	Excel Category 6 <sub>A</sub> U/FTP
Cafe Royale, Regent Street, London, United Kingdom	Excel Category 6
Campanile Hotel	Excel Category 6
Centre Parcs Stage 2, Woburn, United Kingdom	Excel Category 5e
Centre Parcs, United Kingdom	Excel OM3 Fibre
Co-Op	Excel Category 6 UTP + Excel Category 5e LSOH





## Excel Reference Sites and Case Studies

Conrad Hotel, Dubai, United Arab Emirates	Excel Cabinets
DAMAC Arjan Luxury Apartments Dubai Land, Dubai, UAE	Excel OS2 Fibre, Cabinets
DAMAC Water Edge Serviced Apartments & Hotel, Dubai, UAE	Excel Category 6, Fibre, Cabinets
Dixons Group, United Kingdom	Excel Category 6
Dulux Decorator Centres	Excel Category 5e UTP LSOH
Electricity North, Manchester, United Kingdom	Excel Category 6 UTP, Cabinets
Emirates Hotel Towers, Dubai, United Arab Emirates	Excel Category 6
Ferrari World - F59, Dubai, United Arab Emirates	Excel Category 6 U/UTP
Fortunato Hotel, Dubai, United Arab Emirates	Excel Category 6
Four Seasons Hotels	Excel Category 6
Galleria Mall, Jordan	Excel Category 6
Genting Casino, Sheffield, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP
Grand Regency Hotel, Addis Ababa, Ethiopia	Excel Category 6 U/UTP
H & M 2013, Various Sites, United Kingdom	Excel Category 5e and Category 6, Cabinets
Hadley Early Learning Centre, United Kingdom	Excel Category 6
Halfords	Excel Category 5e UTP
Halfords, United Kingdom	Excel Category 6
Harmony Hotel Old Wing	Excel Category 6
Hasbro, Uxbridge, United Kingdom	Excel Category 6
Heron Food Store, North East Region, United Kingdom	Excel Category 5e UTP
Hotel Colbert	Excel Category 6 <sub>A</sub> U/FTP
Hotel Hotusa Cortezo, Madrid, Spain	Excel Category 6 U/UTP
Hotel Neguri	Excel Category 6 <sub>A</sub> UTP
Hotel Olissipo, Lisboa, Portugal	Excel Category 6 FTP, Cabinets
Hotel Wireless Rollout UK, Various Sites, United Kingdom	Excel Category 5e, OM3 Fibre, Wall Boxes
Iceland	Excel Category 5e UTP LSOH
IKEA San Sebastian de Los Reyes	Excel Category 6 UTP
Ikea Stores, Various Sites, United Kingdom	Excel Category 6 U/UTP
Inditex (Zara, Stradivarius & Bershka), Spain & Europe	Excel Category 6 U/UTP, Category 5e UTP
Jeronimo, National, Poland	Excel Wall Cabinets
Jet 2 / New Horizon, Various Sites, United Kingdom	Excel Category 6 UTP, Cabinets
Kensington Project, London, United Kingdom	Excel Category 6 <sub>A</sub> U/UTP, Category 6, Fibre
La Cerisaie, Belgium	Excel Category 6 <sub>A</sub> U/FTP
La Cigale Hotel Project, Doha, Qatar	Excel Category 6
Lancaster County Cricket Club, United Kingdom	Excel Category 6, Fibre
Lexus Hotel, Addis Ababa, Ethiopia	Excel Category 6 OM2 Fibre, Cabinets
Marriott Hotel, Abu Dhabi, United Arab Emirates	Excel Category 6
Narva-Jõesuu Spa & Hotel, Narva-Jõesuu, Estonia	Excel Category 6 UTP, Fibre
New Look Roll Out, United Kingdom	Excel Category 6 U/UTP
Olympics, London, United Kingdom	Excel Category 6, Category 5e, Fibre
Paspaley, Dubai, United Arab Emirates	Excel Category 6 U/UTP, Cabinets
Peterborough Shopping Centre, United Kingdom	Excel Category 6, Fibre
Piastowska Park	Excel Category 6 UTP
Press Room in World Swimming Championship - Barcelona 2013, Spain	Excel Category 5e UTP
Project Voldemort, Nottingham, United Kingdom	Excel Category 6 <sub>A</sub> F/FTP, Cabinets
Retail Rollout (3 Mobile), Various Sites, United Kingdom	Excel Category 5e
Sainsburys, Stevenage, United Kingdom	Excel OM3 Fibre
Scandinavia Hotel Wireless Roll Out, Scandinavia	Excel Category 6 U/UTP, OM3 Fibre, Cabinets
Shamakhi Grand Hotel, Baku, Azerbaijan	Excel Category 6 UTP
Sharjah Co-op, Sharjah, United Arab Emirates	Excel Category 6, OM3 Fibre, Cabinets
Sofitel Dubai The Palm Resort & Spa, Dubai, United Arab Emirates	Excel Category 6, OS2 Fibre
Spantech Solutions, Dubai, United Arab Emirates	Excel Category 6, Cabinets
Sports City, Iraq	Excel Category 3
Stade de France	Excel Category 6 UTP
Tesco Blinkbox, London, United Kingdom	Excel Category 6
Walt Disney - Hammersmith, London, United Kingdom	Excel Category 6 UTP, Category 6 U/FTP, Category 6 <sub>A</sub>
Woolsley Roll Out, Various Sites, United Kingdom	Excel Category 5e U/UTP, Cabinets

Yell.com  
Yirdaw Hotel, Ethiopia

Excel Category 6 UTP  
Excel Category 6

## Transport

Aeroport Marseille, Marseille, France	Excel Category 6 U/FTP, Cabinets
AVANCAR	Excel Category 6 <sub>A</sub> UTP
Birmingham New Street	Excel OM4 Fibre
Enterprise Rental Car - Egham, Surrey, United Kingdom	Excel Category 6, Category 5e, OM3 Fibre
Heathrow Terminal 2, London, United Kingdom	Excel Category 6, Cabinets
Honda, United Kingdom	Excel Category 6
Jarvis, United Kingdom	Excel Category 6
Kapsch Carrier Com, Vienna, Austria	Excel Category 6 <sub>A</sub> U/UTP
Lex Autologistics, United Kingdom	Excel Category 5e, Fibre
Mercedes Ashford, Ashford, United Kingdom	Excel Category 5e, Fibre
National Express, United Kingdom	Excel Category 6
Network Rail, United Kingdom	Excel Category 5e
Puerto Nautico de Port Balis	Excel OM2, 6 Core LT Fibre (2500 mtrs)
Queen Alia Airport, Jordan	Excel Category 5e
SNCF, Nantes, France	Excel Category 6
Stockholm Underground, Stockholm, Sweden	Excel Category 7 <sub>A</sub>
Thameslink Hornsey, London, United Kingdom	Excel Category 6 FTP
Tisseo, Toulouse, France	Excel Cabinets
Transport For London (TFL), London, United Kingdom	Excel Category 5e
Volvo Teeside, United Kingdom	Excel Category 6
Volvo Trucks Ltd, United Kingdom	Excel Category 6





## Case Study Government Department Glasgow

<b>Customer</b>	Government Department
<b>Location</b>	Strathclyde, Glasgow
<b>Requirements</b>	An up to date system able to cope with VoIP requirements
<b>Equipment</b>	Excel Category 6 LSOH copper cable and patch leads, Category 6 24 port patch panels and Category 6 6c modules

### Customer's View

"The work of the department is of a nature where we could not run the risk of being unable to operate during our regular working hours. The team from Cable-Talk provided us with a flexible work schedule which meant we could continue normally with little or no disruption at all. The end result is a fast and efficient network which has resulted in the department being able to provide improved levels of service to customers with the peace of mind that the system installed comes with a 25 year warranty"

*Representative of the Government Dept*

**excel**  
without compromise.

This busy government department based in Strathclyde provides one of two accounting functions covering the entire UK mainland. On a day to day basis the department handles numerous enquiries and endeavours to offer the highest levels of service to its customers.

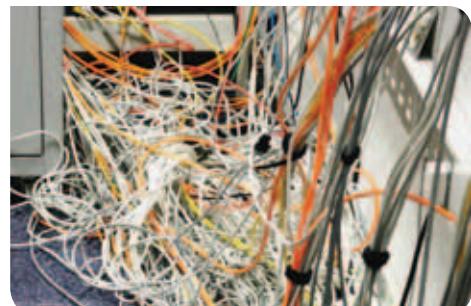
### The Requirement

To handle the growing number of enquiries and to allow the government department to operate more efficiently VoIP handsets were deployed. Not long after this took place it became apparent that the existing Category 3 cabling infrastructure was unable to cope with the volumes of traffic, with errors occurring daily it was essential that a new infrastructure system be installed.

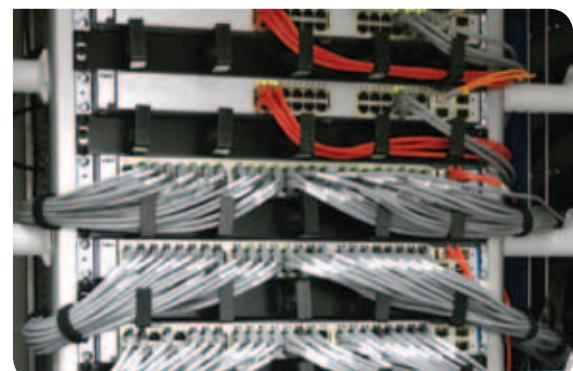
### Sourcing a Partner

Established in 1996 Cable-Talk initially began by specialising in providing fast and competitively priced sub-contract services for major systems integrators. From those foundations they established themselves as a major player in the cable market, seeing growth achieved predominately from referrals from satisfied customers. They had a proven track record of managing large projects, and providing excellent customer support.

Cable-Talk was initially drafted in by the government department to test the existing cabling within the building. This identified a high percentage of failures on the existing Category 3 system which subsequently led to Cable-Talk putting together a detailed quotation and delivering an informative presentation to the government team. This resulted in Cable-Talk winning the project to install a Category 6 system.



(Cabling prior to CableTalk Installation)



### The Right Product

Cable-Talk opted for the Excel range of products, one which they had much experience of installing. The Excel brand is owned and distributed by Mayflex. Mayflex leads the way in the distribution of Converged IP Solutions. Having a long established relationship with Mayflex which provides a reliable source of products and as an approved Excel Cabling Partner, all helped to influence Cable-Talk's decision to go with an Excel Category 6 solution.

Excel structured cabling products constitute an end-to-end solution where performance and ease of installation are prerequisites.

With an emphasis on compatibility and standards compliance 'from cable to cabinet', reliability and product availability, Excel is the complete trusted solution.

Acceptance to become a cabling partner follows an application process based around technical and commercial capability along with a commitment to undergo extensive training which requires applicants to sit an exam to demonstrate they have a full understanding of the Excel Structured Cabling System, including how to design, install and test systems in accordance with the Excel guidelines, best practice and above all standards compliance.

Having undergone the pre-requisites to become a cabling partner and repeatedly working with the Excel product range, Cable-Talk felt this was the best solution for the job in hand.

Another benefit of being an ECP meant that Cable Talk were able to provide a system warranty which would cover the government department for 25 years.

### Design and Installation

A total of 1936 Category 6 data locations were installed in the building spread over 4 floors. The new Category 6 solution had to be installed to run alongside the existing Category 3 network.

Excel Category 6 U/UTP LSOH cable is designed for optimal support of high-speed data protocols delivering 1 Gbps performance to the workstation. Designed to be quick and easy to install the cable requires no specialist installation tools and is supplied in reelec packaging for fast, snag free installation. Installed along with Category 6 patch panels, designed to meet or exceed the latest ISO and TIA requirements and Category 6, 6c modules which allow for fast and easy installation and result in a low profile finish collectively providing full link and channel compliance on the system installed.

Excel Category 6 systems are amongst a handful in the industry with both channel and component verification. Third party verifications are an independent 'tick in the box', verifying either a product or a set of products' compliance with a particular standard. Products are provided to the laboratory for testing to ISO and EIA/TIA cabling standards. Each of the key products used to build an Excel Category 6 cabling solution have component level standards compliant performance verification from Delta.

EC VERIFIED from Delta is the ultimate independent mark of global approval for cables and connecting hardware. It stands for undisputed world-wide quality assurance.

Staff's normal day to day working patterns could not be disrupted neither could they be relocated while the system upgrade took place. All work was carried out over a period of 10 weeks during 12 hour evening shifts, Monday to Thursday 6pm – 6am and at weekends.

The efficient and tidy way in which the Cable-Talk team worked meant that staff were actually unaware that major changes were being made each night once they went home.

### The Result

The Government department now have a structured cabling system that will support the requirements of VoIP. In addition to this users have seen a significant increase in performance along with a huge reduction in costs associated to maintenance call out charges.

