

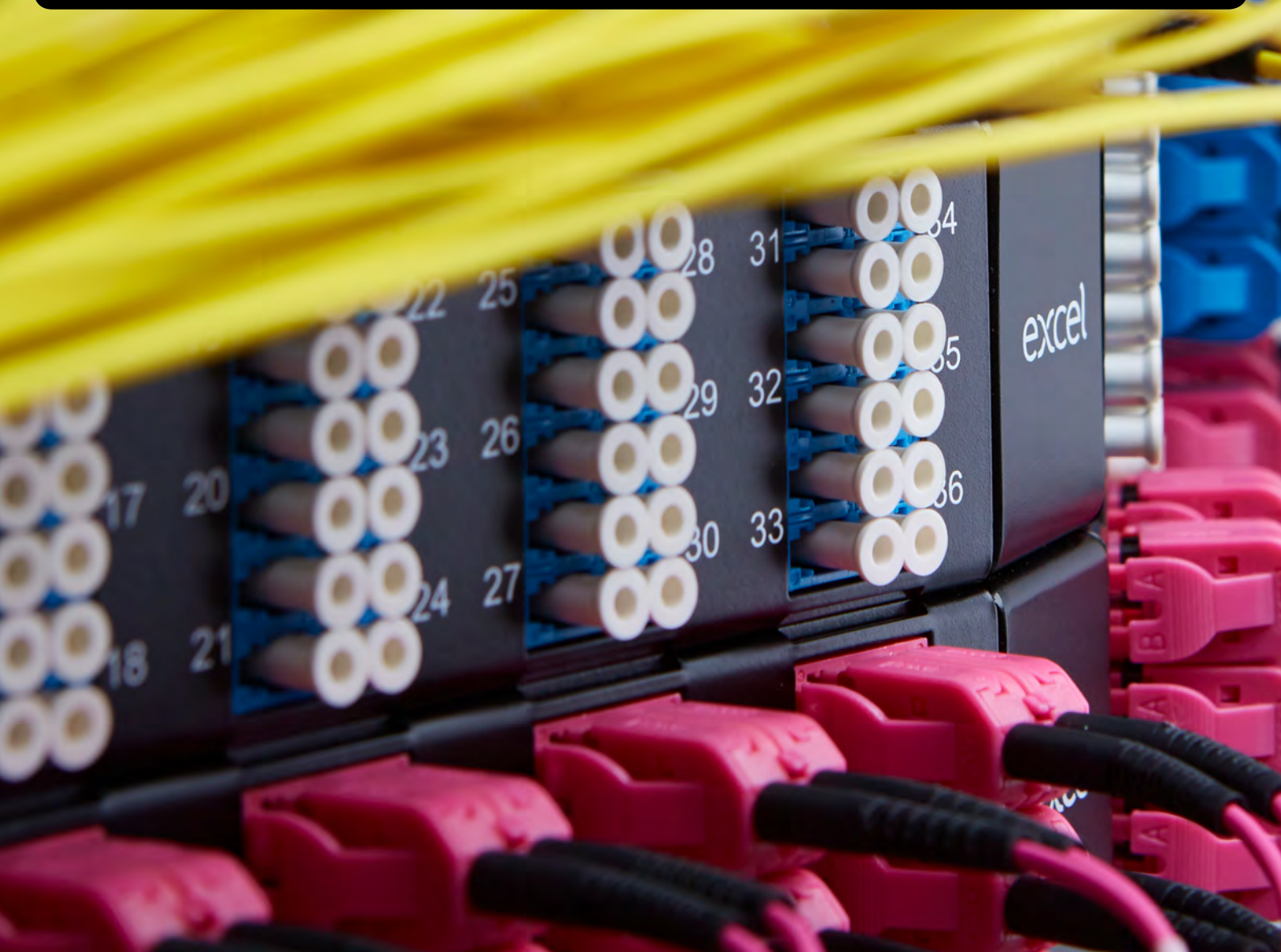
Excel Encyclopaedia Edition 4

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

www.excel-networking.com

January 2018

excel
without compromise.



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Introduction

Welcome to the fourth 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 technical and marketing teams, in this fourth 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.

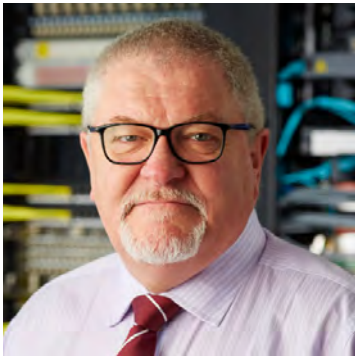
The Excel Encyclopaedia is available in electronic format from the Excel website www.excel-networking.com to allow you to copy and paste the relevant information for your requirements, particularly in the Pre-Sales Support section which provides ready-made specification document templates to assist with complex bids. You can also link through to further information throughout the book.

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.



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The Importance of 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.

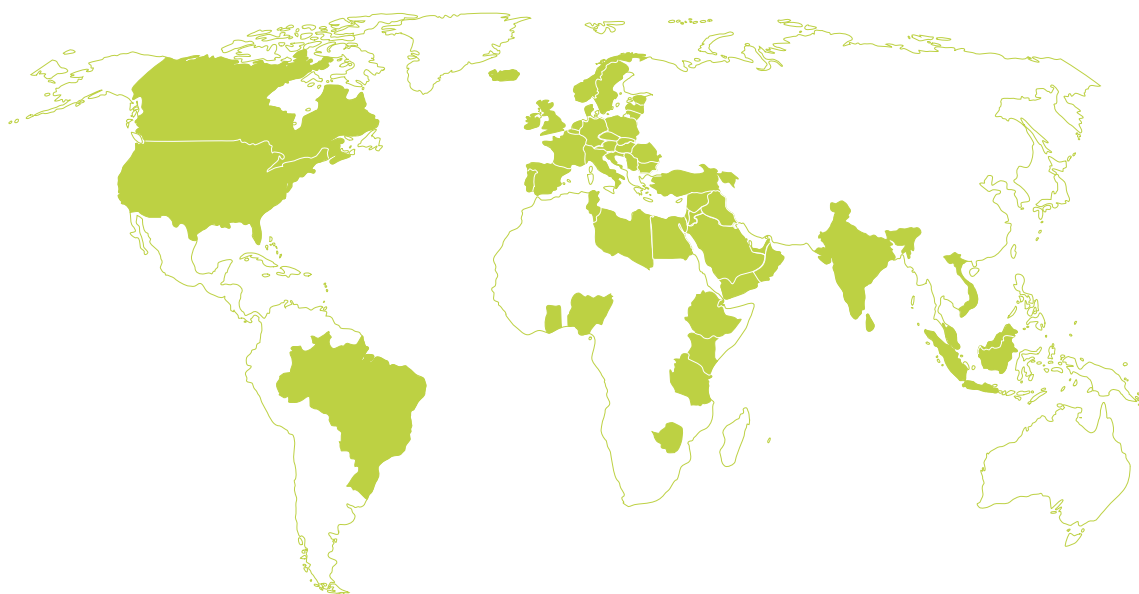
Introducing Excel

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, predominately across EMEA with customers supported by Excel offices in the UK and Dubai but now also expanding into North America, North & South East Asia and the Asia Pacific region.

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

Excel is able to deliver this mix as a result of strict European quality assurance and a growing base of distributors and integrators across the World, 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 data centres, government, enterprise, education and commercial installations.



Excel Features and Benefits

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

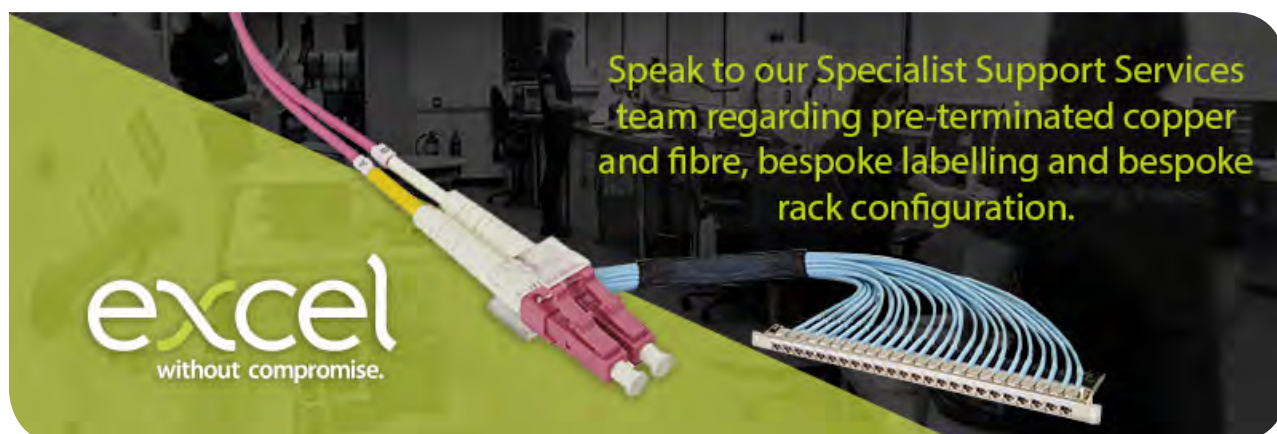
Items shown with an * may not be currently available outside of the UK.