A further major benefit experienced is the future security of the network. As Cable-Talk is an Excel Cabling Partner, the company can provide a 25 year warranty on Excel products, giving peace of mind well into the future.

*"I am delighted to say that upon completion of this project we have seen little if any faults at all. The team were on hand after the last evening shift had been completed to provide support but had very little to do, all in all another successful Excel install for Cable Talk".*

**Mark Taylor, Project Manager, Cable-Talk**





## Case Study The GRO Company

<b>Customer</b>	The GRO Company
<b>Location</b>	Exeter, Devon
<b>Requirements</b>	A future proofed system
<b>Equipment</b>	Excel Category 6 <sub>A</sub> U/FTP cable, Category 6 <sub>A</sub> FTP slimline jacks, angled shutters and Server cabinets

### Customer's View

"The move into new premises was necessary due to the growth of our business. We needed to ensure that the infrastructure installed would support our plans for continued expansion along with providing a network that could accommodate our business needs for a minimum of 10 years.

The Excel Category 6<sub>A</sub> system installed by Peninsula Solutions has given us the capacity to do this along with peace of mind. I am delighted with the results."

*James Green, The GRO Company*

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The GRO Company is a Devon based global nursery brand. They are an award winning and industry accredited manufacturer of safer sleep solutions for babies and young children. The GRO Company are best known for the multi-award winning Grobag, the No 1 baby sleep bag brand in the UK and Australia but also provide other products such as the Gro-clock which helps keep toddlers in bed for longer and the Gro-swaddle that is perfect for soothing newborns.

Grobag is also uniquely endorsed by safe sleep charity The Lullaby Trust. The company's partnership with the trust has seen them donate over £500,000 to date.



### The Requirement

Following a management team buyout, The GRO Company were moving into new premises which had an existing category 5e infrastructure installed. The plan was to stay in this building for at least 10 years and they needed to determine if the system would support their business for that length of time.

To decide the best way forward, The GRO Company needed to enlist the help of an experienced installer that could advise what possibilities were available.

### Sourcing a Partner

Peninsula Solutions Exeter has provided its clients with structured cabling and data cabling solutions since 1991. The team has gained a vast amount of knowledge, experience and expertise whilst working in a wide variety of establishments and environments, ranging from, government, private, residential, hotels, offices and factories.

Peninsula Solutions Exeter manages their client work instructions to the highest standard, by using tailored project management software. This allows transparency of service requests from start to finish.

## The Right Product

After examining the limitations of the existing infrastructure Peninsula Solutions Exeter recommended a Category 6<sub>A</sub> solution from Excel to ensure the longevity of the new system.

Excel is a world-class premium performance end-to-end infrastructure solution, designed, manufactured, supported and delivered, without compromise.

Excel is driven by a team of industry experts, ensuring the latest innovation and manufacturing capabilities are implemented to surpass industry standards for quality and performance, technical compliance and ease of installation and use.

With an emphasis on compatibility and standards compliance 'from cable to cabinet', reliability and product availability, Excel is the complete trusted solution. Since the brand was launched to the UK market in 1997, Excel has enjoyed formidable growth and is now reported in the latest BSRIA UK market report as the 2nd largest structured cabling brand with 17% share of the UK market in 2012.

Excel Category 6<sub>A</sub> systems are amongst a handful in the industry with both channel and component verification. Each of the key products used to build an Excel Category 6<sub>A</sub> cabling solution have component level standard compliant performance verification from Delta a third party verification laboratory.

## Design and Installation

The Excel brand is owned and distributed by Mayflex. Mayflex leads the way in the distribution of Converged IP Solutions.

Excel Category 6<sub>A</sub> cables and associated connectors, take the performance capabilities of copper infrastructure to new levels. The cable has been designed to exceed the ISO/IEC, TIA and CENELEC for Category 6<sub>A</sub> component requirements. This delivers Class EA link performance over distances of up to 90 metres which supports applications including 10GBASE-T, 10 Gigabit Ethernet.

The "S" Foil configuration of the Excel U/FTP cable ensures separation of the pairs which in turn guarantees performance. Using two sets of two pairs has also resulted in a reduced diameter and weight cable. These improvements mean that the cable occupies less space in the chosen containment which also affords improved airflow in under floor installations. One of the restrictions that Peninsula had to work with was that the new infrastructure utilise the existing cabling routes and floor boxes where at all possible to minimise disruption to the fabric of the building. The features in this particular cable made it the perfect solution to achieve this.

Minimal use of space was also achieved by using the Excel slim line jacks, within the existing floor boxes. The Excel Category 6<sub>A</sub> Low Profile Screened Keystone Jack, is a reduced size toolless termination RJ45 socket. A number of compatible black 24 port patch panel frames were also used to complete this installation.

Two Excel 42U Equipment Series Floor standing cabinets were used to house all the equipment. These cabinets are designed with strength, ease of use and aesthetics in mind so they fitted well into the GRO comms room. From Peninsula's point of view, with features such as incremental 1U marking on the mounting profiles, quick release doors and side panels, adjustable front and rear profiles and full access through the base of the cabinet, it made the installation of the system relatively quick and easy to complete.

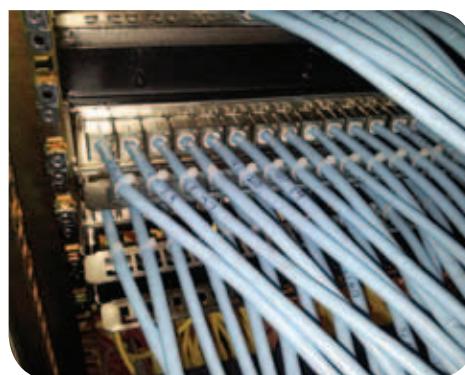
When the aforementioned items are installed by an accredited Excel Cabling Partner, which Peninsula Solutions Exeter is, the copper and cable and components installed were supported by a comprehensive 25 year warranty programme. A pre-requisite of partner status is training the understanding of which is verified through an exam process to demonstrate knowledge of the Excel system and how to design, install and test in accordance with Excel guidelines, best practice and above all standards compliance.

## The Result

The GRO Company now operates from premises which offers their employees a quick up to date infrastructure network.

*"The Excel product range was the obvious choice for us to use for this installation. Our Excel Partner Status also meant that we were able to offer a 25 year warranty as standard on the work that was carried out."*

Russell Satterley, General Manager, Peninsula Solutions





## Case Study Wakefield One - Civic Centre

<b>Customer</b>	Wakefield One - Civic Centre
<b>Location</b>	Wakefield, Yorkshire
<b>Requirements</b>	A new building which required a state of the art infrastructure installed
<b>Equipment</b>	Excel Category 6 <sub>A</sub> U/FTP cable, patch panels, toolless jacks and shutters
<b>Customer's View</b>	"The infrastructure that has been installed in the civic centre allows their systems to operate efficiently, giving them the opportunity to provide a service to customers that continues to improve. Providing excellent levels of service is what Wakefield Civic Centre is about and the new technology installed allows them to do that."

*Mark Cleeve, Fibrenet (Managing Director)*

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Dubbed Wakefield One, the newly built civic offices sit within Wakefield's Merchant Gate development which covers the once vacant land between the railway station and the city centre.

Wakefield One provides one point of contact for a range of Council services which are brought together under one roof. The building has been paid for by vacating and selling other Council buildings and will reduce overall running costs by £1m a year, helping the people of Wakefield and surrounding areas to get an improved level of service which ultimately costs them less.

The building houses a museum, café, library, the district council's One-Stop-Shop a business lounge and offices.

### The Requirement

A modern multi-purpose newly constructed building which demanded a sophisticated and reliable structured cabling system.

### Sourcing a Partner

Fibrenet was established in 1999. Since that time the company has developed considerably to meet the challenges of its client base, increasing its turnover on an annual basis, necessitating the need for the company to relocate several times.

Now based in Stanningley Leeds, the highly experienced team provide guidance for clients by assisting in design, offering invaluable advice and giving support before, during and after a project has been successfully completed.

Fibrenet aim to remain competitive, whilst providing a first class service, carrying out installations that are second to none whilst meeting the challenges that today's market brings.

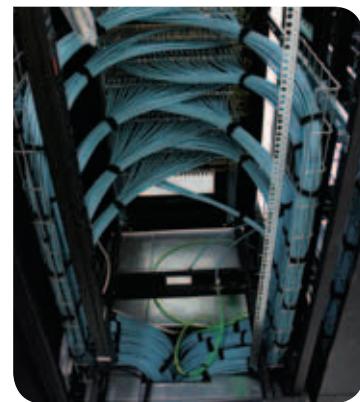
### The Right Product

After consultation with the client and educating them about the Excel product range, Fibrenet moved ahead with installing an Excel Category 6<sub>A</sub> solution which included cable, patch panels, toolless jacks, and shutters.

OM3 tight buffered fibre cable was also installed along with multi-pair telephone cables.

Excel structured cabling products constitute an end-to-end solution where performance and ease of installation are prerequisites. With an emphasis on compatibility and standards compliance 'from outlet to cabinet', reliability and product availability, Excel is the complete and trusted solution.





Excel Category 6<sub>A</sub> systems are amongst a handful in the industry with both channel and component verification. Each of the key products used to build an Excel Category 6<sub>A</sub> cabling solution have component level standard compliant performance verification from Delta a third party verification laboratory.

#### Design and Installation

The Excel brand is owned and distributed by Mayflex. Mayflex leads the way in the distribution of Converged IP Solutions. Working closely with Fibrenet, Mayflex were able to provide the products direct to site at the desired time allowing the engineers to progress with the install quickly and efficiently.

Excel Category 6<sub>A</sub> cables and associated connectors take the performance capabilities of copper infrastructure to new levels. The cable has been designed to exceed the ISO/IEC, TIA and CENELEC for Category 6<sub>A</sub> component requirements. Each cable consists of two pairs wrapped together in an "S" configuration. The use of two sets of pairs has resulted in a reduced diameter and cable weight. Reducing the size and weight means the cable occupies less space in the containment which in turn improves the airflow in under floor installations. Less weight means the containment can be of a lighter construction.

The Excel Category 6<sub>A</sub> Low Profile Screened Keystone Jack, is a reduced size toolless termination RJ45 socket which takes less than 2 minutes to terminate, utilising this product helped to keep the project on track and meet the deadlines imposed.

A modular system like the one used in this installation brings many benefits, especially when using consolidation points in GOP boxes as the system uses the same jacks in the panel, consolidation point and telecommunication outlet. Systems designed where the same jack is used at both ends on average, give better performance when tested.

The Excel fibre range provides a broad choice of multimode and singlemode solutions. Excel's OM3 Multimode Tight Buffered Fibre cables are constructed from a number of 900Um buffered fibres which are colour coded and packed in water resistant rodent protected strength members. The outer sheath is both flame resistant and low smoke zero halogen (LSOH). The design and construction of this range has resulted in a light, easy to install, cost effective cable.

Consolidation points were used to enable flexible seating arrangements for the users. This allows the client to have an infinite amount of layout designs available to them, taking into consideration the constraints of the building itself. Work areas, desks, departments or whole divisions can be easily re-arranged.

When installed by an accredited Excel Cabling Partner, which Fibrenet Office Solutions is, both the copper and fibre cables installed were supported by a comprehensive 25 year warranty programme, offering longevity and peace of mind for the Civic Centre.

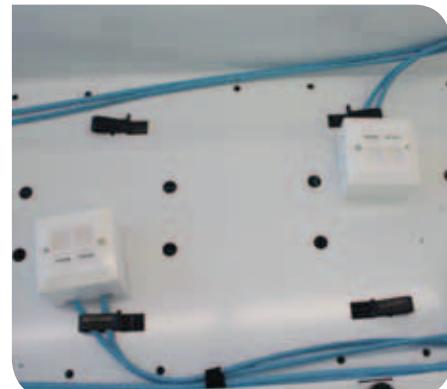
#### The Result

The Civic Centre understood that to run an efficient operation it needed a well designed, expertly installed system which would also allow for future expansion. This is exactly what they got with the Excel system, recommended and delivered by Fibrenet Office Solutions.

*"During the installation phase I was invited to attend site on a couple of occasions to carry out a technical evaluation as part of the warranty process as well as providing comment.*

*The level of workmanship evident was of the highest level, which given the experience and technical capabilities of Fibrenet Installations came as no surprise, who should be complimented on their work"*

**Paul Cave, Technical Manager – Excel Networking**





## Case Study

# Swedish Football Association – Friends Arena

<b>Customer</b>	Swedish Football Association – Friends Arena
<b>Location</b>	Solna, Sweden
<b>Requirements</b>	A new stadium with a sophisticated infrastructure network installed
<b>Equipment</b>	Excel
<b>Customer's View</b>	<p>"We needed to order large quantities of products all for delivery in a very short time frame. Getting the stock that we needed from a local established supplier was one of the factor's that helped us to make the decision that the Excel product set was the one for the job."</p>
	<i>Representative of Midroc</i>

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The Friends Arena is Sweden's new national stadium situated in Solna a suburb of Stockholm about 5 kilometres north of the city centre. The construction of the 300 million Euro stadium began in May 2009, and the Friends Arena officially opened on the 27th of October 2012 with a concert of Swedish artists headlined by Roxette.

The Friends Arena will play host to a variety of events; its standard football layout can easily be converted into various concert and event formats with different capacities. The standard capacity of the stadium is 50,000 seats, which is divided over three tiers. The maximum capacity for concerts is 65,000 and world-class acoustics ensure a great experience for ticket holders. Artists already confirmed are Kiss, Iron Maiden, One Direction and Bruce Springsteen. Other events include Speedway, Ice Hockey, Horse Show Jumping and the UEFA Womens' European Final.

### The Requirement

A completely new stadium was being built that had to provide a home for the Swedish National football team and also be able to change quickly into a venue for other major events. The technical solutions being installed into the building demanded a category 6 network to host these technologies to ensure they would work to the best of their capabilities.

Hanging from the roof is a media cube with four screens 65sqm each and weighing 64 tonnes. In addition there are 647 LED screens that enhance the visual experience along with a state or the art sound system. WI-FI covers every seat and allows guests to share their experiences with the rest of the world as it happens.

The standard star topology structured cabling infrastructure supports a wide range of technology well beyond the pure IT requirements of the facility. From the Main Control Room, they are able to control a combination of security cameras along with access control, both internally and externally, ensuring the safety of the visitors. It also provides state of the art communication links to the world's press in a dedicated facility to get their stories out to the world.

### Sourcing a Partner

Once Friends Arena had recognised their requirement, they then needed a solution partner to help them source the right products and also install the new system. Midroc was chosen due to their experience in working with companies primarily in the property development, property management and industrial and environmental contracting sector.



Midroc worked closely with Solar to ensure that the project had the right electrical and data products and could be completed within the specified time frame.

Solar is one of Northern Europe's leading technology vendors, having multiple branches across Scandinavia, Poland, Netherlands & Germany. Solar added value in the supply chain by offering the best logistics solutions available and a dedicated experienced project support team.

Working together both Midroc and Solar decided that the Excel product range was the best solution for the project. Excel is a complete, end-to-end networking solution, offering exceptional performance, reliability and support, manufactured to European quality standards and covered by one warranty. Solar is an established distributor for the product range throughout Sweden and Excel has been part of the company's product portfolio for the last four years.

#### The Right Product

The Excel product range met the technical requirements of this project, fitting the bill perfectly. Midroc knew that they could get the large quantities of stock that was required via Solar in a short period of time. Solar operate a modern and automated central warehouse reassuring Midroc Electro that the products would be delivered to the right place at the right time. In fact Solar guarantee that orders placed before 6pm will be delivered by 7am the next working day.

#### Design and Installation

Category 6 Unscreened (U/UTP) cable was installed in the new Arena. This cable is designed for optimal support of High-Speed data protocols delivering 1 Gbps performance. Designed to be quick and easy to install, the cable requires no specialist installation tools.

The Excel toolless jack is one of the simplest methods of providing a high level of repeatable quality fast termination. Suitable for both traditional and pre-terminated installations, each jack has a standard RJ45 keystone jack footprint. These jacks were loaded into keystone jack patch panel frames. These frames come with a rear management tray which has purposely designed cable tie positions supplied with each panel, which can be fitted without the need for any tools or fixings by simply snapping them into place.

One of the greatest challenges Midroc came up against was ensuring that they delivered a standards compliant system in a timely manner. The project had to be completed within extremely tight deadlines as events such as concerts and football matches had been booked to take place and could not be rescheduled or delayed in anyway.

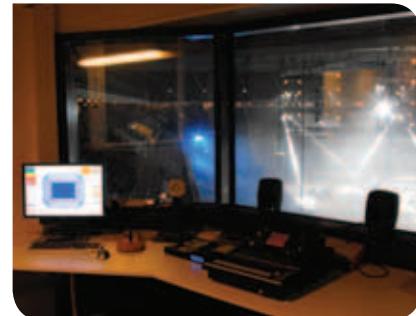
Employing this modular system assisted Midroc to meet the tight deadlines in place and also provided a standards compliant system.

Excel offers proven standards compliant products, with third party independent verification from test houses such as Delta and 3P. Third party verifications are an independent 'tick in the box' verifying either a product or a set of products' compliance with a particular standard.

The installation took place throughout 2011-2012.

#### The Result

Friends Arena has access to a high bandwidth network which is being used for their IP telephone system, SCADA along with Wi-Fi and IPTV. The structured cabling infrastructure installed also runs security cameras, access control systems, point of sale systems and provides a dedicated link for the press, all competed on time, first time.





## Case Study BAC A - Bank

<b>Customer</b>	BAC A - Bank
<b>Location</b>	Hanoi, Vietnam
<b>Requirements</b>	A new Data Centre
<b>Equipment</b>	Excel Cat 6 cable, panels, modules, patch leads and OM3 fibre

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North Asia Commercial Joint Stock Bank (BAC A Bank) was established in 1994 its mission is to provide a consultancy service and to cater to a new generation of sustainable business development, creating core values, bringing real value to the community and being environmentally friendly.

### The Requirement

BAC A Bank recognised that they needed a new state of the art Data Centre. One of the highest priorities for any bank is to ensure there is strong protection of highly sensitive customer data. They knew a brand new Data Centre was essential for the ongoing protection of their customer data and also for the continued future expansion of the whole banking group.

Once the bank had recognised their requirement, they then needed a solution partner to help them source the right products and also install the new state of the art system. Their ultimate goal is to build a standards compliant Data Centre in North Vietnam.

### Sourcing a Partner

N.E.T.S.Y.S Vietnam was established in 2005 and has contributed to the Information Technology Industry in Vietnam by providing effective solutions, cost-effective products and consultancy services. Staff at N.E.T.S.Y.S are highly skilled, experienced engineers and specialists who have gained certifications that are recognised worldwide.

N.E.T.S.Y.S is an official distributor for the Excel product range in Vietnam and the surrounding regions. They were chosen for the job due to their background and experience in the industry.

With past experience of deploying large networks, N.E.T.S.Y.S believe that the Excel products installed offer an exceptionally high quality system compared to Belden and Krone in the Vietnam marketplace.

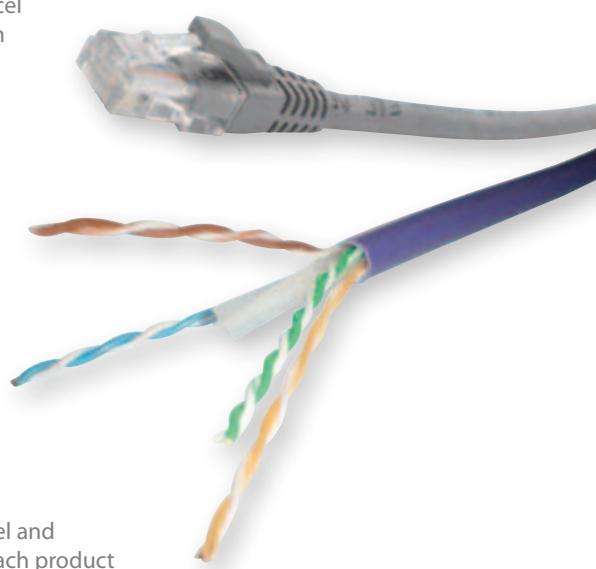
### The Right Product

N.E.T.S.Y.S chose the Excel range of products to complete this project. The Excel product range provides an end-to-end solution. Performance and ease of installation are its foundation, along with standards compliance, reliability and product availability.

Excel offers one of the market's most comprehensive ranges of passive cabling products designed to suit installations in data centre, enterprise, campus, and manufacturing environments.

All Excel products come with third party verification, and offer an independent 'tick in the box'; verifying either a product or a set of products' giving product and channel verification and compliance with a particular standard. Excel works closely with third party test laboratories such as Delta, ETL, and 3P.

Excel category 6 systems are amongst a handful in the industry with both channel and component verification. With component certification there is no hiding place. Each product is tested to meet the standard; this really is the ultimate performance test to promote third party verification for a brand such as Excel.



The Excel products installed into the Data Centre include Category 6 LSOH U/UTP cable, Category 6 patch panels and modules, Category 6 patch leads and OM3 patch leads and pigtails.

Excel Category 6 UTP cable is designed for optimal support of high-speed data protocols delivering

1 Gbps performance to the workstation. It is designed to be quick and easy to install and the cable requires no specialist installation. The inclusion of a polyethylene cross filler ensures optimum cross talk performance.

The Excel keystone jack patch panel frames were then installed along with Excel keystone jack outlets which are extremely quick and easy to install.

#### Design and Installation

Using a distribution topology commonly found in a Data Centre,

N.E.T.S.Y.S was able to link the 13 server racks to the

central distribution frame which in turn

was linked to the networking

rack using the Excel

Category 6 cable.

A modular system like the one used in this installation brings many benefits, especially when in a cabinet to cabinet Data Centre environment. The engineers were able to work outside of the cabinet space itself, when terminating and putting the modules and panels into place. These particular products are also ideal for offsite pre-terminated applications which also help to eliminate waste on site and help to keep the Data Centre environment clutter and debris free.

The installation took place throughout August and September 2012 and was carried out with the minimum amount of fuss and disruption to the banks day to day operations.

#### The Result

The new Data Centre now provides a stable high speed network with the ability to manage the high levels of traffic which use the network on a daily basis. It also connects all servers to the bank networking system effectively.

Nguyen Thanh Nam of N.E.T.S.Y.S, who oversaw the project said, *"The Excel products that we used were easy to install into the new Data Centre quickly and effectively, more importantly they are easy for the Data Centre staff to manage. I would have no hesitation in specifying Excel for any future project i am involved with."*





## Case Study The Bank

<b>Customer</b>	The bank
<b>Location</b>	London
<b>Requirements</b>	Completely refurbished office and technology refresh
<b>Equipment</b>	Excel Category 6 <sub>A</sub> F/FTP and Excel OM3 24C Fibre

### Customer's View

"I found the Excel products were efficient in design, entirely robust, whilst also achieving excellent headroom, even with the difficult building environment encountered. Due to the minimal dimensions of the low profile category 6<sub>A</sub> shielded module, we were able to construct a GOP suitable for a 40mm floor void. This afforded the client the flexibility of a GOP grid design which otherwise may not have been possible. In a challenging project it was reassuring to know that the products performed without any issues."

*Representative of PTS Consulting, John Denyer*

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The bank provides a wide range of financial products and services to 3.61 million corporate clients and 216 million individual customers through 16,232 outlets, 162 overseas subsidiaries and a global network of more than 1,504 correspondent banks as well as Internet Banking, Telephone Banking and self-service banking.

### The Requirement

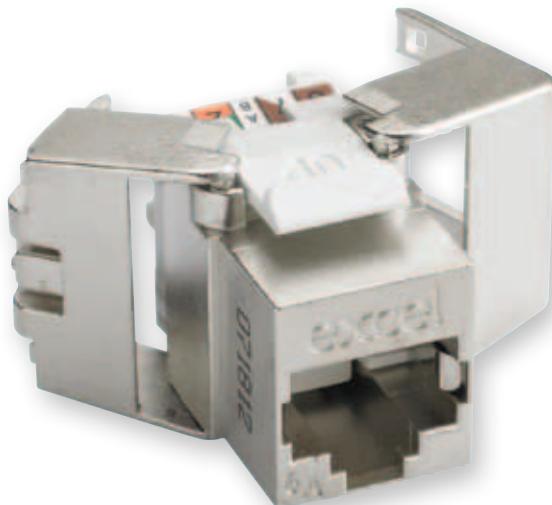
The bank was carrying out a complete refurbishment of its London offices and wanted to invest in a high performance structured cabling system.

### Sourcing a Partner

The bank engaged directly with PTS Consulting Group PLC (PTS) a world class IT consulting and project Management Company which provides its clients with professional services, managed services and resourcing solutions. Since 1983, PTS has successfully delivered high-value, vendor independent solutions to its clients. PTS needed to identify and specify a structured cabling system that was reliable, met all of its clients' requirements and was backed up by quality and performance standards.

The next step was then for PTS to appoint an experienced installer who could not only carry out the project but also work to tight timescales. PTS had previously worked with Line Management Group (LMG) a company established in 1986 which specialise in the delivery of major cabling and technology installations.

LMG's core values are a commitment to service excellence, ensuring all employees have the latest training, tools and knowledge to provide the infrastructure services and intelligence necessary to reduce operational costs and improve business performance.