Products	Excel	Alternative
CPR Compliant - Copper and Fibre exceed the required standard. We offer Cca, s1b, d1, a1	✓	
Complete end-to-end Copper, Fibre and Rack Solution	✓	
Copper Structured Cabling System in a choice of, Category 8, Category 7 _A , Category 6 _A , Category 6 and Category 5e (screened & unscreened)	✓	
Pre-terminated Copper Solutions	✓	
Angled Toolless Jacks - ideal for high density applications	✓	
High density Solutions including the 0.5U and V Panel	✓	
Smallest Category 6 _A screened module on the market - Just 28mm in depth	✓	
The Category 6 _A U/FTP cable is just 6.7mm in diameter and allows the installation of 12% more cables in containment than a typical 7.1mm diameter product	✓	
Enbeam Fibre Optic System in a choice of Multimode and Singlemode	✓	
Enbeam MTP Fibre Optic Solution in a choice of Multimode and Singlemode	✓	
The Enbeam MTP offering is based around the US Conec Elite® connector	✓	
Enbeam Fibre Optic Pre-terminated Solutions	✓	
Blown Fibre Solutions in Multimode and Singlemode	✓	
Fibre cleaning range	✓	
Enbeam Fibre Trunking	✓	
Environ Rack and Open Frames - wall, floor and server racks (up to 47U & 1200mm deep)	✓	
Environ CL Co-Location Racks	✓	
Environ Locking Solutions	✓	
Power Distribution Units (PDUs) – Standard, Modular and Intelligent	✓	
Single Residential Solution	✓	
Voice Cabling	✓	
Bespoke Engraved Labelling	✓	

Quality Management	Excel	Alternative
25 Year Product and Application Warranty across all Copper, Fibre, Voice Systems and Racks	✓	
Third Party Verification from leading test houses Delta and ETL	✓	
Category 6 and 6 _A carry both component and channel performance Third Party Verification	✓	
CPR compliant	✓	
ISO9001: 2015 Accreditation	✓	

X Introduction

Services	Excel	Alternative
Online warranty application process	✓	
Warranty applications processed within 5 working days	✓	
Free Next day delivery to the UK mainland *	✓	
Choice of timed & same day deliveries *	✓	
Placement Plus Delivery Service - racks placed in final location & packaging removed *	✓	
Order between 8.00 a.m. and 8.00 p.m. for next day delivery in the UK *	✓	
Trade Counter at Birmingham UK Headquarters open 6am to 6pm *	✓	
Free labelling software	✓	
Bespoke engraved labelling service	✓	
Faceplate printing service	✓	
Rack Configuration Service – in-house built to specification service	✓	
In-house Pre-terminated copper and fibre service	✓	
Pre-Sales Support from product selection to design support	✓	
Cut to length cable service	✓	
Available throughout EMEA	✓	
Extensive Stock Availability	✓	
Partner Programme	✓	
Finance options *	✓	
Toolbox Training *	✓	
Audit Overview *	✓	



Marketing\Collateral Information	Excel	Alternative
Winner of the Network Computing 'Cabling Supplier of the Year' Award for 6 years in a row	✓	
Numerous reference sites - visit www.excel-networking.com for a full list	✓	
Case studies across multiple verticals	✓	
Comprehensive multilingual website www.excel-networking.com	✓	
Powerpoint and iPad partner slide presentations	✓	
Online Specification Sheet Generator	✓	
Branded Literature – Excel Partners can brand literature with logo and address details	✓	
Partner Area – includes warranty application and technical documentation	✓	
Literature – includes brochures, catalogues, specification sheets	✓	
White Papers	✓	
'How To' Videos	✓	
Blog	✓	
Installation Guidelines	✓	
Encyclopaedia Reference Manual	✓	
Delta Verification Certificates	✓	
Excelerator Pre-terminated fibre configurator	✓	
Excel containment sizing calculator	✓	

Creating a truly connected home

Make homes future ready with the Excel residential cabling solutions.



Click here for more details or speak to the team for further details.

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Excel Brand Values



- **Proven:** Standards compliant products, CPR compliant, with third party independent verification from test houses such as Delta , ETL and 3P.
- **Accepted:** Numerous reference sites across EMEA, including many 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, residential & voice cabling systems.
- **Flexible:** From Category 3 through to Category 8 copper cabling and Enbeam fibre optical systems from conventional multimode OM1 to OM5 and Singlemode OS2 to pre-terminated high density MTP and highly flexible blown fibre systems, Residential, Racks, Locking Solutions and Intelligent Power Distribution Units.
- **Reliable:** EMEA wide partner programme, 25 year warranty programme, pre and post sales technical support, 22 year plus product development programme, third party verification as standard on all key solutions.
- **Available:** Worldwide stock availability via Excel Distribution Partners for immediate delivery.

Excel Award Winning System

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

 <p>INTELLIGENT CIO TECHNOLOGY EXCELLENCE AWARDS 2016</p> <p>INTELLIGENT CABLING VENDOR OF THE YEAR LOGO</p>	 <p>NETWORK computing AWARDS 2016</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>	 <p>NETWORK computing AWARDS 2015</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>
Intelligent CIO Technology 2016	Network Computing 2016	Network Computing 2015
 <p>NETWORK computing AWARDS 2014</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>	 <p>NETWORK computing AWARDS 2013</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>	 <p>NETWORK computing AWARDS 2012</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>
Network Computing 2014	Network Computing 2013	Network Computing 2012
 <p>WINNER 2012</p> <p>COMMS EXPO AWARDS</p> <p>20th - 21st June 2012 London</p>	 <p>NETWORK computing AWARDS 2011</p> <p>★ WINNER ★</p> <p>CABLING SUPPLIER OF THE YEAR</p>	 <p>View our Awards</p>
Comms Expo 2012	Networking Computing 2011	

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.

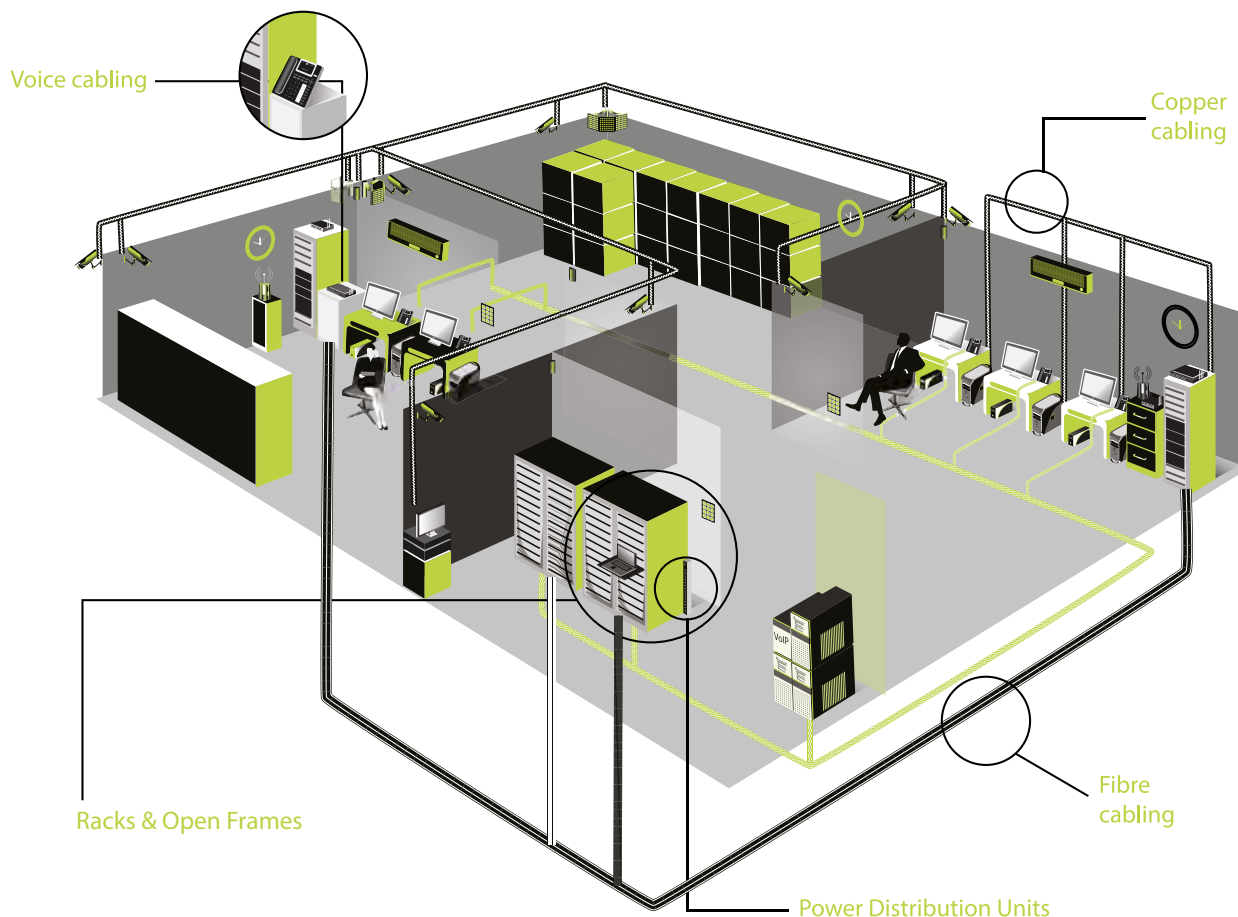
Excel is accredited to provide a series of courses covering different aspects of structured cabling for use by CIBSE members within the Continuing Professional Development (CPD) programme.

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 or can email cibse@excel-networking.com for further information.

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_A U/UTP, U/FTP and F/FTP
- Category 7_A S/FTP
- Category 8
- Pre-Terminated Solutions

Fibre

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

Residential

- Cables and Patch Leads
- Patch Panels
- Enclosures
- USB, HDMI, SVGA Cables
- AV Inserts

Voice

- Internal Grade Cabling
- External Grade Cabling

Racks & Open Frames

- Environ® CR (Comms) Racks
- Environ® ER (Equipment) and SR (Server) Racks
- Environ® CL (Co-Location) Racks
- Environ® 2 Post Racks
- Environ® Wall Mount Racks
- Environ Locking Solutions
- 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.

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 three of our approved Excel manufacturing facilities:

Watch the processes at our manufacturing facilities



Copper production
Physical foam PE Machine

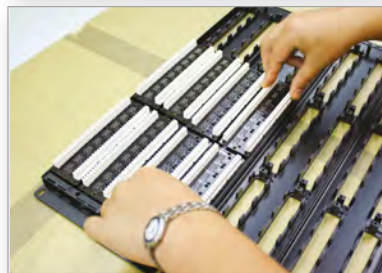


Copper production
HDMI high density quality (foam) machine



High frequency network analyser

Patch Panel Assembly Line
100% Testing



Pairing Machines



Semi-finished Product
(Insulation Wire)



Fibre Panel Production



Environ House



Environ House, Birmingham UK

Environ House was opened in January 2014 and provides a 16,000 sq ft warehouse, office and training 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, demonstrations and training. We can also arrange for a tour of the Environ assembly area if required.



View our Rack Building Facility
in Birmingham!



Excel's Pedigree

The Excel brand is owned by Mayflex who are part of the Sonepar Group.

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 £130 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.

In April 2015 Mayflex was acquired by Sonepar, an independent family-owned company with global market leadership in B-to-B distribution of electrical products and related services. Sonepar has €20.6 billion of revenue and is represented by 239 entities operating in 44 countries on five continents with 43,000 associates.



Excel House, Birmingham UK

Mayflex Middle East and Africa

Our Middle East and Africa (MEA) office is based in the international hub of Dubai in the United Arab Emirates. Located in Jumeirah Lakes Towers, serviced by a team of 20, consisting of Sales, Technical Support, Sales Support, Finance and Logistics. Supporting customers across the region, the experienced team focus on projects across many verticals, including, hospitality, government, retail, commercial and residential.

Customers are serviced by a global 3rd party logistics facility located in the Jebel Ali Free Zone, which is situated next to the Jebel Ali port, the biggest and busiest port in the Middle East. The 3rd party warehousing facility utilised by Mayflex is a 24/7 operation, with a stockholding of 144,000 m3 equating to 130,000 pallet locations. Services provided by the 3PL include, warehousing and distribution, land transport, freight services and customs & other government related business support. The 3PL also offer Value Added Services (VAS), which includes, floor & wall cabinet assembly and cable cutting. A local collection facility is also available to Dubai based customers.