## The Right Product

PTS had decided that the Excel structured cabling system had the necessary product portfolio to meet with the project requirements. Excel structured cabling products constitute an end-to-end solution where performance and ease of installation are pre-requisites. With an emphasis on compatibility and standards compliance 'from outlet to cabinet', reliability and product availability, Excel is the complete and trusted solution.

The Excel brand is owned and distributed by Mayflex. Mayflex leads the way in the distribution of Converged IP Solutions. LMG not only had a long standing relationship with Mayflex but they also hold the status of an Excel Solutions Partner (ESP). ESP partner status requires extensive training, the understanding of which is verified through an exam process to demonstrate knowledge of the Excel system and how to design, install and test in accordance with Excel guidelines, best practice and above all standards compliance.

Once partner status is awarded ESP's are able to provide the comprehensive 25 year warranty for cabinet, copper, fibre and voice installations.



## Design and Installation

Products chosen for the project included Excel Category 6<sub>A</sub> F/FTP cable. This type of cable takes the performance capabilities of copper infrastructure to new levels. The cable has been designed to exceed the ISO/IEC, TIA and CENELEC for Category 6<sub>A</sub>/Augmented Category 6 component requirements. This delivers Class EA/Augmented Category 6 link performance over distances of up 90 meters which supports the applications including 10GBASE-T, 10 Gigabit Ethernet.

Each cable consists of two sets of two pairs which are wrapped together in an "S" configuration with high quality, strong, aluminium/polyester foil tape which provides screening for each pair. These are then wrapped in another, overall foil. This configuration has resulted in both a reduction in diameter and the weight of the actual cable. This in turn has reduced the cable cross-sectional area by 19.7%

Reducing both the size and the weight of the cable means that it occupies less space in the containment installed; this improves airflow in under floor installations especially when at a premium. Less weight means that the containment can also be of lighter construction and handling the cable on site is easier.

To provide the backbone of the installation which was of an inverted design, Excel's OM3 Multimode Tight Buffered Fibre cable was chosen. OM3 fibre cables are constructed from a number of 900Um buffered fibres which are colour coded and packed in water resistant strength members. The outer sheath is both flame resistant and low smoke zero halogen (LSOH). The design and construction of this range has resulted in a light, easy to install cable.

Due to the limited floor space Line Management worked closely with Mayflex to produce a bespoke Grid Outlet Position (GOP) box. These were then fitted with the standard Excel Category 6<sub>A</sub> low profile screened keystone jacks, which provided the perfect solution to the small floor void.

All of this work was carried out in a short 8 week programme, completely driven by the bank, leaving no room for error.

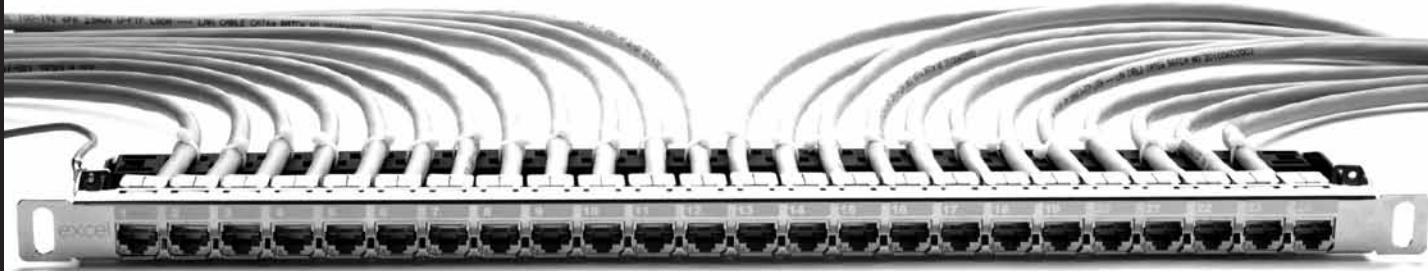
## The Result

The pre-tender support received from Mayflex was vital and well received particularly during the design stage of the project. Test results received back from the completed installation were exemplary and the client was provided with a full test result history along with the standard Excel 25 year warranty and supporting documentation.

This was a major installation using Excel products, the completed project has given the bank a future proofed network that will continue with the life of the building. Its flexibility will mean that it can grow and change as the bank does.



# SmallSPACE



## 0.5U Panel

Packing upto 24 Category 6A, 6, or 5e jacks, with screened and unscreened options into an aesthetically pleasing frame, the Excel 0.5U panel is the ultimate in port density, and rack space efficiency.

S14

**Want to save  
space, time  
and money?**

Contact us  
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[sales@excel-networking.com](mailto:sales@excel-networking.com)  
[www.excel-networking.com](http://www.excel-networking.com)

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# Excel Website

## Section 15

### In this Section:

[Excel Website](#)

[Excel Partner Area](#)

### Pages

428

430



A screenshot of the Excel Networking website homepage. The header features the "excel" logo and navigation links for Home, Contact, Advanced Site, Newsfeed, Book Up, Video, About, and Blog. A large banner at the top reads "CyberSPACE" in bold letters, with a subtext "Become an accredited Excel Partner and get access to a leading online resource. Click here." Below the banner, there are four main sections: "New Resource Videos" (with a thumbnail for "excel ENVIRON VIDEOS"), "Partnership Facilities" (with a thumbnail for "excel"), "Latest White Papers" (with a thumbnail for "White Papers"), and "The EXCELICATE Award" (with a thumbnail for "ENVIRON"). At the bottom, there are links for "About Us", "Contact", "Vertical Partners", "Sponsors", "Report", and "Video". Social media icons for YouTube, LinkedIn, and Facebook are at the very bottom.

# Excel Website

[www.excel-networking.com](http://www.excel-networking.com)

The Excel website provides you with everything that you need to know about the Excel Structured Cabling System. The site is updated on a regular basis and we are regularly adding to the content with educational information as well as details on Excel.

The Excel site is currently available in English, French, Spanish, Italian, German, Polish and Turkish.

The main features of the site include:

## ● Product Catalogue

The [online catalogue](#) contains an overview of each of the products within the Excel range – you can search for a particular part code, which is the quickest way to find a product or alternatively navigate through the categories to narrow your search. The majority of the products have 360° photography so you can view the products from every angle and zoom in, to view any particular features. Where available there are also specification sheets and third party verification certificates which can be downloaded.

## ● Reference Sites

Excel has been installed into numerous sites across EMEA – you can see a snapshot of some of those installations by clicking on the '[Reference Sites](#)' tab. Here you can view the wins by vertical market. The list is updated on a monthly basis and includes projects across EMEA.



## ● Downloads

We offer an extensive range of literature and collateral to help sell and support the Excel solution. In the [downloads area](#) you can find: White Papers, Brochures, Specification Sheets, Third Party Certificates, the Encyclopaedia, Labelling Software, Warranty Details, Newsletters and much more.

Excel Partners can personalise a large amount of Excel literature with their own logo and address details – see the **Partner Area** for further details.

## ● Videos

We have a number of [videos](#) in our 'How to' series that show you the best way to install and terminate Excel products - these are perfect for the use by engineers who are installing Excel. Our fibre video runs through our pre-terminated offering and demonstrates the ease of installation. We have a series of videos to highlight the Environ® range and you can also view a video of one of our manufacturing facilities for the Excel copper cable. We are regularly adding to our video library and more products will be featured in the future.



## ● Blog

The Excel multi-language blog provides customers with an additional source of useful information on relevant topics and updates on the Excel solution.

The Excel blog provides an informal platform to share with customers, consultants and end users Excel's thoughts and advice on product updates, standards, installation tips plus anything else industry related that is felt to be relevant. As is usual with blogs, readers can engage in conversation and debate by posting their comments and opinions.

This is a further extension to Excel's social media activities which include Twitter, Linked In and Facebook.

To follow the Excel blog please visit [blog.excel-networking.com](http://blog.excel-networking.com) and add the site to your favourites or subscribe via RSS by using the link at the top right of the blog pages.

## ● News

Read the latest press releases and newsletters, Excel case studies and keep up to date on all the latest developments on Excel.

## Excel Partner Area

Accredited Excel Partners can gain access to the [Partner Area](#) where they can utilise the following tools and information:

- **Warranties**

Excel Partners can register an Excel Installation for a warranty and the application if successful will be processed within 5 working days and a warranty certificate will be issued. See Section 13 for step by step instructions on how to use this facility.

- **Branded Literature**

The full range of Excel literature including product specification sheets and brochures and end user targeted mailing pieces can be personalised with the Excel Partners logo and address details.

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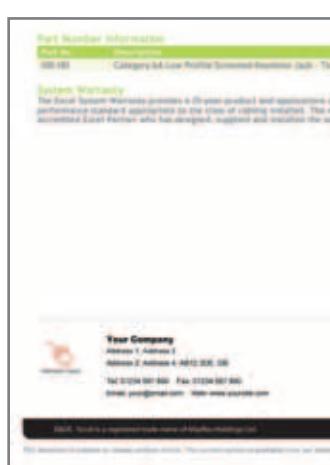
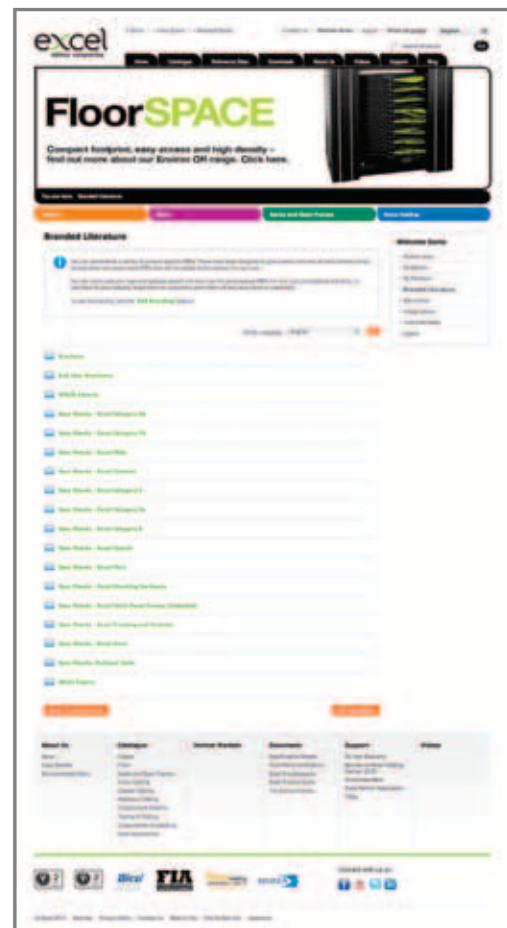
- **Technical Notes**

Excel Partners can download a copy of the Excel Installation Guides as well as a series of technical notes that cover subjects such as cable segregation distances, extended distance protocol support guidelines, liquid contamination etc. These notes are updated on a regular basis and provide invaluable information and advice with regards to installing the Excel structured cabling system.

Please check regularly that you have the latest version.

- **Sales Support**

In here Partners can download a copy of the latest Excel Corporate Presentation in various formats, together with the Site Installation Template and the word version of the Tender Response Document.