Excel acknowledges the provenance of all trade names, brand names and registered names or marks referred to within the Encyclopaedia.

Excel and the Environment

Corporate and Social Responsibility

At Excel we recognise that good CSR embraces all aspects of sustainable development and the way we affect people through our business operations. We build our business for the long term by balancing social, environmental and economic considerations in the decisions we make. We are committed to ensuring that our business is conducted in all aspects according to rigorous ethical, professional and legal standards, by:

- Continuous improvement in our Corporate and Social Responsibility strategy
- Encouraging our business partners to strive for matching performance
- Acting in a socially responsible way
- Continually improving our performance and meeting all relevant legislation
- Encouraging our staff to be mindful of the effect of their actions on any natural resource

Supply Chain Code of Conduct

For the above reasons Excel is committed to ensuring that its suppliers adhere to the highest standards of ethics. Suppliers are therefore required to demonstrate that they provide safe working conditions where necessary, treat workers with dignity and respect, and act ethically and within the law in their use of labour.

We work with our suppliers to avoid complicity in human rights violations related to our own operations and our products.

Environmental Policy

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

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

1. Comply fully with all relevant environmental legislation, regulations and other relevant requirements.
2. Identify the significant environmental impacts of our business and review them on an ongoing basis to ensure they are still relevant to our business model and locality.
3. Work with our 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 our employees and supply partners only.
6. Ensure that we retain our ISO 14001 Certification on an ongoing basis.
7. Commit to continual improvement aimed at enhancing the environmental performance, protection of the environment and prevention of the pollution.

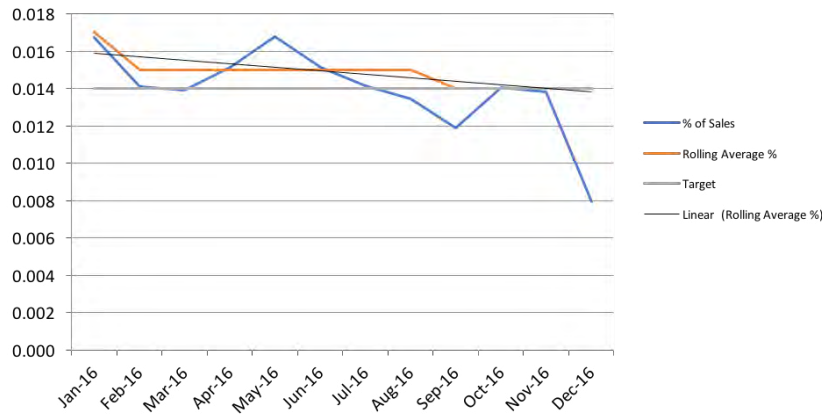
Excel Environmental Objectives, Targets and Initiatives

After analysing our environmental aspects and impacts, we have introduced several objectives towards which our performance is constantly monitored and yearly measured.

Our environmental objectives are:

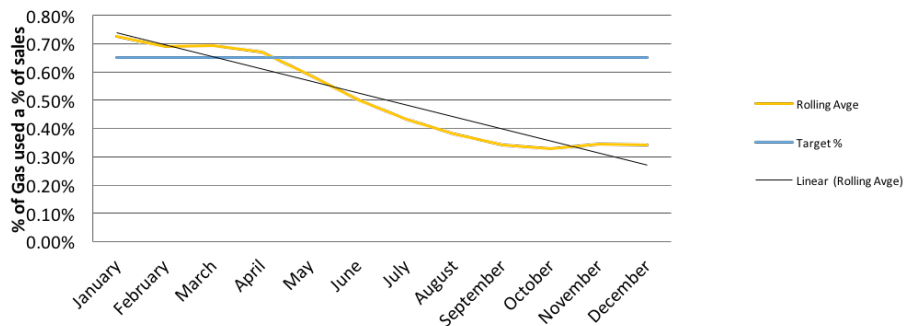
- Paper consumption to be kept at or below 0.014% of the overall turnover

Paper Printed as % of Revenue 2016



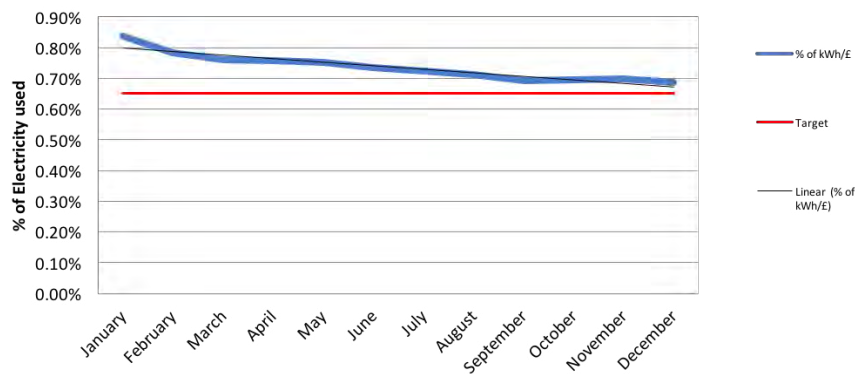
- Gas consumption to be kept at or below 0.65% of the overall turnover

Gas Consumption as % of Sales Revenue 2016



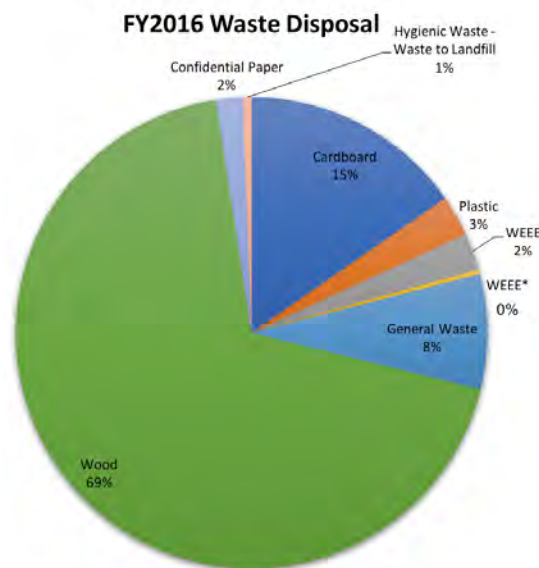
- Energy consumption to be kept at or below 0.65% of the overall turnover

Electricity Consumption as % of Sales Revenue 2016



Introduction

- Waste to landfill to be brought to 0%



The above long terms objectives are pursued through short terms targets and process related initiatives like increasing of electronic invoicing to 35% of overall customer base, increasing the level of orders received through the web by 20%; separate receptacles for the disposal and recycling of paper, tins/cans and plastic bottles around the offices and operations areas, energy efficiency LED lighting introduction, etc.

In particular:

We aim at reducing our packaging and waste through our waste management programme.

Our goal 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 to recycle all our waste cardboard, paper, plastic and wood.

In 2016 we recycled and reused almost all our waste and only 0.556% of the total went to landfill.

A Solid and Dependable Environmental Responsibility Programme allows Excel to continually review and reduce 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 our literature being produced on paper made from recycled fibres.

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

Being a supplier of electrical and electronic equipment, Excel has implemented a WEEE Compliance programme, which shows our transparent and compliant approach to our ethical and environmental responsibility. As per European Union's Waste Electrical and Electronic (WEEE) Directive, all EE products 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.

REACH and ROHS Compliance

Both REACH and ROHS are regulations of the European Union aiming at the protection of human health and the environment from the risks that can be posed by certain chemicals and hazardous substances.

Excel is fully compliant with the above regulations and has put in place appropriate measures to ensure compliance for its supply chain.

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



Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2015

This is to certify that:

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

Holds Certificate No:

FS 547274

and operates a Quality Management System which complies with the requirements of ISO 9001:2015 for the following scope:

Stockholding, product sourcing, supply, assembly and testing of configured cabling infrastructure, networking products, IP Security products, from quality assured sources without lot traceability. The design and manufacture of end-to-end infrastructure solutions, copper and optical structured cabling as well as components, panels and enclosures. The assembly of pre-terminated copper and fibre solutions, configured enclosures and panels as well as other customized specific solutions.

For and on behalf of BSI:

Andrew Launn, EMEA Sys Cert Ops & Compliance Director

Original Registration Date: 2009-03-06

Latest Revision Date: 2017-09-30

Effective Date: 2015-01-28

Expiry Date: 2018-01-27

Page: 1 of 2



...making excellence a habit.™

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](http://www.bsi-global.com/ClientDirectory).
Printed copies can be validated at www.bsi-global.com/ClientDirectory or telephone +971 (4) 3364917.

Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 345 080 9000

BSI Assurance UK Limited, registered in England under number 7805321 at 389 Chiswick High Road, London W4 4AL, UK.

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 14001:2015

This is to certify that:

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

Holds Certificate Number:

EMS 542863

and operates an Environmental Management System which complies with the requirements of ISO 14001:2015 for the following scope:

Stockholding, product sourcing, supply, assembly and testing of configured cabling infrastructure, networking products, IP Security products, from quality assured sources without lot traceability. The design and manufacture of end-to-end infrastructure solutions, copper and optical structured cabling as well as components, panels and enclosures. The assembly of pre-terminated copper and fibre solutions, configured enclosures and panels as well as other customized specific solutions.

For and on behalf of BSI:

Andrew Launn - EMEA Systems Certification Operations and Compliance Director

Original Registration Date: 19/11/2009

Latest Revision Date: 13/04/2017

Effective Date: 24/04/2015

Expiry Date: 23/04/2018

Page: 1 of 2



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An electronic certificate can be authenticated [online](http://www.bsigroup.com/ClientDirectory).
Printed copies can be validated at www.bsigroup.com/ClientDirectory

Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 345 080 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 Registration No. RM06302

has fulfilled their **recycling and recovery obligations**
for the **2016** 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 and helps safeguard resources.

Your contribution has helped the UK to achieve the recovery of 8,191,549* tonnes of packaging during 2016.

*National Packaging Waste Database (NPWD)



Construction Products Regulation (CPR)

Section 2

In this Section:

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FLAMES



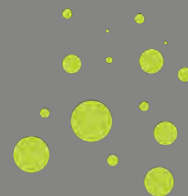
HEAT



SMOKE



DROPLETS



ACIDITY



What is CPR?

The Construction Products Regulation (CPR) replaced the original Construction Product Directive in 2011. To give it its formal name 'EU/305/2011' its reach has broadened over time, in terms of the products that it applies to. In 2016 a series of characteristics relating to a cables reaction to fire were published. This led to legislation that sets out to harmonise these characteristics across all EU countries, via a classification structure.

When will this happen?

The A period of "co-existence" began on 1st June 2016 and operated for 12 months. From 1st July 2017, cables that are within scope and placed onto the EU market must meet CPR requirements. Products in the market prior to 1st July 2017 and not CE-marked can be sold and installed without breaching CPR, however anything placed in the market after this date must adhere to the regulation.

Why the update?

Every year, many people die or are seriously injured as a result of building fires across the European Union. In 2015/16 in the UK alone, 17% of building fires were caused by Structures and Fittings within a building. Proportionally, 10% of casualties and 4% of deaths were caused by fire as a result of structures and fittings* hence the importance of ensuring that all permanently installed cables are regulated to be as safe as possible to protect lives.

Ultimately the objective of CPR is to improve building safety by creating a common set of performance characteristics at national level to ensure everyone in the supply chain complies with the same set of standards.

CPR is key for saving lives, helping to provide a safer environment by creating maximum timeframes for people to evacuate a building in the event of a fire.

*(Source: FIRE0604: Primary fire fatalities and casualties by material responsible for development of fire, Gov.uk, July 2017).

Which products are affected?

Any cable which is deemed to be permanent once installed is within the scope of CPR, covering power, data and communications cables. In the case of data and communications cables, copper, fibre, coax, and multi-conductor cables are covered, with the exception of patch leads.

Who is affected?

It is the legal responsibility of the manufacturer, distributor, or wholesaler to ensure products entering the supply chain meet the requirements of the directive, and in turn any minimum Euroclass required within a specific country or market. Each layer of the supply chain, from factory through distribution, to specifier and installer of the products in scope have clear responsibilities to ensure market compliance with CPR. These are summarised below:

Manufacturers

- Ensure that products are tested and classified.
- Ensure that the Declaration of Performance (DOP) is made available to the purchaser.
- Ensure that the product label carries the appropriate CE-Mark to EN 50575 standard, Euroclass, DOP ID, Notified Body ID and scheme of Assessment.

Distributors

- Ensure that cable supplied is accompanied with all required regulatory documents.
- Ensure not to supply any product that they deem not to conform to its declared performance.
- Ensure that products they believe do not meet either/both CPR or country specific minimum Euroclass requirements are withdrawn from the market.
- Ensure product traceability is transparent and documentation such as DOPs are easily and freely accessible via web sites and catalogues.
- Alert authorities to any cables they believe are being sold in the market that do not meet either/both CPR or country specific minimum Euroclass requirements.
- Store and transport cables as not to ruin conformity.

Specifiers

- Ensure technical specifications and tenders clearly state the required minimum Euroclass appropriate to the country or vertical market minimum requirement, as determined by regulators, standards bodies, or client.
- In the UK the minimum Euroclass is defined in BS6701:2016 +A1:2017 and is stated as Cca, S1b, d2, a2.

Installers

- Ensure that all installed cable is correctly marked and accompanied with correct DOP.
- Ensure technical specifications and tenders requirements are met, adhering to the minimum Euroclass appropriate to the country or vertical market minimum requirement, as determined by regulators, standards bodies, or client.
- If in doubt, contact the distributor or manufacturer for advice.

CPR Characteristics

The CPR update means performance tests on a cable's reaction to fire will now be performed on; flame spread, heat release, smoke production, light transmittance, flaming droplets and acidity. Cables will be categorised according to their performance level denoted by unique classification codes. In general the higher the performance class the higher the cable cost, due to differences in materials used, cable design and certification process (see pages 26 and 27 of this chapter), as has previously been seen when comparing PVC and LSOH cables.

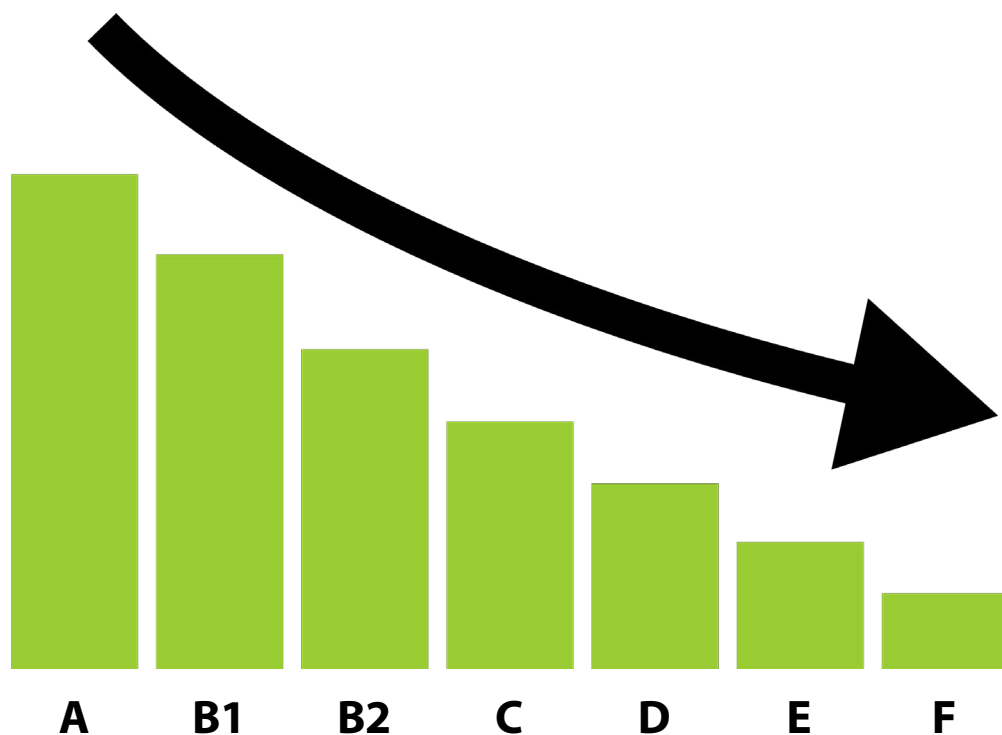
	Additional Requirements							
Flames		Aca	B1ca	B2ca*	Cca	Dca	Eca	Fca
Heat		Aca	B1ca	B2ca*	Cca	Dca	Eca	Fca
Smoke	s			s1a	s1b	s2	**	
Droplets	d			d1	d1	d2	**	
Acidity	a			a1	a1	a2	**	

HIGH ← Fire retardance → LOW

The above categorisation elements will be specified to form a complete Euroclass reference for ordering and specification purposes, for example Cca, S1b, d1, a1.

*We do not expect that communication cables will ever be above B2ca

** No Requirement



Smoke Production Explained



The levels of Total Smoke Production (TSP) and the Smoke Production Rate (SPR) determine how quickly people will be able to find their way out of a building easily in the event of a fire. By measuring the smoke density of burning cables and evaluating the levels of light that can be transmitted in a test environment, the different levels of visibility are clear.

The exposure period shall originate from the test with 20,5kW flames.

Smoke Production Classification	Measurement	Test Period
s1	TSP1200 ≤ 50 m2 Peak SPR ≤ 0.25 m2/s50 m2 Peak SPR ≤ 0.25 m2/s	20 minutes
s2	TSP1200 ≤ 400 m2 Peak SPR ≤ 1.5 m2/s	20 minutes
s3	Products for which no performance is declared or where the product does not comply with either 's1' or 's2'.	-
Additional Testing (in accordance with EN61034-2)		
s1a	s1 and transmittance ≥ 80%	20 minutes
s1b	s1 and transmittance 60% < 80%	20 minutes

Legend: TSP = Total Smoke Production SPR = Smoke Production Rate

Note: Having just s1 is not sufficient to meet the requirements of most countries in Europe including the UK who have specified the additional testing requirements of s1b for Cca class cables.



Flaming Droplets Explained

The flaming droplets segment of the classification determines the risk of personal injury during evacuation from falling flames. Additionally, the different levels indicate the potential for secondary fire sources being created by flaming droplets falling from the burning cables.

The exposure period shall originate from the test with the 20,5 kW flames.

Flaming Dropets Classification	Measurement	Test Period
d0	No flaming droplets occur (droplets may fall but they must not be alight)	20 minutes
d1	No flaming droplets occur for longer than 10 seconds (these droplets may happen but they must self-extinguish within 10 seconds)	20 minutes
d2	Products for which no performance is declared or where the product does not comply with either 'd0' or 'd1'.	-

Acid Gas Explained

The levels of acid gas determine a person's ability to breathe properly during a fire evacuation without choking. Levels of acid gas are assessed in accordance with EN 60754-2 and have two values; conductivity and acid gas.



Acid Gas Classification	Measurement
a1	<2.5 µS/mm pH value of > 4.3
a2	<10 µS/mm pH value of > 4.3
a3	Products for which no performance is declared or where the product does not comply with either 'a1' or 'a2'.

Legend:

µS = Micro Seimens (conductance or a measure of dissolved solids in a liquid)

pH = Potential for Hydrogen (the scale of acidity)

Euroclass Criteria






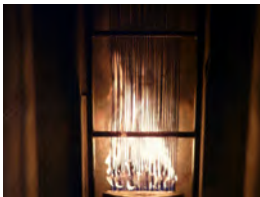
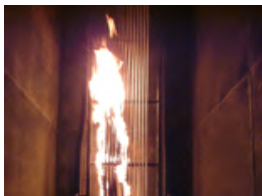

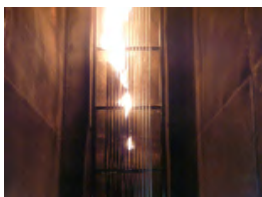
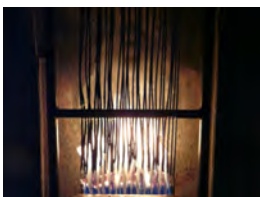
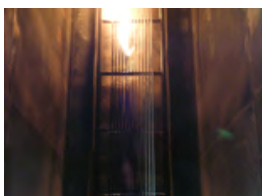
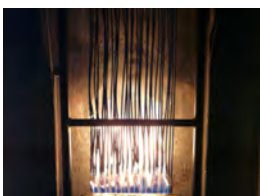
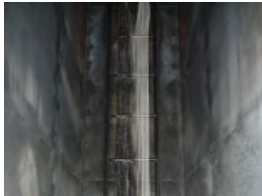

Euroclass (ca)	Classification Criteria	Additional Criteria	Attestation of conformity system
A	EN ISO 1716 Gross heat of combustion		1+
B1	EN 50399 Heat release Flame spread	Smoke production* (s1a, s1b, s2, s3) EN50399/EN61034-2	Initial type-testing and continuous surveillance with audit testing of samples by 3rd party certification body factory production control (FPC) by manufacturer
B2		Acidity (a1, a2, a3) EN 50267-2-3	
C			
D	EN 50575 Flame propagation	Flaming droplets (d0, d1, d2) EN 50399	3 Initial type testing by 3rd party laboratory
E	EN 50575 Flame propagation		FPC by manufacturer
F			4 Initial type testing and FPC by manufacturer

*EN50399 covers the test for s1,s2 & s3, which covers smoke production. EN61034-2 is an additional test carried out for s1 only, to define the density of the smoke produced, hence s1a.