# Appendices

## Section 16

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## Appendices

# Glossary of Terms

Term	Definition
10GBase-SR	IEEE 802.3an Standard for "Short Range" using 850nm lasers can transmit up to 300metres using 50 micron OM3 multimode fibre.
10GBase-LR	IEEE 802.3an Standard for "Long Reach" using 1310nm lasers can transmit up to 10km using OS1 Single mode fibre.
10GBase-T	IEEE 802.3an Standard released in 2006, to provide 10Gbit/s Ethernet connections over unshielded or shielded twisted pair cables, over distances up to 100metres.
1000Base-LX	IEEE 802.3 shorthand term for 1000 Mbps Gigabit Ethernet based on 8B/10B signaling using long wavelength laser transmitters over fibre optic cable.
1000Base-SX	IEEE 802.3 shorthand term for 1000 Mbps Gigabit Ethernet based on 8B/10B signaling using short wavelength laser transmitters over fibre optic cable.
1000Base-T	IEEE 802.3 shorthand term for 1000 Mbps Gigabit Ethernet over twisted pair cable.
1000Base-X	IEEE 802.3 shorthand term for any 1000 Mbps Gigabit Ethernet based on 8B/10B signaling. Includes 1000Base-CX, 1000Base-LX and 1000Base-SX
100Base-FX	IEEE 802.3 shorthand term for 100 Mbps Fast Ethernet based on 4B/5B signal encoding over fibre optic cable.
100Base-T	IEEE 802.3 shorthand term for entire 100 Mbps Fast Ethernet system.
100Base-TX	IEEE 802.3 shorthand term for 100 Mbps Fast Ethernet based on 4B/5B signal encoding and using two pairs of category 5 twisted pair cable.
100Base-X	IEEE 802.3 shorthand term for any 100 Mbps Fast Ethernet system based on 4B/5B signal encoding. Includes 100Base-TX and 100Base-FX
10Base2	IEEE 802.3 shorthand term for 10 Mbps Ethernet based on Manchester signal encoding over thin coaxial cable. Also called "Thinnet" or "Cheapernet".
10Base5	IEEE 802.3 shorthand term for 10 Mbps Ethernet based on Manchester signal encoding over thick coaxial cable. Also called "Thicknet".
10Base-T	IEEE 802.3 shorthand term for 10 Mbps Ethernet based on Manchester signal encoding over category 3 or better twisted pair cable.
ANSI	American National Standards Institute
Asynchronous	Transmission where sending and receiving devices are not synchronized. Data must carry signals to indicate data division.
ATM	Asynchronous Transfer Mode. This is a networking protocol which can support multimedia (i.e. Voice, data, video, text etc.) communications. It was initially developed as a wide area protocol for use by the major public carriers (e.g. BT Mercury etc.). However, it is now commonly used as a local area backbone protocol in private networks. ATM will ultimately provide connectivity right to the desktop.
Attenuation	The decrease in magnitude of a signal as it travels through any transmission medium such as a cable or optical fibre. Measured in dB per unit of length.
ACR (Attenuation Crosstalk Ratio)	The difference between attenuation and crosstalk, measured in dB, at a given frequency. A quality factor for cabling to assure that signal sent down a twisted pair is stronger at the receiving end of the cable than any interference imposed on the same pair by crosstalk from other pairs.
ACR-F	Attenuation Crosstalk Ratio Far End
AWG	American Wire Gage - A wire diameter specification. The smaller the AWG number, the larger the wire diameter.
Back reflection	The light reflected back towards the source from the fibre optic ends and deformations.
Backbone	Term used to refer to the common central elements of any communications network. The backbone is the part of the network which connects all the individual network components.
Bandwidth	The range of frequencies required for proper transmission of a signal. Expressed in Hertz (cycles per second). The higher the bandwidth, the more information that can be carried. A continuous range starting from zero is said to be "baseband", while a range starting substantially above zero is "broadband".

Baud	The number of changes in signal per second. A given baud rate does not necessarily transmit an equal number of bits/sec. For example, a signal with four voltage levels may be used to transfer two bits of information for every baud.
Bend Loss	A form of increased attenuation in an optical fibre caused by an excessively small bend radius. The attenuation may be permanent if micro fractures caused by the bend continue to affect transmission of the light signal.
Bend Radius	Radius of curvature that a fibre optic or metallic cable can bend before the risk of breakage or increased attenuation occurs.
BICSI	Building Industry Consulting Service International.
Bit	One binary digit.
BER (Bit Error Rate)	A measure of data integrity, expressed as the ratio of received bits that are in error, relative to the amount of bits received. Often expressed as a negative power of ten.
Bit Stream	A continuous transfer of bits over some medium.
BNC	A coaxial connector that uses a "bayonet" style turn and lock mating method. Used with RG58 or smaller coaxial cable. Used with 10Base2 Ethernet thin coaxial cable. BNC is an acronym for Bayonet Neill Concelman.
BPS	Bits per second.
Braid	Fine wires interwoven to form a tubular flexible structure that may be applied over one or more wires for the purpose of shielding. May also be formed into a flattened conductor to be used as a grounding strap.
BRI	ISDN Basic Rate Interface
Broadband	A transmission facility having a bandwidth sufficient to carry multiple voice, video or data channels simultaneously. Each channel occupies (is modulated to) a different frequency bandwidth on the transmission medium and is demodulated to its original frequency at the receiving end. Channels are separated by "guardbands" (empty spaces) to ensure that each channel will not interfere with its neighbouring channels. This technique is used to provide many CATV channels on one coaxial cable.
Broadcast	Sending data to more than one receiving device at a time.
Buffer	A protective coating over a strand of optical fibre.
Bus Topology	In general, a physical layout of network devices in which all devices must share a common medium to transfer data, and no two devices may transmit simultaneously. With LANs, a linear network topology in which all computers are connected to a single cable.
Byte	A group of 8 bits.
Campus	The buildings and grounds of a complex, such as a university, college, industrial park or military establishment.
Carrier	An electrical signal of a set frequency that can be modulated in order to carry data.
Category 3, Cat 3	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 16 MHz. with a characteristic Impedance of 100Ohm.
Category 5e, Cat 5e	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 100 MHz. with a characteristic Impedance of 100Ohm.
Category 6, Cat 6	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 250 MHz. with a characteristic impedance of 100Ohm
Category 6 <sub>A</sub> , Cat 6 <sub>A</sub>	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 500 MHz. with a Characteristic impedance of 100Ohm
Category 7, Cat 7	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 600 MHz. with a characteristic impedance of 100Ohm
Category 7 <sub>A</sub> , Cat 7 <sub>A</sub>	Balanced twisted-pair copper cable and component specifications characterised in a frequency range up to 1000 MHz.(1Ghz) with a characteristic Impedance of 100Ohm.
Category 8, Cat 8	Whilst not yet ratified this is intended to support short 40Gb links within the Data Centre environment. It will be a balanced twisted-pair copper cable and component specifications characterised in a frequency range of up to 2GHz with a characteristic Impedance of 100Ohm.
CDDI	Copper Distributed Data Interface A version of FDDI that uses copper wire media instead of fibre optic cable.



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Channel	The end to end transmission path between two points at which application specific equipment is connected.
Channel Insertion Loss	For fibre optic links, the static loss of a link between a transmitter and receiver. It includes the loss of the fibre, connectors, and splices.
Characteristic Impedance	The impedance that an infinitely long transmission line would have at its input terminal. If a transmission line is terminated in its characteristic impedance, it will appear (electrically) to be infinitely long, thus minimizing signal reflections from the end of the line.
Chromatic Dispersion	Synonym for "material dispersion". Characteristic of long fibre runs
Class C	ISO/IEC 11801 designation for twisted pair cabling rated to 16 MHz. Corresponds to the TIA/EIA Category 3 cabling standard.
Class D	ISO/IEC 11801 designation for twisted pair cabling rated to 100 MHz. Using Category 5e components it corresponds to the TIA/EIA Category 5e cabling standard.
Class E	ISO/IEC 11801 designation for twisted pair cabling rated to 250 MHz. Using Category 6 components it corresponds to the TIA/EIA Category 6 cabling standard.
Class E <sub>A</sub>	ISO/IEC 11801 designation for twisted pair cabling rated to 500 MHz. Using Category 6 <sub>A</sub> components it corresponds to the TIA/EIA Category 6 <sub>A</sub> cabling standard.
Class F	ISO/IEC 11801 designation for twisted pair cabling rated to 600 MHz and corresponds to the TIA/EIA Category 7 cabling standard.
Class F <sub>A</sub>	ISO/IEC 11801 designation for twisted pair cabling rated to 1000 MHz. (1Ghz) corresponds to the proposed TIA/EIA Category 7 <sub>A</sub> cabling standard.
CLI	Calling Line Identity. The term used to describe the feature whereby the telephone number of a calling party is presented to the equipment of the called party.
Coax, Coaxial Cable	A type of communication transmission cable in which a solid center conductor is surrounded by an insulating spacer which in turn is surrounded by a tubular outer conductor (usually a braid, foil or both). The entire assembly is then covered with an insulating and protective outer layer. Coaxial cables have a wide bandwidth and can carry many data, voice and video conversations simultaneously.
Collision	When electrical signals from two or more devices sharing a common data transfer medium crash into one another. This commonly happens on Ethernet type systems.
Conductor	A material that offers low resistance to the flow of electrical current.
Conduit	A rigid or flexible metallic or nonmetallic raceway of circular cross section in which cables are housed for protection and to prevent burning cable from spreading flames or smoke in the event of a fire.
Consolidation Point (CP)	A CP is a location for interconnection between the permanently installed horizontal cables the TR and the horizontal cables extending to the telecommunications outlet (TO)
Continuity	An uninterrupted pathway for electrical signals.
Core	The central region of an optical fibre through which light is transmitted.
Cross Connect	A facility enabling the termination of cable elements and their interconnection, and/or cross connection, primarily by means of a patch cord or jumper.
Cross Connection	A connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware at each end.
Crossover Cable	A twisted pair patch cable wired in such a way as to route the transmit signals from one piece of equipment to the receive signals of another piece of equipment, and vice versa.
Crosstalk	The coupling of unwanted signals from one pair within a cable to another pair. Crosstalk can be measured at the same (near) end or far end with respect to the signal source.
CSMA/CD	Carrier Sense Multiple Access with Collision Detect.
CTI	Computer Telephony Integration. The integration of computer and telephone systems to support intelligent applications. At its simplest this might be the ability to support a simple telephone from a PC. Conversely CTI is used extensively in Call Centres to co-ordinate the transfer of telephone calls with associated database details applicable to the caller.
Customer Premises	Buildings, offices, and other structures under the control of a telecommunications customer.

CW1128	External grade multipair voice cable that meets the (BT) British Telecom specification.
CW1308	Internal grade multipair voice cable that meets the (BT) British Telecom specification.
Data Connector	A four position connector for 150 - ohm STP used primarily with Token Ring networks.
dB	Decibel. A unit for measuring the relative strength of a signal. Usually expressed as the logarithmic ratio of the strength of a transmitted signal to the strength of the original signal. A decibel is one tenth of a "bel".
DC Loop Resistance	The total DC resistance of a cable. For twisted pair cable, it includes the round trip resistance, down one wire of the pair and back up the other wire.
DCE	Data Communications Equipment. Any equipment that connects to Data Terminal Equipment (DTE) to allow transmission between DTEs.
DCIE	Data Centre Infrastructure Efficiency
DDI	Direct Dialing Inward. This facility enables external callers to dial directly to PABX extensions (without going via the switchboard) by inserting a prefix in front of the extension number.
Demarcation Point	A point where the operational control or ownership changes, such as the point of interconnection between telephone company facilities and a user's building or residence.
Dielectric	An insulating (non conducting) material.
Direct Current (DC)	An electric current that flows in one direction and does not reverse direction as with "alternating current".
Dispersion	The phenomenon in an optical fibre whereby light photons arrive at a distant point in a different phase than they entered the fibre. Dispersion causes receive signal distortion that ultimately limits the bandwidth and usable length of the fibre cable. The two major types of dispersion are 1) mode (or modal) dispersion caused by differential optical path lengths in a multimode fibre, and 2) material dispersion caused by differing transmission times of different wavelengths of light in the fibre optic material.
Distribution Frame	A structure with terminations for connecting the permanent cabling of a facility in a manner that interconnections or cross connects may be readily made.
Drain Wire	An uninsulated wire in contact with a shield throughout its length. Used to terminate the shield.
DTE	Data Terminal Equipment. Any piece of equipment at which a communications path begins or ends.
Duct	A single enclosed raceway for wires or cable or an enclosure in which air is moved.
Duplex	A circuit used to transmit signals simultaneously in both directions or two receptacles or jacks in a common housing which accepts two plugs.
E1/E3	The European versions of T1 and T3. E1 runs at 2.048 Mbps and E3 runs at 34 Mbps.
Earth	A term for zero reference ground.
EC	European Community
EIA	Electronic Industry Association (formerly RMA or RETMA). An association of manufacturers and users that establishes standards and publishes test methodologies.
Electromagnetic Field	The combined electric and magnetic field caused by electron motion in conductors.
Electromagnetic Interference	An interfering electromagnetic signal. Network wiring and equipment may be susceptible to EMI as well as emit EMI.
ELFEXT	Equal Level Far End Crosstalk - superseded by ACR-F
EMI	see Electromagnetic Interference.
Encircled Flux - EF	Fraction of cumulative near-field power to the total output as a function of radial distance from the optical centre of the core.
Encoding	A means of combining clock and data information into a self synchronized stream of signals.
Entrance Facility (EF)	The point at which the ISP or Service Providers cables enter the building.
Environ®	Floor standing and wall mounted racks and frames from Excel.
Equipment Room (ER)	An enclosed area housing telecommunications and network equipment, distinguished from the telecommunications or wiring closet by its increased complexity and presence of active equipment.