The Importance of Choosing a Euroclass

When selecting a CPR-compliant cable, it is important to consider which Euroclass to select. Each member state has their own national minimum standards which installations must comply with - this will be discussed in more detail throughout this chapter - however the following images in the table show the difference between two differently classified cables, which gives a strong indication of the retardance to fire and the impact that a fire could cause.

EN50399 Flame FS Requirement: B2ca ≤ 1.5 ; Cca ≤ 2.0 ; Dca: no requirement

Time	Dca Example	B2ca & Cca Example
Before test		
1 minute		
3 minutes		
5 minutes		
10 minutes		
17 minutes		
After test		

Euroclass by Country

All EU member states must comply with the new CPR regulation according to their national minimum standards, which may be dependent upon the installation environment. Respective requirements could depend on the type of building and potential risk based on usage and occupancy. Each country, local client and end users will specify their Euroclass requirements based on this guidance and/or local standards or regulation.

Please contact your local Excel Sales Representative or our team at the UK Head Office for country specific advice.


Proving Compliance


The regulation defines clear process and requirements for proof of compliance to a specific Euroclass. This begins with independent testing of a product against the desired Euroclass performance. Once independent verification has been received, an item specific Declaration of Performance (DOP) is issued and approval given to label the product with specification, standards and DOP reference to enable traceability. All manufacturers and distributors MUST be able to provide this documentation and provide a correctly labelled product to comply with industry standards.



The degree of testing required is dependent on the Euroclass to which the declaration is required. At the lower end of the range, for example Eca and Dca, product samples are tested, whilst at the higher end – from Cca and above – this test process includes both a factory audit and product test. An example DOP is included below. Copies of these are also available in relevant product and [technical sections](#) of the Excel website product pages.

EN50575:2014 + A1:2016 also defines clearly the labelling requirements for CPR compliant product, regardless of Euroclass. Product labelling should be fixed to the box or drum of cable supplied and clearly show the following together with any market or manufacturer specific markings.

- The CE mark
- Euroclass
- DOP Reference Number
- Assessment scheme and notified body that completed the testing

 0199
Excel Excel House, Junction 6 Industrial Park Electric Avenue Birmingham, B6 7JJ UK 17 DOP-EXL222
EN 50575:2014 + A1:2016 100-074 Supply of communication in buildings and other civil engineering works with the objective of limiting the generation and spread of fire and smoke Reaction to Fire: D Additional Requirements S2, d2, a2 Dangerous substances: none

		<table border="1"> <tr> <td>Page</td> <td>1/2</td> </tr> <tr> <td>Doc No.</td> <td>DOP-EXL305</td> </tr> </table>	Page	1/2	Doc No.	DOP-EXL305
Page	1/2					
Doc No.	DOP-EXL305					
Declaration of Performance						
1 - Unique identification code of the product-type: 190-071						
2 - Type, batch or serial number or any other element allowing identification of the construction product as required The type number of 190-071: see the print on the cable or sticker on the box						
3 - Intended use or uses of the construction product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer: Supply of communication in buildings and other civil engineering works with the objective of limiting the generation and spread of fire and smoke						
4 - Name, registered trade name or registered trade mark and contact address of the manufacturer as required under Article 11(5): Excel Excel House, Junction Six Industrial Park Electric Avenue, Birmingham, UK, B6 7JJ Tel : +44 (0)121 326 7557 Fax : +44 (0)121 326 1537 e-mail : CPR@excel-networking.com						
5 - Where applicable, name and contact address of the authorized representative whose mandate covers the tasks specified in Article 12(2): N/A						
6 - System or systems of assessment and verification of constancy of performance of the construction product as set out in CPR, Annex V: System 1+						
7 - In case of the declaration of performance concerning a construction product covered by a harmonized standard: Notified product certification body No. 0200 performed the determination of product type, the initial inspection of the manufacturing plant and of FPC, the continuous surveillance, assessment and evaluation of the FPC and the audit testing of samples taken before placing the product on the market and issued the certificate of constancy of performance.						

		<table border="1"> <tr> <td>Page</td> <td>2/2</td> </tr> <tr> <td>Doc No.</td> <td>DOP-EXL305</td> </tr> </table>	Page	2/2	Doc No.	DOP-EXL305					
Page	2/2										
Doc No.	DOP-EXL305										
8- Declared performance											
<table border="1"> <thead> <tr> <th>Essential characteristics</th> <th>Performance</th> <th>Harmonized technical specification</th> </tr> </thead> <tbody> <tr> <td>Reaction to fire</td> <td>Cca, s1a,d1,a1</td> <td>EN 50575:2014 + A1:2016</td> </tr> <tr> <td>Dangerous substances</td> <td>None</td> <td></td> </tr> </tbody> </table>	Essential characteristics	Performance	Harmonized technical specification	Reaction to fire	Cca, s1a,d1,a1	EN 50575:2014 + A1:2016	Dangerous substances	None			
Essential characteristics	Performance	Harmonized technical specification									
Reaction to fire	Cca, s1a,d1,a1	EN 50575:2014 + A1:2016									
Dangerous substances	None										
The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 8. This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.											
Signed for and on behalf of the manufacturer by:											
Name: Paul Cave RCDD, RTPM, CDCDP Position: Technical Product Manager											
Signature: 											
Place & Date: Birmingham, UK, 24/10/2017											

View our
DOP List

Excel Networking Solutions and CPR

Excel customers can rest assured that our copper and fibre cabling solutions meet a wide range of application and EU member state requirements. Our sales and technical support teams have an extensive knowledge of CPR requirements, and how the changes will impact upon our customers, so we are able to provide you with the right advice to ensure your installations are compliant.

All products supplied by Excel into the EU market since 1st July 2017 are CPR compliant. We demonstrate this through certificates known as Declarations of Performance (DOPs) (available on the [Excel website](#), through labelling on product packaging, printing in the legend on the outer sheath of the cable jackets, or by the product being placed on the market prior to this date. A product's Euroclass will also appear on all Excel Networking specification sheets and in forthcoming editions of the product catalogue, along with sub-classifications for smoke development, flaming droplets and acidity.

When purchasing products in scope of the Regulation it is advisable to request suppliers to provide confirmation of compliance by means of a DOP or to demonstrate that the product was placed on the market prior to 1st July 2017. Inability to meet either of these requests should cause alarm and we would recommend a 'proceed with caution' approach. Note that a DOP is a legal requirement if a product is claimed to meet and have been independently tested to a specific Euroclass.

A product should not be purchased if this claim is made and a DOP cannot be provided with a matching part code and description to the part in question.

Excel has adopted a transparent approach to providing the market with relevant information, updating its data sheets and web content to include clear references to the Euroclasses that each product meet, and DOPs for each item.

For more detail on the Regulation please refer to the Excel website, contact your local Excel distributor or installer, or contact us directly.

Support

Our expert sales teams can give you a clear vision of the products you need with the correct documentation, advice and installation tools.

Clarity

A consistent labelling system across all Excel cabling products aim to satisfy the requirements of CPR by denoting ten specific parameters: the Excel logo and address details, the product part number, the CE marking, the year of initial certification, the classification of reaction to fire, the reference to the standard, the certification body, the ID of the Declaration of Performance and the intended use of the cable. This label layout is consistent across all infrastructure products supplied by Excel, showing all mandatory information making it easier to explain to customers.

Ready

The Excel team have been preparing for the introduction of CPR since early 2016, as a result we are ready to meet multiple Euroclass and country specific minimum requirements, from Eca through to B2ca.

We have stock of unscreened, screened copper cables and multi and single mode fibre optic cables. We have already successfully delivered a number of UK and International projects to Cca class and above.

On Time

Excel products across the range of copper and fibre solutions already exceed the minimum requirement of related country specific standards. For example, in the UK we exceed the requirements of BS6701:2016+A1 2017, as we offer Cca, s1b,d1,a1 as standard. It is important when considering vendor offerings to ensure this full Euroclass is met and all required paperwork and labelling is in order.

Excel and Market Adoption

As one of Europe's largest suppliers of copper and fibre cabling systems, Excel is ready for the changes to cable specifications made necessary through the introduction of CPR and amendments to the UK-specific BS6701 standard.

We have a full suite of products, stock across Europe, and a range of educational and support documents, together with a trained sales and pre-sales team alongside subject matter experts that were part of the working party that developed the BS6701 amendment.

At the time of writing this advisory note (January 2018) it is clear some parts of the supply chain are not equipped to meet these new specifications, specifically those stated in the BS6701 amendment.

This may delay market adoption, which is unfortunate when we consider the principle driver behind these changes was people's safety.

If you are involved in writing or defining specifications it is advisable to check documentation to ensure that – as a minimum – references to BS6701 are updated to reflect the most recent issue. This should be stated in full as 'BS6701:2016+A1:2017' thus ensuring your advice to clients, or cabling installed within your premises are compliant with current best practice.

It is encouraging to see responsible and specification-aware integrators, consultants, and end-user clients beginning to introduce this reference to current standards in tenders. With this approach likely to increase across the market and vendors such as Excel providing compliant products, market adoption should build during 2018.

The UK Market and Minimum Euroclasses

It is the responsibility of each EU member state to define the recommended minimum Euroclass for installations within its market.

The UK market is currently unregulated and therefore no government or independent body owned this responsibility when the regulation became a legal requirement on 1st July 2017.

Since this time the market has chosen to install CPR compliant products – to meet the legal requirement – which offer performance, commercial and design characteristics similar to the previously specified LSOH cables.

Excel products generally meet Dca.s2.d2.a2 as a minimum, exceeding the minimum requirements offered by other suppliers offering an Eca cable which as we have already identified is not certified for smoke, acid, light or droplet performance.

However, on 30th November 2017 the British Standards Institute issued BS6701:2016+A1:2017, an amendment to the frequently used standard entitled "Telecommunications Equipment and Telecommunications Cabling – Specification for installation, operation and maintenance."

Within this amendment is the requirement to adopt a specific minimum Euroclass in order to comply with this standard.

BS6701:2016+A1:2017 & Minimum Euroclass

The amendment states that the minimum Euroclass for telecommunications cable within scope of CPR shall be Cca.s1b.d2.a2.

It is important to understand that there are varying levels of performance for each of the measured parameters that lead to a product Euroclassification and issuing of DOPs.

For example, within the measurement of smoke a cable may be classified as 'S1' 'S2' or 'S3' – none of which would meet the minimum requirement as stated within the amended BS6701 as these classifications refer only to smoke production, and do not consider light transmittance. When this important parameter is measured, a suffix of 'a' (being the highest possible) or 'b' is added to denote certified performance.

Excel products meet or exceed the minimum requirements defined within BS6701:2016+A1:2017 – across each of the previously mentioned performance categories.

We strongly recommend you ask for DOPs and product specification sheets to confirm whether products offered by alternative suppliers meet each element of the required specification, checking each part of the Euroclass definition carefully.

This check – against a DOP – should confirm independent certification for Cca, for S1b, for d2, and for a2, as a minimum to meet the minimum requirements of the standard. Anything less than this, is quite simply not compliant. For example any product offered as S1 does not meet the standard.

FAQs

Why CPR for cables?

There is currently no harmonised structure for how a cable reacts to fire, therefore resulting in varying safety standards at a national level. The introduction of CPR, and specifically a series of classification criteria, known as 'Euroclasses', creates a common set of performance characteristics, test and documentation processes and a timeline for compliance for all those in the supply chain, from specifiers, through manufacturing and distribution to installation organisations. Ultimately the objective of CPR is to improve in building safety, this will be achieved through this new set of reaction to fire specifications, enabling local regulators and clients to select the performance requirement at national or even project level from the Euroclasses which are defined in EN 50575:2014.

Which products are in the scope?

Any cable which is deemed to be permanent once installed is within scope of the CPR. This covers power, data and communications cables. In the case of data and communications cables copper, fibre, coax, and multiconductor cables are covered, with the exception of patch leads.

What are the time frames?

The transitional period, known as 'co-existence' began on 1st June 2016 and lasted for 12 months. From the 1st July 2017 cables placed on the market that are within scope must meet the requirements of the CPR. Manufacturers of such cables must demonstrate this compliance through Declarations of Performance (DOP) and CE marking applied to either product and/or packaging. The performance requirements to which DOPs are issued against, and the associated processes for certification and labelling are found in the aforementioned EN 50575:2014 specification. Placed on the market is legally defined 'as the supply of the (individual) construction product for the first time within the European Internal Market for distribution or use in the course of a commercial activity.' Product which is in the market prior to the 1st July 2017 and is not CE marked can be sold and installed without breaching the CPR regulation.

What characteristics are tested?

CPR focuses purely on a product/materials reaction to fire. All other performance and specification criteria for cables are defined in separate, established standard or vendor specific documents. In the case of cable, four key characteristics are measured and are central to the classification matrix that customers and regulators will use to specify the minimum and maximum required specification, these are:

- Propagation and heat emission
- Smoke emission
- Burning droplets
- Acid gas emission

The individual performance standard required for each of these four measures is found in the aforementioned EN50575:2014 standard documentation.

How do I ensure I have CPR compliant products?

As previously mentioned processes have been defined within European standards to enable customers to purchase and install product in a confident and traceable manner. Specifically, what are known as Declarations of Performance (DOPs) and a standardised method of labelling on the product packaging. Whilst it is not a requirement to mark products to denote CPR compliance, or the related Euroclass, it is expected that most manufacturers, including Excel will do so. Declarations of Performance (DOPs) are legal documents prepared by manufacturers and are placed in the public domain, following testing by independent organisations known as 'notified bodies'.

How do we meet current, and advise on future customer requirements?

To provide some guidance on this question we need to separate CPR from Euroclass. CPR is EU wide regulation, it is mandatory, product supplied into the market from 1st July 2017, must be CE marked and hold DOPs to confirm testing completed, and certification gained.

Euroclasses provide a range of low to high reaction characteristics, how these are applied will vary from country to country, and in some instances building type to building type. In the majority of countries within the EU the directive over choice of Euroclass will be driven by regulators, or equivalent bodies, and customers should seek this local clarification either via our sales teams, distributors or independent sources.

In the UK, which is not regulated, the market will be driven by related BS standards documents and transition from Eca to Cca as the recommended minimum classification over the coming months.

Please refer to www.excel-networking.com for further updates on CPR.

Excel Copper Structured Cabling Systems

Section 3

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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 categories and classes support different applications. By specifying and installing the correct category/class you are assured that all current and future applications designed for that standard of infrastructure cabling will work.

With the implementation of the Construction Product Regulation (CPR) in July 2017, all permanent structured cabling must pass stringent reaction to fire performance testing and be compliant to the specific CPR requirements as defined by each EU member state. All Excel products have undergone this testing and comply with this new European standard.

To read more about CPR click here.

Category		5e	6	6 _A	7	7 _A
Class		D	E	E _A	F	F _A
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			✓	✓	✓

Note 1: Refer to 'Excel Copper Terminology Explained' for details of the anomalies between the standards.

Note 2: Category 8 has not been included in this chart, because at the time of this Encyclopaedia going into production, ratification was incomplete. Please keep an eye on the Excel website for further clarification

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 EA 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.

Category 8

At the time of writing this version of the Excel Encyclopaedia, developments into a new Category/Class of copper cabling. These developments have now been completed and soon to be ratified by the ISO/IEE in early 2018* and therefore, any products on the market may only meet the draft versions of the time of development. 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.

* For the latest information on Category 8 ratification, please see the [Excel website](#) or contact the team.

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.

The Institute of Electrical and Electronics Engineers (IEEE) 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 is 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 30m made from up to 2 connectors

TIA – the TIA has 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 CENELEC standard, the equivalent is not recognised by the TIA). The TIA have developed 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
- ≤ 2 connectors
- ≤ 30 m Channel

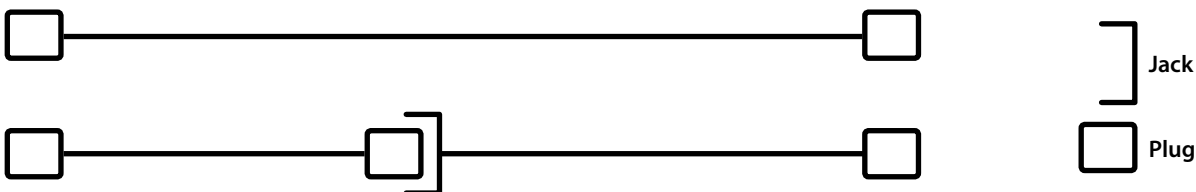
ISO – has existing components that are Category 7_A that forms channels of Class F_A that have a bandwidth of 1000 MHz. ISO are looking to develop two versions to support 40 Gigabit Ethernet. One based on developments of the Class F_A increased to 1600 MHz and the other a 2000 MHz bandwidth. ISO will 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. These channels are likely to have the following attributes:

- 1600 MHz
- ≤ 1 connector
- ≤ 10 m Channel

≤ 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:



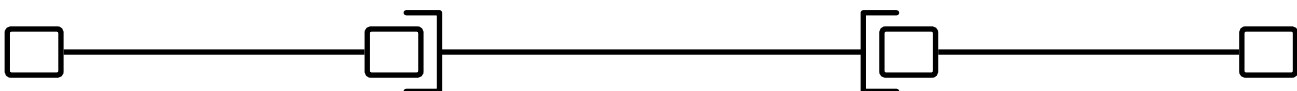
2000 MHz

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
- ≤ 2 connector
- ≤ 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 and will probably reference the ISO version.



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).

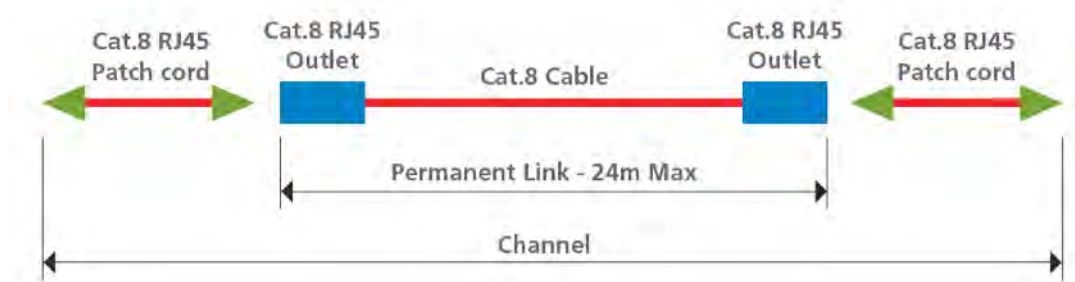
Connector Type

The IEEE require that the connector is standardised on one type. This is to remain as the RJ45 to ensure backwards compatibility with legacy equipment.

As stated earlier in the encyclopaedia Category 8 is still to be signed/ authorised by ISO later this year, however Excel have been working closely with the standards committee allowing us to release the Excel Category 8 system.

The development of Category 8 allows speeds above the traditional speed of Category 6 and 6_A. Back in 2013 the IEEE wanted a 40GbE delivered over twisted pair Copper cable to be known as NGBASE-T (next generation) this resulted in a project known as IEEE 802.3bq being formed to define the applications and needs of the cabling system to support this. Current requirement is for a cabling system to support a channel of up to 30mtr made from 2 connectors or less.

The TIA have announced this system be categorized as Category 8 in 2016 hence Category 8 was born.



With the limit being set at 30mtr it pushes the system toward the data centre market and away from the enterprise and Premise networks. For data centre planning higher speed networks, Category 8 will support Top of Rack and End of Row topology.

The Excel Category 8 system will play a key role in future proofing networks to emerging technology, whilst remaining cost competitive in termination costs compared to Fibre Optic connections.

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 therefore a level of 'Future proofing' is desirable in network designs. Design for Tomorrow not Today!

Both Cenelec and ISO/IEC are changing the wording of future revisions of the standards to state, 'a minimum requirement of Category 6 should be used with a recommendation that all future installs should be Category 6_A' to meet the previous statement.

Screened and Unscreened

Categories 6 and 6_A 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 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 EA/Category 6_A also brings in the need to consider Alien Cross Talk. Alien Cross Talk is when the cable is subject to external noise from adjacent cables or other sources. As the cross-talk influence is from outside of the sheath it is referred to as alien. Please see section Category 6_A Screened or Unscreened Systems for further details.

Which Standard Body?

As previously mentioned, EN, ISO, and TIA standards are the 3 main standards bodies. 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".