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Ethernet	A local area networking protocol. Ethernet was designed as a common bus system operating at 10Mbit/s. Ethernet Switches are commonly used to support a star based topology with speeds of up to 10Gbs over twisted pair cabling.
Far End Cross Talk (FEXT)	Crosstalk that is measured on the quiet line at the opposite end as the source of energy on the active line. FEXT is not typically measured in cabling, with Near End Cross Talk (NEXT) being the preferred crosstalk measurement.
Farad	A unit of capacitance that stores one coulomb of electrical charge when one volt of electrical pressure is applied.
Fast Ethernet	Ethernet standard supporting 100 Mbps operation.
Fibre Channel	Fibre Channel or FC is a high speed network technology running at 2, 4, 8 or 16 Gbs primarily used to connect Data Storage or SANs (Storage Area Networks).
FDDI	Fibre Distributed Data Interface. FDDI is a 100Mbit/s networking protocol which operates over optical fibre. FDDI was initially developed as a MAN protocol but is also commonly supported in the LAN environment.
FEXT	see Far End Cross Talk
Frequency	The number of times a periodic action occurs in a unit of time. Expressed in hertz (abbreviated Hz). One hertz equals one cycle per second.
Frequency Division Multiplexing (FDM)	A technique for combining many signals on a single circuit by dividing the available transmission bandwidth by frequency into narrower bands, each used for a separate communication channel.
F/UTP	Screened cable construction, of overall Foil outer with unscreened twisted pairs.
F/FTP	Screened foil outer with individual screened foil twisted pairs
Full Duplex Transmission	Data transmission over a circuit capable of transmitting in both directions simultaneously.
Gateway	A term used for a device which enables two networks to communicate with each other. The term strictly refers to a device which undertakes a protocol conversion between two non-like networks. However, it is now commonly applied to any device which acts as an access point between networks even if no protocol conversion is necessary (e.g. internet gateway).
Gbps	Gigabits per second.
Gigahertz (GHz)	One billion hertz.
GIPOF	Graded Index Plastic Optical Fibre
GOP	Grid Outlet Position
Graded Index fibre	A multimode fibre optic cable design in which the index of refraction of the core is lower toward the outside of the core and progressively increases toward the centre of the core, thereby reducing modal dispersion of the signal.
Ground	A common point of zero potential such as a metal chassis or ground rod.
Ground Loop	A condition where an unintended connection to ground is made through an interfering electrical conductor.
Half Duplex Transmission	Data transmission over a circuit capable of transmitting in either direction, but not simultaneously.
Headroom	The amount by which a cable exceeds NEXT.
Hertz	The unit of frequency, one cycle per second (abbreviated Hz).
Horizontal Cabling, Horizontal Wiring	The portion of the cabling system that extends from the work area outlet to the horizontal cross connect in the telecommunications or wiring closet.
Horizontal Cross Connect	A cross connect of horizontal cabling to other cabling, e.g. horizontal, backbone, or equipment.
http	Hyper Text Transfer Protocol, used for WWW documents.
Hub	A device which is utilised to connect multiple other devices. The most common application is an Ethernet hub which is used to support star based Ethernet topologies.
HVAC	Heating, ventilation, and air conditioning system.
IC	see Intermediate Cross Connect.
ICEA	Insulated Cable Engineers Association

IDC	Insulation Displacement Contact/Connector
IDF	Intermediate Distribution Frame. This is usually located on each floor within a building. It is tied directly to the Main Distribution Frame via cables.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers. A professional organization and standards body. The IEEE Project 802 is the group within IEEE responsible for LAN technology standards.
IEEE 802.1	The IEEE standards committee defining High Level Interfaces, Network Management, Internetworking, and other issues common across LAN technologies.
IEEE 802.2	The IEEE standards committee defining Logical Link Control (LLC).
IEEE 802.3	The IEEE standards committee defining Ethernet networks.
IEEE 802.5	The IEEE standards committee defining Token Ring Standards
Impedance	A unit of measure, expressed in Ohms, of the total opposition (resistance, capacitance and inductance) offered to the flow of an alternating current.
Insertion Loss	A measure of the attenuation of a device by determining the output of a system before and after the device is inserted into the system. For example, a connector causes insertion loss across the interconnection (in comparison to a continuous cable with no interconnection).
Insulation	A material which is nonconductive to the flow of electrical current.
Interconnection	A connection scheme that provides for the direct connection of a cable to another cable or to an equipment cable without a patch cord or jumper.
Interference	Undesirable signals which interfere with the normal operation of electronic equipment or electronic transmission.
Intermediate Cross Connect	A cross connect between 1st level and 2nd level backbone cabling.
Intranet	A closed user group internet which uses browser style interfaces to present information. An intranet may either exist only within a private network or may be accessible via the internet.
IP	Internet Protocol. Now becoming the dominant protocol for WANs and LANs.
ISDN	Integrated Services Digital Network. The ISDN is the modern, digital equivalent of the PSTN. It employs digital technology throughout and can be used to support multimedia communications including voice, data, video and image. Two narrow band ISDN products are commonly available in the UK; basic rate (2B+D, 144Kbit/s, ISDN2) and primary rate (30B+D, 2Mbit/s). Broadband services will become available in the future. ISDN2e is BT's European ISDN 2B+D service.
ISO	International Organisation for Standardisation - publishers of international standards. <a href="http://www.iso.org">www.iso.org</a>
Isolated Ground	A separate ground conductor which is insulated from the equipment or building ground.
ISP	Internet Service Provider. Companies who provide access to the internet. Access may be via dial-up modems basic rate ISDN or digital leased lines.
IT	Common abbreviation for the generic term "information technology" used to describe any aspect of computing and networking.
ITU	International Telecommunications Union. An international organization that develops communications standards.
Jack	A female connector
Jacket	The outer protective covering of a cable.
Jumper	An assembly of twisted pairs without connectors used to join telecommunications circuits at the cross connect. Similar to a patch cable (which has connectors).
Keying	The mechanical feature of a connector system that guarantees correct orientation of a connection, or prevents the connection to a jack, or to an optical fibre adapter, of the same type intended for another purpose.
LAN	Local Area Network
Laser	Light Amplification by Stimulated Emission of Radiation. A device which produces light with a narrow spectral width. Used in fibre optic communication systems, usually single mode, where high capacity and low attenuation are required.



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LC	(SFF) Small Form Factor fibre connector, currently the most common connector used for premise cabling installations, due to the high density that can be achieved, uses a 1.25mm ferrule, LC stands for 'Lucent Connector'
Leased Line	A circuit rented from a PTO. A leased line provides permanent guaranteed bandwidth between two locations.
LED (Light Emitting Diode)	A semiconductor diode which emits incoherent light when a current is passed through it. Used as a light source in fibre optic transmission.
Link	A transmission path between two points not including terminal equipment, work area cables, or equipment cables.
Loopback	A type of diagnostic test in which a transmitted signal is returned to the sending device after passing through a data communications link or network. This test allows the comparison of a returned signal with the transmitted signal.
LSOH	Low Smoke Zero Halogen - refers to compound construction. Usually cable sheath or flexible conduit.
LSPM	Light Source & Power Meter
mA	Milliampere (one thousandth of an ampere)
Main Cross Connect	A cross connect for first level backbone cables, entrance cables, and equipment cables. The main cross connect is at the top level of the premises cabling tree.
MAN	Metropolitan Area Network. Strictly a term used to define a network throughout a metropolitan area. Such a network would generally be PTO provided. However the term is now commonly used to describe an extended LAN which serves a number of buildings in a restricted geographical area.
Mbps	Megabits per second.
MDF	Main Distribution Frame
Medium Access Control (MAC)	A mechanism operating at the data link layer of local area networks which manages access to the communications channel (medium).
Medium Dependent Interface (MDI)	In Ethernet, the connector used to make the mechanical and electrical interface between a transceiver and a media segment. An 8 pin RJ 45 connector is the MDI for the 10BaseT, 100BaseTX, 100BaseT2, 100BaseT4, and 1000BaseT media systems.
Medium Independent Interface (MII)	Used with 100 Mbps Ethernet systems to attach MAC level hardware to a variety of physical media systems. Similar to the AUI interface used with 10 Mbps Ethernet systems. An MII provides a 40 pin connection to outboard transceivers (also called PHY devices).
Megahertz (MHz)	One million hertz.
MER	Main Equipment Room
Micro	Prefix meaning one millionth.
Micron	One millionth of a meter. Abbreviated $\mu\text{m}$ .
Modal Dispersion	Dispersion that results from the different transit lengths of different propagating modes in a multimode optical fibre.
Mode	A single electromagnetic wave travelling in an optical fibre.
Modem	A device that implements "modulator demodulator" functions to convert between digital data and analogue signals.
Modular Jack	The equipment mounted half of a modular interconnection. Typically a female connector. A modular jack may be keyed or unkeyed and may have six or eight contact positions, but not all the positions need to be equipped with jack contacts.
Modular Plug	The cable mounted half of a modular interconnection. Typically a male connector. A modular plug may be keyed or unkeyed and may have six or eight contact positions, but not all the positions need to be equipped with contacts.
MPO	Multi-fibre connector, designated stands for Multi-Fibre Push On Pull Off
MTP	Low Loss MPO connector produced by US Conec
Multimode Fibre	A fibre optic cable which supports the propagation of multiple modes. Multimode fibre may have a typical core diameter of 50 or 62.5 micron to 100 $\mu\text{m}$ with a refractive index that is graded or stepped. It allows the use of inexpensive LED light sources and connector alignment and coupling is less critical than single mode fibre. Distances of transmission and transmission bandwidth are less than with single mode fibre due to dispersion.

mV	Millivolt (one thousandth of a volt)
mW	Milliwatt (one thousandth of a watt)
Nanometer (nm)	One billionth of a metre.
Nanosecond (ns)	One billionth of a second.
NEXT (Near End Crosstalk)	Crosstalk between two twisted pairs measured at the same end of the cable as the disturbing signal source. NEXT is the measurement of interest for crosstalk specifications.
Network	An interconnection of computer systems, terminals or data communications facilities.
Network Interface Card	A circuit board installed in a computing device used to attach the device to a network. A NIC performs the hardware functions that are required to provide a computing device with physical communications capabilities. Also Network Interface Unit (NIU).
NFPA	National Fire Protection Association
NIR	Nearend Crosstalk to Insertion Loss Ratio
Node	End point of a network connection. Nodes include any device connected to a network such as file servers, printers, or workstations.
NVP	Nominal Velocity of Propagation. The speed a signal propagates through a cable expressed as a decimal fraction of the speed of light in a vacuum.
Octet	8 bits (also called a byte).
OFTEL	Office of Telecommunications. The Government appointed watchdog organisation in the UK.
Ohm	The electrical unit of resistance. The value of resistance through which a potential of one volt will maintain a current of one ampere.
Ohm's Law	Stated $E=IR$ , $I=E/R$ , or $R=E/I$ , the current "I" in a circuit is directly proportional to the voltage "E", and inversely proportional to the resistance "R".
Open	A break in the continuity of a circuit.
Optical Fibre	A thin glass or plastic filament used for the transmission of information via light signals. The signal carrying part of a fibre optic cable.
Optical Fibre Cable	An assembly consisting of one or more optical fibres.
Optical Fibre Duplex Adapter	A mechanical media termination device designed to align and join two duplex connectors.
Optical Fibre Duplex Connection	A mated assembly of two duplex connectors and a duplex adapter.
Optical Fibre Duplex Connector	A mechanical media termination device designed to transfer optical power between two pairs of optical fibres.
Optical Time Domain Reflectometry	A method for evaluating optical fibre based on detecting and measuring backscattered (reflected) light. Used to measure fibre length and attenuation, evaluate splice and connector joints, locate faults, and certify cabling systems.
OSI	Open Systems Interconnection
OTDR	Optical Time Domain Reflectometry.
Outlet	See Telecommunications Outlet
Outlet Box	A metallic or non metallic box mounted within a wall, floor, or ceiling used to hold outlet, connector, or transition devices.
Output	The useful signal or power delivered by a circuit or device.
Outside Plant	Cabling, equipment, or structures that are out of doors.
PABX	Private Automatic Branch Exchange
Packet	Bits grouped serially in a defined format, containing a command or data message sent over a network.
Patch Panel	A passive device, typically flat plate holding feed through connectors, to allow circuit arrangements and rearrangements by simply plugging and unplugging patch cables.
Patch Cord (Patch Lead)	A flexible piece of cable terminated at both ends with connectors. Used for interconnecting circuits on a patch panel or cross connect.
PBX	Private Branch Exchange
PC	Personal Computer