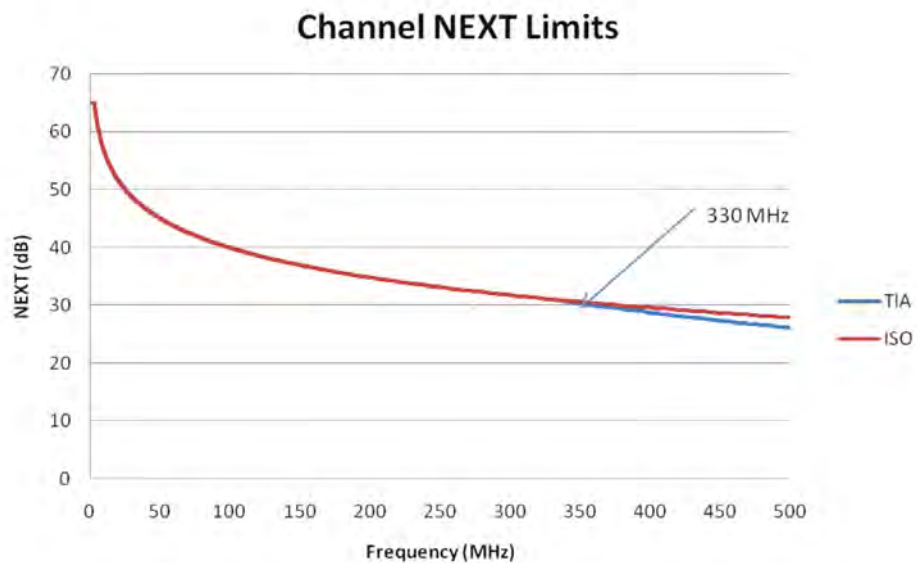
Phase of Project	Appropriate Standard
Design	EN 50173 series
Administration, Spaces, Pathways	EN 50174 series
Installation	EN 50174 series
Functional Bonding	EN 50174 series & EN 50310
Testing	EN 50173 series

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_A 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_A standards - Key Differences Explained

The key difference between the standards for Category 6_A is the requirements for Near End Cross Talk (NEXT) performance. The 'A' in Category 6_A 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. Edition 2 (or Ed 2.2)

Note: By early 2018 ISO/IEC will be re-published as edition 3 and when this appears it will adopt exactly the same section or part structure as EN 50173.

CENELEC EN

EEN 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
	<i>Note: Parts 1 & 2 of EN 50174 is under revision due to the CPR and will be republished in early 2018.</i>
EN 50310:2016	Application of equipotential bonding and earthing in buildings with information technology equipment.
	<i>Note: the wording in this standard is replicated within both ISO and TIA versions of this standard</i>

The British Standards Institute - BS

BS 6701:2016: +A1:2017	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance.
	<i>Note: This has been republished on the 30th of November 2017 and contains the minimum class requirements for the UK implementation of the CPR</i>
BS 7671:2015	Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition. 3rd Revision
	<i>Note: The 18th Edition of BS 7671 is due to be published on the 1st January 2018 and will come into force on the 1st of July 2018</i>

Telecommunications Industry Association - TIA

TIA/EIA-568-D.1 general requirements:

- TIA-568-D.2 components of balanced twisted-pair cable systems
- TIA-568-D.3 components of fibre optic cable systems, and
- TIA-568-D.4, coaxial cabling 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 **S2 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	www.as-institute.at	ÖVE/ÖNORM
Belgium	The Belgian Standards Body Bureau de Normalisation (NBN)	www.nbn.be	NBN
Bulgaria	Bulgarian Institute for Standardisation	www.bds-bg.org	БДC
Croatia	Croatian Standards Institute / Hrvatski zavod za norme	www.hzn.hr	HRH
Czech Republic	The Czech Office for Standards, Metrology and Testing / Úřad pro technickou normalizaci, metrologii a státní zkušebnictví (ÚNMZ)	www.unmz.cz	ČSN
Cyprus	The Cyprus Organisation for Standardisation (CYS)	www.cys.org.cy	CYS
Denmark	Danish Standards Foundation / Fonden Dansk Standard	www.ds.dk	DS
Estonia	Estonian Centre for Standardisation / Eesti Standardikeskuse	www.evs.ee	EVS
Finland	The Finnish Standards Association SFS / Suomen Standardisoimisliitosta	www.sfs.fi	SFS
France	French Association for Standardisation Association française de normalisation (AFNOR)	www.afnor.org	NF
Germany	German Institute for Standardisation / Deutsches Institut für Normung e.V.	www.din.de	DIN
Greece	Hellenic Organisation for Standardisation / Ελληνικός Οργανισμός Τυποποίησης	www.elot.gr	ΕΛΟΤ
Hungary	Hungarian Standards Institution / Magyar Szabványügyi Testület	www.mszt.hu	MSZ
Iceland	Icelandic Standards / Staðlaráð Íslands	www.ist.is	ÍST
Ireland	National Standards Authority of Ireland	www.nsai.ie	I.S.
Italy	Italian Organisation for Standardisation / Ente Nazionale Italiano di Unificazione	www.uni.com	UNI
Latvia	Latvian Standard / Latvijas standartus	www.lvs.lv	LVS
Lithuania	Lithuanian Standards Board / Lietuvos standartizacijos departamentas	www.lsd.lt	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	www.ilnas.public.lu	ILNAS
Malta	Malta Competition and Consumer Affairs Authority	www.mccaa.org.mt	MSA
The Netherlands	Netherlands Standardisation Institute / Nederlands Normalisatie-instituut	www.nen.nl	NEN
Norway	Standards Norway / Standard Norge	www.standard.no	NS
Poland	Polish Committee for Standardisation / Polski Komitet Normalizacyjny	www.pkn.pl	PN

Country	National Standards Organisation	Website	Standards Prefix
Portugal	Portuguese Institute of Quality / Instituto Português da Qualidade	www.ipq.pt	NP
Romania	Romanian Standards Association / Asociația de Standardizare din România	www.asro.ro	SR
Slovakia	Slovak Standards Institute / Slovenského ústavu technickej normalizácie	www.sutn.sk	STN
Slovenia	Slovenian Institute for Standardisation / Slovenski inštitut za standardizacijo	www.sist.si	SIST
Spain	Spanish Association for Standardisation and Certification / Asociación Española de Normalización y Certificación	www.aenor.es	UNE
Sweden	Swedish Standards Institute / Svenska Standards Institute	www.sis.se	SS
Switzerland	Swiss Association for Standardisation / Schweizerische Normen-Vereinigung	www.snv.ch	SN
Turkey	Turkish Standards Institution / Türk Standardları Enstitüsü	www.tse.org.tr	TS
United Kingdom	British Standards Institution	www.bsigroup.com	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:

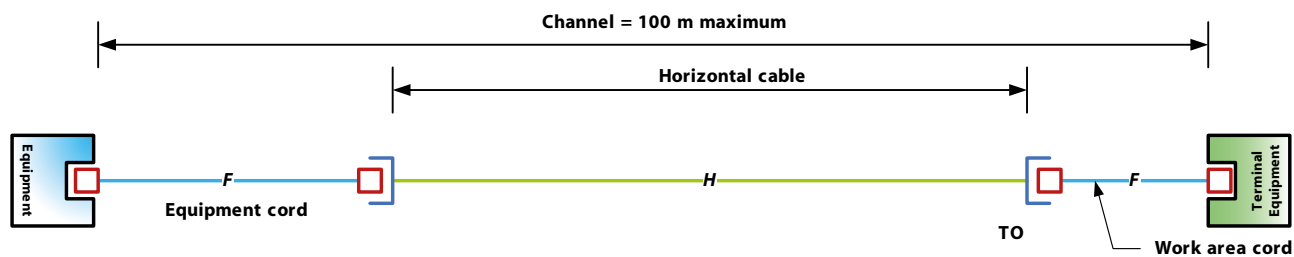
- The physical length of the channel shall not exceed 100 m
- The physical length of the horizontal cable shall not exceed 90 m. This may need reducing depending on the length of the attached cords
- Where a MUTO (Multi User Telecommunications Outlet) is used the length of the work area cord shall not 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

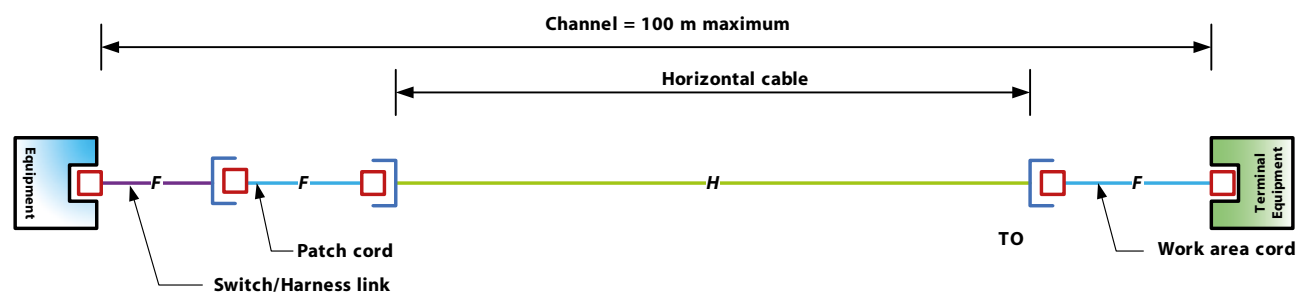


Interconnect to Telecommunications Outlet (TO)



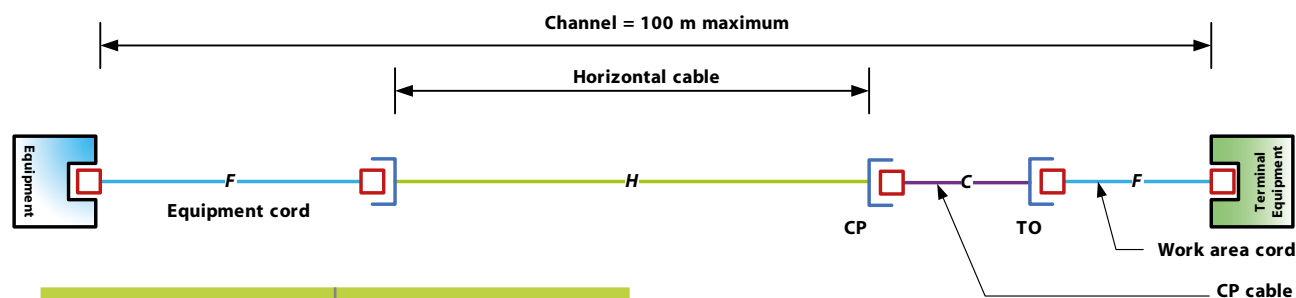
Class	Equation
Class D (Category 5e)	$H = 109 - (F \times X)$
Class E (Category 6)	$H = 107 - 3 - (F \times X)$
Class E _A (Category 6 _A)	$H = 107 - 3 - (F \times X)$
Class F (Category 7)	$H = 107 - 2 - (F \times X)$
Class F _A (Category 7 _A)	$H = 107 - 2 - (F \times X)$

Cross-connect to Telecommunications Outlet (TO)