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PCC	Premises Communication Cable, CSA Cable Designation.
PHY	Physical Layer device.
Physical Layer	Layer one of the seven layer ISO Reference Model for Open Systems Interconnection. The physical layer is responsible for the transmission of signals, such as electrical signals, optical signals, or radio signals, between computing machines.
Picofarad	One millionth of one millionth of a farad. Abbreviated "pf".
PIMF	Pairs in metal foil and early term used for F/FTP and S/FTP cable
Plastic Fibre	An optical fibre made of plastic rather than glass.
Plenum	The air handling space between the walls, under structural floors, and above drop ceilings used to circulate and otherwise handle air in a building. Such spaces are considered plenums only if they are used for air handling. Work spaces are generally not considered plenums.
Plenum Cable	A cable that is rated as having adequate fire resistance and low smoke producing characteristics for use in air handling spaces (plenum).
PMD	Physical Media Dependent or Polarisation Model Dispersion
PoE	Power over Ethernet, a method of providing low power to end devices over the balanced twisted pair cabling. POE delivers 12.95watts to the end device. POE+ delivers 25.5 watts.
POF	Plastic Optical Fibre.
Polyethylene	A thermoplastic material having excellent electrical properties.
Polymer	A substance made of repeating chemical units or molecules. The term is often used in place of plastic, rubber, or elastomer.
Polypropylene	A thermoplastic material similar to polyethylene but somewhat stiffer and with a higher softening point (temperature).
Polyurethane	Broad class of thermoplastic polymers with good abrasion and solvent resistance. Can be solid or cellular (foam).
Polyvinyl Chloride (PVC)	A general purpose thermoplastic used for wire and cable insulation and plastics. PVC is known for high flexibility. Often used in nonplenum wire insulation and cable jackets. A modified version of the material may be found in jacketing of some plenum rated cables.
POTS	Plain Old Telephone System
Potting	Sealing by filling with a substance to exclude moisture.
Power Ratio	The ratio of power appearing at the load to the input power. Expressed in dB.
Premise Cabling	The entire cabling system on the user's premises used for transmission of voice, data, video and power.
Pre-wiring	Wiring installed before walls and ceilings are enclosed.
Propagation Delay	Time required for a signal to pass from the input to the output of a device.
Protocol	A set of agreed upon rules and message formats for exchanging information among devices on a network.
PSELFEXT	Power Sum Equal Level Far End Crosstalk
PSNEXT	Power Sum Near End Crosstalk
Public Switched Network	Any common carrier network that provides circuit switching between public users, such as the public telephone network, telex or MCI's Execunet.
PUE	Power Usage Effectiveness
Pull Strength, Pull Tension	The pulling force that can be applied to a cable without affecting the specified characteristics of the cable.
R	Symbol for Resistance
RAS	Remote Access Server. A device which enables external devices to access network facilities. The RAS will generally be equipped with analogue modems and/or ISDN terminal adapters to enable remote users to "dial-in". The RAS will incorporate security features including password control, dial back, CLI recognition and hardware handshaking.
RCDD	Registered Communication Distribution Designer. A certification of BICSI, an industry organisation, for individuals qualified to consult and design telecommunications distribution systems.

Reflection	A return of electromagnetic energy that occurs at an impedance mismatch in a transmission line, such as a LAN cable.
Refractive Index	The ratio of the speed of light in a vacuum to its velocity in a transmitting medium, such as an optical fibre core.
Repeater	A device that receives, amplifies (and sometimes reshapes), and retransmits a signal. It is used to boost signal levels and extend the distance a signal can be transmitted. It can physically extend the distance of a LAN or connect two LAN segments.
Resistance	In dc circuits, the opposition a material offers to current flow, measured in ohms. In ac circuits, resistance is the real component of impedance and may be higher than the value measured at dc.
Reversed Pair	A wiring error in twisted pair cabling where the conductors of a pair are reversed between connector pins at each end of a cable.
RFI	Radio Frequency Interference. Electromagnetic interference at radio frequencies.
RFP	Request for Proposal
RFQ	Request for Quote (or Quotation)
Ripcord	A cord placed directly under the jacket of a cable in order to facilitate stripping (removal) of the jacket.
Riser	The conduit or path between floors of a building into which telephone, networking, and other utility cables are placed to bring service from one floor to another.
Riser Cable	A type of cable used in vertical building shafts, such as telecommunications and utility shafts. Riser cable typically has more mechanical strength than general use cable and has an intermediate fire protection rating.
RJ	A term from the telephone industry, used for jacks (connectors) that were registered for use with particular types of telephone services. RJ stands for "registered jack".
RJ45	A USOC code identifying an 8 pin modular plug or jack used with unshielded twisted pair cable. Officially, an RJ45 connector is a telephone connector designed for voice grade circuits only. RJ45 type connectors with better signal handling characteristics are called 8 pin connectors in most standards documents, though most people continue to use the RJ45 name for all 8 pin connectors.
Router	A device which controls the routing of information on a network. The term strictly refers to a layer 3 (OSI model) device which can interpret network addressing information and route data packets accordingly. Routers undertake broadly the same function as bridges but can dynamically manage bandwidth more effectively and can provide enhanced levels of security.
Rx	Receive
SAN	Storage Area Network
SC Connector	A fibre optic connector having a 2.5mm ferrule, push pull latching mechanism, and the ability to be snapped together to form duplex and multifibre connectors.
Screened Twisted Pair, (STP)	Generic term for screened cables irrespective of Category or construction of the screen and covers from an F/UTP Cable, through to S/FTP variants.
SCS	Structured Cabling System
Secondary Equipment Room (SER)	Secondary room typically situated on a Floor or Area of the building and services the Outlets in that area.
Semiconductor	In wire industry terminology, a material possessing electrical conductivity that falls somewhere between that of conductors and insulators. Usually made by adding carbon particles to an insulator. Not the same as semiconductor materials such as silicon, germanium, etc.
Separator	Pertaining to wire and cable, a layer of insulating material such as textile, paper, Mylar, etc. which is placed between a conductor and its dielectric, between a cable jacket and the components it covers, or between various components of a multiple conductor cable. It can be utilised to improve stripping qualities, flexibility, or can offer additional mechanical or electrical protection to the components it separates.
S/FTP	Screened Braid outer with individual foil screened twisted pairs
Sheath	see Jacket



## Appendices

Shield	A metallic foil or multiwire screen mesh that is used to prevent electromagnetic fields from penetrating or exiting a transmission cable. Also referred to as a "screen".
SI Unit	International System of Units - there are 7 base units of measure from which all other units of measure are derived (see SI Base Units table)
Signal to noise ratio (SNR)	The ratio of received signal level to received noise level, expressed in dB. Abbreviated S/N. A higher S/N ratio indicates better channel performance.
Simplex Transmission	Data transmission over a circuit capable of transmitting in one preassigned direction only.
Single Mode Fibre	An optical fibre that will allow only one mode to propagate. The fibre has a very small core diameter of approximately 9 µm. It permits signal transmission at extremely high bandwidth and allows very long transmission distances.
Skew Rays	A ray that does not intersect the fibre axis. Generally, a light ray that enters the fibre at a very high angle.
SLA	Service Level Agreement. A term commonly used within the IT industry to refer to the service standards which a service provider agrees to deliver to a user. Initially used in contractual arrangements with third parties but now commonly used as an internal agreement within organisations.
SMA Connector	A threaded type fibre optic connector. The 905 version is a straight ferrule design, whereas the 906 is a stepped ferrule design.
SMTP	Simple Mail Transfer Protocol. The protocol used to exchange mail between an organisations email system and the internet.
SNMP	Simple Network Management Protocol. The protocol used by devices to communicate with a network management system.
SONET	see Synchronous Optical Network.
Speed of Light	In a vacuum, 299,800,000 meters per second.
Splice	A joining of conductors generally from separate sheaths.
Splice Closure	A device used to protect a cable or wire splice.
Split Pair	A wiring error in twisted pair cabling where one of a pair's wires is interchanged with one of another pair's wires. Split pair conditions may be determined with a transmission test. Simple DC continuity testing will not reveal the error, because the correct pin to pin continuity exists between ends. However, the error may result in impedance mismatch, excessive crosstalk, susceptibility to interference, and signal radiation.
SRL	see Structural Return Loss
ST Connector	Designation for the "straight tip" connector developed by AT&T. This fibre optic connector features a physically contacting non rotating 2.5mm ferrule design and bayonet connector to adapter mating. Used with Ethernet 10Base FL and FIOFL links.
Standing Wave	The stationary pattern of waves produced by two waves of the same frequency travelling in opposite directions on the same transmission line. The existence of voltage and current maxima and minima along a transmission line is a result of reflected energy from an impedance mismatch.
Standing Wave Ratio (swr)	A ratio of the maximum amplitude to the minimum amplitude of a standing wave stated in current or voltage amplitudes.
Star Topology	A topology in which each outlet/connector is wired directly to the distribution device.
STP	see Screened Twisted Pair
Strength Member	That part of a fibre optic cable that increases the cable's tensile strength and serves as a load bearing component. Usually made of Kevlar aramid yarn, fibreglass filaments, or steel strands.
Structural Return Loss (SRL)	A measure of the impedance uniformity of a cable. It measures energy reflected due to structural variations in the cable. A higher SRL number indicates better performance (more uniformity and lower reflections).
Structured Wiring	Telecommunications cabling that is organised into a hierarchy of wiring termination and interconnection structures. The concept of structured wiring is used in the common standards from the TIA and EIA.
Surge Suppression	The process by which transient voltage surges are prevented from reaching sensitive electronic equipment.

Switch	Generic term for a PABX. Also a device employed in LANs to partition networks. A LAN switch (Ethernet or token ring) is strictly a matrix of bridges that isolates Ethernet collision domains.
Synchronous	Transmission in which the data character and bits are transmitted at a fixed rate with the transmitter and receiver being synchronised.
Synchronous Digital Hierarchy (SDH)	International standard for optical digital transmission at hierarchical rates from 155 Mbps to 2.5 Gbps and beyond.
Synchronous Optical Network (SONET)	A USA standard for optical digital transmission at hierarchical rates from 155 Mbps to 2.5 Gbps and beyond.
T1	T1 is a 1.544 Mbps multichannel digital transmission system for voice or data provided by long distance carriers. Also referred to as DS1 (Data Services).
T3	T3 is a 44.736 Mbps multichannel digital transmission system for voice or data provided by long distance carriers. Also referred to as DS3 (Data Services).
TC	Telecommunications Cross Connect.
TCP	Transmission Control Protocol. Often used as a suite with IP as TCP/IP with jointly forms the protocols used on the Internet.
TDR	See Time Domain Reflectometry
Telecommunications Closet	Cupboard or Closet containing equipment and structured cabling infrastructure to support a small area of the Floor within a Building.
Telecommunications Equipment Room	see Equipment Room
Telecommunications Outlet (TO)	Provides the means for the user to connect end equipment to the Structured Cabling System (SCS) by way of an equipment/patch cord
Thicknet	Ethernet 10Base5 coaxial cable
Thinnet	Ethernet 10Base2 coaxial cable. Also called "cheapernet".
TIA	Telecommunications Industry Association. Body which authored the TIA/EIA 568 A "Commercial Building Telecommunications Wiring Standard" in conjunction with EIA.
Time Domain Reflectometry	A technique for measuring cable lengths by timing the period between a test pulse and the reflection of the pulse from an impedance discontinuity on the cable. The returned waveform reveals many undesired cable conditions, including shorts, opens, and transmission anomalies due to excessive bends or crushing. The length to any anomaly, including the unterminated cable end, may be computed from the relative time of the wave return and nominal velocity of propagation of the pulse through the cable. See also Optical Time Domain Reflectometry.
Token Ring	A local area network (LAN) protocol defined in the IEEE 802.5 standard in which computers access the network through a token passing scheme. Uses a star wired ring topology.
Topology	The physical or logical interconnection pattern of a network.
Transceiver	A combination of the words TRANSMITTER and reCEIVER. A transceiver is the set of electronics that send and receive signals on the Ethernet media system. Transceivers may be small outboard devices, or may be built into an Ethernet port. Also called Media Attachment Unit, or MAU.
Transition Point	A location in the horizontal cabling where flat undercarpet cable connects to round cable.
Transmission Media	Anything such as wire, coaxial cable, fibre optics, air or vacuum, that is used to carry a signal.
Transmitter	A device that converts electrical signals for transmission to a distant point. In fibre optic systems, the electronic component that converts electrical energy to light energy.
TSB	Telecommunications Systems Bulletin
Turn-key	A contractual arrangement in which one party designs and installs a system and "turns over the keys" to another party who will operate the system.
Twinaxial Cable, Twinax	A type of communication transmission cable consisting of two center conductors surrounded by an insulating spacer which in turn is surrounded by a tubular outer conductor (usually a braid, foil or both). The entire assembly is then covered with an insulating and protective outer layer. It is similar to coaxial cable except that there are two conductors at the center.



## Appendices

Twisted Pair	A multiple conductor cable whose component wires are paired together, twisted, and enclosed in a single jacket. Each pair consists of two insulated copper wires twisted together. When driven as a balanced line, the twisting reduces the susceptibility to external interference and the radiation of signal energy. Most twisted pair cabling contains either 2, 4, or 25 pairs of wires.
Type 1	150 ohm shielded twisted pair (STP) cabling conforming to the IBM Cabling System Specifications. Two twisted pairs of 22 AWG solid conductors for data communications are enclosed in a braided shield covered with a sheath. Tested for operation up to 16 MHz. Available in plenum, non plenum, riser, and outdoor versions.
Type 1A	Enhanced version of IBM Type 1 cable rated for operation up to 300 Mhz. Meets electrical specifications for 150 ohm STP - A Cable as documented in the TIA/EIA 568 - A standard.
U Height	Equates to 1.75 inches (44.45 mm) and is used to measure vertical Usable space in IT equipment cabinets. Most IT equipment is sized in U's.
U/FTP	Unscreened outer with individual foil screened twisted pairs.
UL	Underwriters Laboratories, Inc.
Unscreened Twisted Pair (UTP)	Generic Term for all Unscreened cable constructions
UPoE	Universal Power over Ethernet, Cisco's proprietary 4 pair powering form of POE delivering 51watts powered
VA	Volt-ampere. A designation of power in terms of voltage and current.
Vampire Tap	see Tap
VFL	Visual Fault Locator - used in optical fibre fault diagnostics
Voice Grade	A term used for twisted pair cable used in telephone systems to carry voice signals.
Volt	The unit of electrical potential. One volt is the electrical potential that will cause one ampere of current to flow through one ohm of resistance.
WAN	Wide Area Network. The term used to describe any network which is not restricted to a limited geographical area.
Watt	A unit of electrical power. One watt is equivalent to the power represented by one ampere of current flowing through a load with a voltage drop of one volt in a dc circuit.
Wavelength	The distance between successive peaks or nodes of a wave.
Wavelength Division Multiplexing (WDM)	The process of combining and splitting signals on the basis of difference in their wavelengths.
Wiring Closet	See Telecommunications Closets
$\lambda$	wavelength, measured in nm (nano-metres) for optical fibre

Glossary details compiled with assistance from Fluke Networks.

# Excel Literature

The following Excel literature is available in both printed and PDF format as shown below.  
 To download any of the literature please visit [www.excel-networking.com](http://www.excel-networking.com) and click on 'Downloads'  
 To order printed copies of the items shown below simply email [admin@excel-networking.com](mailto:admin@excel-networking.com)

Item	Printed Version Available	PDF Version Available
<b>Catalogues</b>		
Excel A5 Product Guide	✓	✓
Excel Short Form Product Guide	✓	✓
Environ® Product Guide		✓
<b>Brochures</b>		
Excel Encyclopaedia Edition 3		✓
Excel Corporate Overview Brochure	✓	✓
Excel Partner Programme Brochure		✓
Excel Installation Guidelines		✓
Excel Fibre Installation Guidelines		✓
Excel Environ® OR Installation Guidelines		✓
Excel Warranty Brochure		✓
Excel Verification Certificates Brochure		✓
<b>Misc</b>		
Excel Specification Sheets		✓
Excel White Papers		✓
Excel Technical Notes		✓
Excel Capacity Calculator		Excel Spreadsheet
Excel Testing Methodology		✓
Excel Case Studies	✓	✓
Excel Express Newsletters	✓	✓
Excel Literature Wallet	✓	
Excel Accreditation Certificate	✓	✓
Excel Warranty Certificate		✓
Excel Partner Plaque	✓	
Excel Labelling Software		✓

## Excel Specification Sheets

You can download a technical specification sheet for the majority of products within the Excel product portfolio.

Simply visit [www.excel-networking.com](http://www.excel-networking.com) and search for the product on the Excel product database. From here you will be able to download the specification sheet relating to that product.

Accredited Excel Partners can also add their logo and address details to each of the specification sheets by visiting the Excel Partner Area located at [www.excel-networking.com](http://www.excel-networking.com).

After uploading their logo and confirming their contact information, each specification sheet will automatically be updated with their details, which are perfect for including in tenders and customer quotations.



## Excel Labelling Software - Instructions

You can download a free copy of the Excel Labelling Software by visiting [www.excel-networking.com](http://www.excel-networking.com) and clicking on Downloads.

Things you can do with Excel Labelling Software from Sharpmark Solutions LLP:

- Choose coloured backgrounds and / or text for your labels
- Import from Excel (or other spreadsheets)
- Run both simple and complex numbering sequences by simply entering start and end points of sequence
- Build up your job using number sequences, fixed text, random labels or a mixture of all three
- Choose any layout with any part number
- Import graphics

1) Follow the instructions on the Wizard to set up your label

2) Once you are in the Layout Editor click on one of the following buttons to place text on your labels:

Add Label

Paste

Add Title

Fixed Text

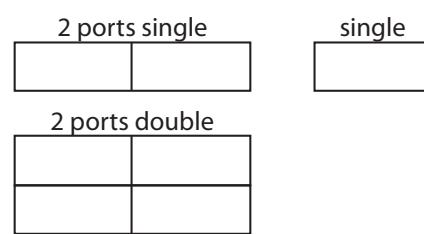
Sequence

- 3) If you are entering a sequence, enter the start and end points respectively in the two boxes. If you are entering fixed text enter the number of labels you require then type your text in the left hand box.
- 4) Once you have added your first item, if you want to add further items to your job just click another of the buttons above and build up your label job as you require.

**NOTE:** If you wish to add a title line to your label, you must have chosen a layout with a title when setting up your label in the label wizard. You can then click the "Add Title" or "Fixed Text" button to insert your title line text. Use the Add Title button to have the same title for all your labels. If you will want to use more than one title in your job use the Fixed Text button instead and define the quantity of labels for each title. If you have chosen a layout with a title, or are working on a cable label with a number of rows, enter the data for one row at a time, switching between the rows using the diagram to the left of the data entry boxes. The row shown in blue is the one you are working on at any one time.

### An Explanation of the Layout Options

Single  
Single, title  
2 ports single  
2 ports single, title  
2 ports double  
2 ports double, title  
3 ports single  
3 ports single, title etc.



Single will leave the label completely undivided.

Title means that the label will be laid out with a title bar across its width.

The number of ports is the number of divisions a label will have across its width.

Double means that the label will be laid out with two rows of however many ports you have chosen.

### Toolbar Captions

The software has been designed with captions as well as images on the buttons to make their functions clear and easy to understand. If your screen resolution is very low, Sharpmark will detect this and remove the captions to make the buttons smaller for your convenience.

If your screen is showing the captions you can choose to remove them once you are familiar with the buttons' functions. This will give you a larger work area and may be a preferred setting. This can be done using the Toolbar Captions option on the Options menu.

## Print Alignment

You can choose to align your text left, right, top or bottom by clicking the Edit menu. If you are experiencing minor misalignment on your labels please run the **Printer Calibration** option on the Options menu. If this doesn't fix your problem adequately check that your printer is set to print on A4 paper, and that you are using the correct printer driver. Always use the manufacturer's disks if possible.

## Default Font

You can set a default font of your choice by using the option on the Options menu.

## Insert Graphic Image ie. Logo

This option is on the Edit menu

## Changing the Increment of your sequence

If you want to increase the increment from 1, use the Change Sequence Increment option on the Edit menu

## Pasting in from Excel (or other spreadsheet)

Copy the cells from Excel onto the Windows clipboard by selecting them and clicking copy. Set up your label in Sharpmark using the wizard to select the part number and layout option you want then click the paste button on the toolbar.

## To Colour the text or Background of a Label

You can choose the colour of the text by using the font options. To alter the background colour, click on the cell you wish to colour on the cell selector diagram. (This is the illustration of the label to the left of the data entry boxes). The selected cell will appear bright blue. Then right-click the mouse, and you will see a colour chart from which you can select your preferred colour for that cell.

## To Alter the order of items once you have built up a job

If you have added more than one item (an item being a sequence, a blank label or a run of fixed text labels) you can change their order in the layout editor by selecting the item you wish to move and clicking on the **Move up** and **Move down** buttons on the toolbar.

## "Special" Sequences

If you enter a complex sequence, ie one that has more than one moving increment (eg 1/A up to 10/D) you will notice that the word "special" appears between the data entry boxes in the Layout Editor. If this occurs you will be unable to add further items using the toolbar buttons and you will see that they have become greyed out. If you wish to add further items before printing you need to use the **Sections** buttons on the toolbar.

## Add and Drop Sections

Adding sections to your job is effectively a way of creating a number of separate jobs in one session and printing them out together directly after one another so that you don't waste labels. To add a new section click the Add Section (Add Sect'n) button and enter the items you require for your job.

The new section starts off as a repeat of the previous one - just amend it as you require. You can see which section you are currently working on by looking at the display to the left of the buttons, and you can flip through the sections you have created by clicking on the arrows. Sections can be deleted by going to the section you want to delete and clicking the Drop Section button.

Although when you view the various sections they are all separate from each other they will be printed out directly following one another.

## Deleting Jobs from your System

To delete jobs, close down any open jobs and choose Maintenance from the File menu.

## Exporting and Importing Jobs

You can export and import jobs in order to transfer them from one PC to another by clicking on Maintenance from the file menu once all jobs are closed.

## Exporting

Click the Export and select the job(s) you wish to export by using shift and the cursors, or by holding down Control and clicking on the ones you wish to select. Sharpmark will ask you for a name for the group of jobs you are exporting and will export a folder containing the files for your jobs, and a .smx file of the same name.

## Importing

When you import, it is the smx file that you need to select, and you will then get the list of your exported jobs from which you can select the ones you wish to import.

2 ports single  
2 ports double  
single

# Engraved labels

You can give your Excel installations an even greater quality feel by using the Sharpmark engraved labels.

Sharpmark engraved labels provide cost effective solutions for extremely durable and high quality labelling of professional installations.

Sharpmark produce them in-house using state of the art laser engraving technology, so you can have them quickly at very competitive prices.

Suitable for a wide range of applications from labelling patch panels and outlet modules to warning signs on high voltage installations, Sharpmark engraved labels are made to your precise specifications.

Sharpmark provide template information for most networking equipment on the market so ordering is simple.

- **High quality** – Traffolyte style labels produced using precision lasers
- **Cost-effective** – only £1.78 for a full length patch panel or 12p per outlet label
- **Fast lead time** – Sharpmark aim to deliver within 1-2 working days and will confirm the delivery date when you place your order
- **Easy ordering** – email your numbering scheme, the type of equipment and colour choice then Sharpmark will do the rest. Or send us the size and text required.
- **Wide colour range** – 12 standard colours plus other colours and specialist materials available on request

**Please note** - *these colours can only be approximations as Sharpmark has no control over your display device or media.*

- **Supplied in sheet form** – your labels arrive in order on a backing sheet to save you time and money on site. You simply peel them off and apply.
- **Durable adhesive** – high quality 3M permanent adhesive which has been proven in tests to stay put.

To order engraved Sharpmark Labels for your Excel installations contact the sales team on **0800 75 75 65**.



# International System of Units (SI)

The International System of Units (SI) is based on seven base units. From these there are derived units.

## SI Base Units

Base Quantity	SI Base Unit	
	Name	Symbol
Length	Metre	m
Mass	Kilogram	kg
Time	Second	s
Electrical current	Ampere	A
Thermodynamic temperature	Kelvin	K
Amount of substance	Mole	mol
Luminous intensity	candela	cd

## Prefixes

The following are the standard prefixes for the SI units

Factor	Name	Symbol	Factor	Name	Symbol
1024	yotta	Y	10-1	deci	d
1021	zetta	Z	10-2	centi	c
1018	exa	E	10-3	milli	m
1015	peta	P	10-6	micro	μ
1012	tera	T	10-9	nano	n
109	giga	G	10-12	pico	p
106	mega	M	10-15	femto	f
103	kilo	k	10-18	atto	a
102	hecto	h	10-21	zepto	z
101	deka	da	10-24	yocto	y

## AWG Size Guide

AWG Size	Diameter	
	mm	in
6	4.1	0.16
14	1.6	0.063
19	0.91	0.036
22	0.64	0.025
23	0.57	0.022
24	0.51	0.020
26	0.41	0.016

in = inch

mm = milimetre



### Closing words

As you will have hopefully seen the third edition of the Excel Encyclopaedia is packed with information on the Excel solution as well as educational information that will assist you with all aspects of structured cabling.

A digital version of the Encyclopaedia is available to download from [www.excel-networking.com](http://www.excel-networking.com) and the book has been designed so that you can cut and paste information into your own documentation to help you sell and support the Excel solution.

Don't forget to add [www.excel-networking.com](http://www.excel-networking.com) to your favourites and make sure you regularly check on the website to see the latest news and product information.

We would welcome your feedback on the latest edition of the Excel Encyclopaedia and any suggestions that you may have for content to include in future editions – please email [feedback@excel-networking.com](mailto:feedback@excel-networking.com)

Thank you for taking the time to read the Excel Encyclopaedia.

Yours sincerely



**Andrew Percival**

Managing Director



# FloorSpace OR Range

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## Notes



**European Headquarters**

Excel House  
Junction Six Industrial Park  
Electric Avenue  
Birmingham B6 7JJ  
England

**T:** +44 (0)121 326 7557

**E:** sales@excel-networking.com

**Middle East & Africa Headquarters**

PO Box 293695  
Office 11A, Gold Tower  
Cluster I  
Jumeirah Lake Towers  
Dubai  
United Arab Emirates

**T:** +971 4 421 4352

**E:** salesme@excel-networking.com



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