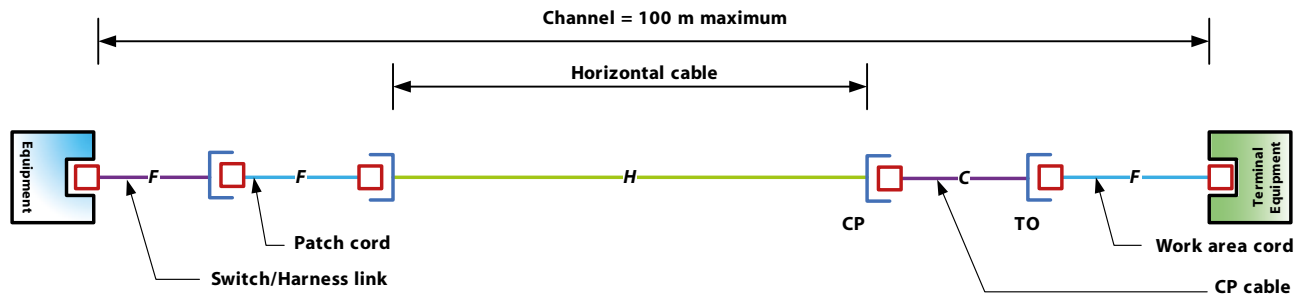
Class	Equation
Class D (Category 5e)	$H = 107 - (F \times X)$
Class E (Category 6)	$H = 106 - 3 - (F \times X)$
Class E _A (Category 6 _A)	$H = 106 - 3 - (F \times X)$
Class F (Category 7)	$H = 106 - 3 - (F \times X)$
Class F _A (Category 7 _A)	$H = 106 - 3 - (F \times X)$

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 _A (Category 6 _A)	$H = 106 - 3 - (F \times X) - (C \times Y)$
Class F (Category 7)	$H = 106 - 3 - (F \times X) - (C \times Y)$
Class F _A (Category 7 _A)	$H = 106 - 3 - (F \times X) - (C \times Y)$

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



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 _A (Category 6 _A)	$H = 105 - 3 - (F \times X) - (C \times Y)$
Class F (Category 7)	$H = 105 - 3 - (F \times X) - (C \times Y)$
Class F _A (Category 7 _A)	$H = 105 - 3 - (F \times X) - (C \times Y)$

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.

When installed by an accredited Excel Partner the Excel copper range can be covered by a 25-year product and application warranty

Remote Powering (Power over Ethernet, PoE)

PoE is something we have all heard about for many years and sometimes even over look, as technology changes and products using PoE grows you can see a market that is key to copper cabling being produced to handle this emerging market.

- Lighting
- Smart buildings
- CCTV
- Access control
- Intruder alarms
- Point of sale equipment
- Smoke detection

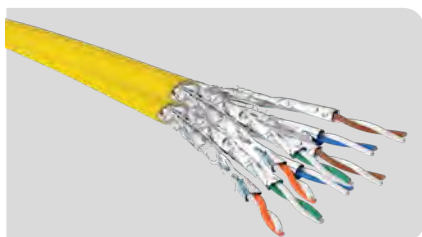
Are just a few applications in today's works using PoE, Excel Networks now offer a full range of products including certified keystone jacks capable of running the higher powered PoE in accordance to 802.3 BT Standards due to release in 2018.

The Excel copper cabling solution includes:



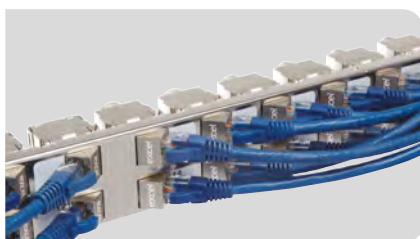
Excel [Category 8](#) Range

- C- S/FTP cable
- Screened butterfly tooless jacks
- Field termination RJ 45 plugs
- Choice of straight and angled patch panel frames
- CPR Compliant cable



Excel [Category 7_A](#) Range

- Choice of S/FTP LS0H cable
- Choice of straight and angled patch panel frames
- Choice of keystone jack modules
- Third Party Verified Standards Compliance Performance
- CPR Compliant Cables as standard



Excel [Category 6_A](#) Range

- Choice of screened straight or angled jacks and compatible panel frames
- Choice of S/FTP, F/FTP, U/FTP or U/UTP cable
- Choice of a 'shotgun' twin cable in S/FTP, F/FTP and U/FTP designs
- Screened and unscreene patch leads in a variety of lengths and colours
- Full range of mounting hardware available
- Excel Zone Cabling - reduced diameter cabling
- High Density (HD) Patch Leads
- Mini-Patch Leads
- Third Party Verified Standards Compliance Performance
- CPR Compliant cable as standard

Comparison

Category	Standard	Data Rate	Frequency
Category 8	40GBase-T	40Gbit	1600-2000 MHz
Category 7 _A	10GBase-T	10Gbit	1000 MHz
Category 6 _A	10GBase-T	10Gbit	500 MHz



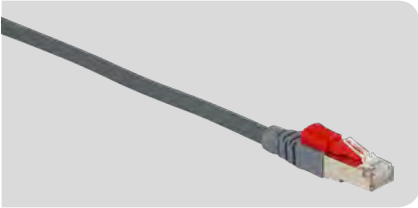
Excel [Category 6](#) Range

- 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 F/UTP design
- Screened and unscreened patch panels
- Excel Plus Patch Panel range offers enhanced labelling system
- CPR Compliant U/UTP cable as standard
- Screened and unscreened patch leads in a variety of lengths and colours
- High Density (HD) Patch Leads
- 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
- CPR Compliant as standard



Excel [Lockable Patch Leads](#)

Excel's range of lockable patch cords in Category 6_A and Category 6 are manufactured and tested to ISO 11801, EN50173 and TIA/EIA 568 requirements.

Designed to prevent unauthorised disconnection within secure or sensitive areas this range of patch lead is the preferred choice in the following applications:

- Healthcare
- Military
- Education
- Data Center
- Public footfall areas



Excel Copper [Accessories](#)

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

Category 6_A 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.

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 historically chosen unscreened while France and Germany favours screened cabling system installations. However with the move to the higher bandwidth of 10GBase-T and Class Ea/ Category 6_A this is changing. 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.

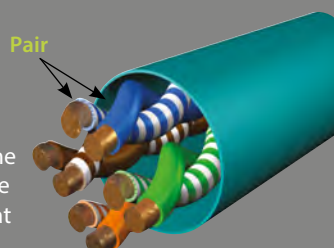
The effect of crosstalk within the cable has been known about, and therefore measured, since the early Categories and Classes of cabling systems. This was always in the form of Near End Crosstalk (NEXT) as measured from each end. NEXT is the influence from the signal of one pair to another within the 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 unscreened cable if the cable is installed in strict 'tramline' fashion.

Whether the installed cabling system is to be screened or unscreened 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 inducted 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_A Installations

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

By design, a screened Class EA/Category 6_A does not require additional Alien Crosstalk testing. However, for unscreened cabling installations a level of Alien Crosstalk testing may need to be carried out and this is tested in the channel configuration. The channel under test is referred to as the 'Disturbed or Victim' 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 = 2323
- 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 EA / Category 6_A to bundle sizes to about 12, or even 6.

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

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_A Screened, Category 6 Screened and Unscreened, LC fibre and MTP.



Watch our video

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 _A 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

Excel Copper Terminology Explained

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

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:

1. Unscreened Cabling System
2. 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 unscreened or screened.

Excel Terminology	
Category 6 Unscreened Jack	
Replace with appropriate Category (5e , 6 or 6_A)	↑
or Screened	↑
or Patch Panel	↑



3. Copper Cable Terminology

There are two families of copper cable

- Unscreened Cable
- Screened Cable

	Excel Terminology
	Category 6 Unscreened Twisted Pair (U/UTP) Cable
Replace with appropriate Category (5e, 6, 6 _A and 7)	↑
Change to Screened for any cable other than U/UTP	↑
Use acronym that fits in accordance with chart on page 46	↑

4. Patch Cord Terminology

There are two families of patch cords

- Unscreened
- Screened

	Excel Terminology
	Category 6 Unscreened Twisted Pair (U/UTP) Patch Lead
Replace with appropriate Category (5e, 6 or 6 _A)	↑
Change to Screened for any cable other than U/UTP	↑
Use acronym that fits in accordance with chart on page 46	↑

Anomalies

The term Category 6_A only applies to ISO & EN cables. The TIA refer to Category 6_A. As Excel cable is ISO compliant it shall standardise on Category 6_A. Cable compliant with ISO is also compliant with the TIA requirements. This is not necessarily true the other way round.

5. Cable Types

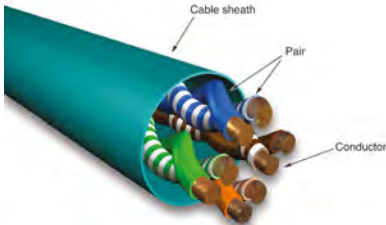
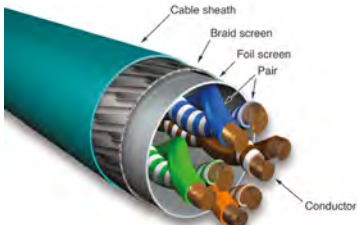
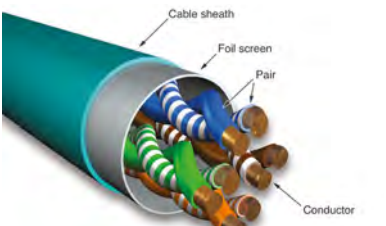
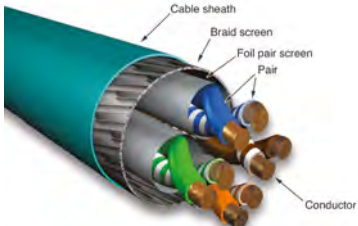
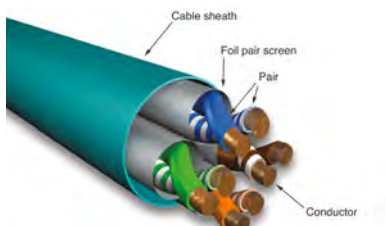
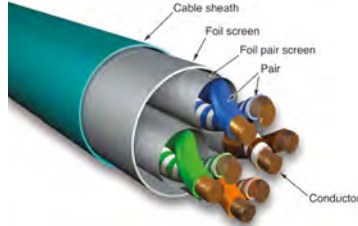
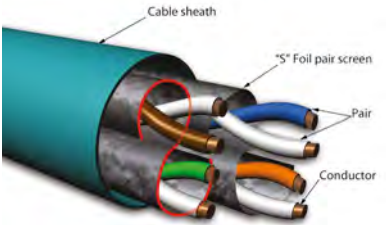
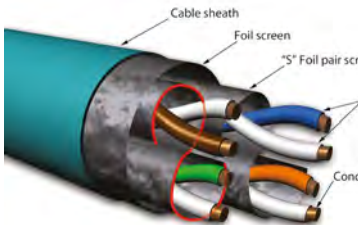
The first letter of the acronym describes the overall screening. The second letter describes the screening of individual pairs and the TP refers to the Twisted Pairs.

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

	F/UTP
Describes the overall screen	↑↑
Describes the screening of the pairs	↑
Describes the Twisted Pairs	↑

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

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

"S" Foil Cable

"S" Foil cable has been added to the [Excel Category 6_A 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_A Cables.

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

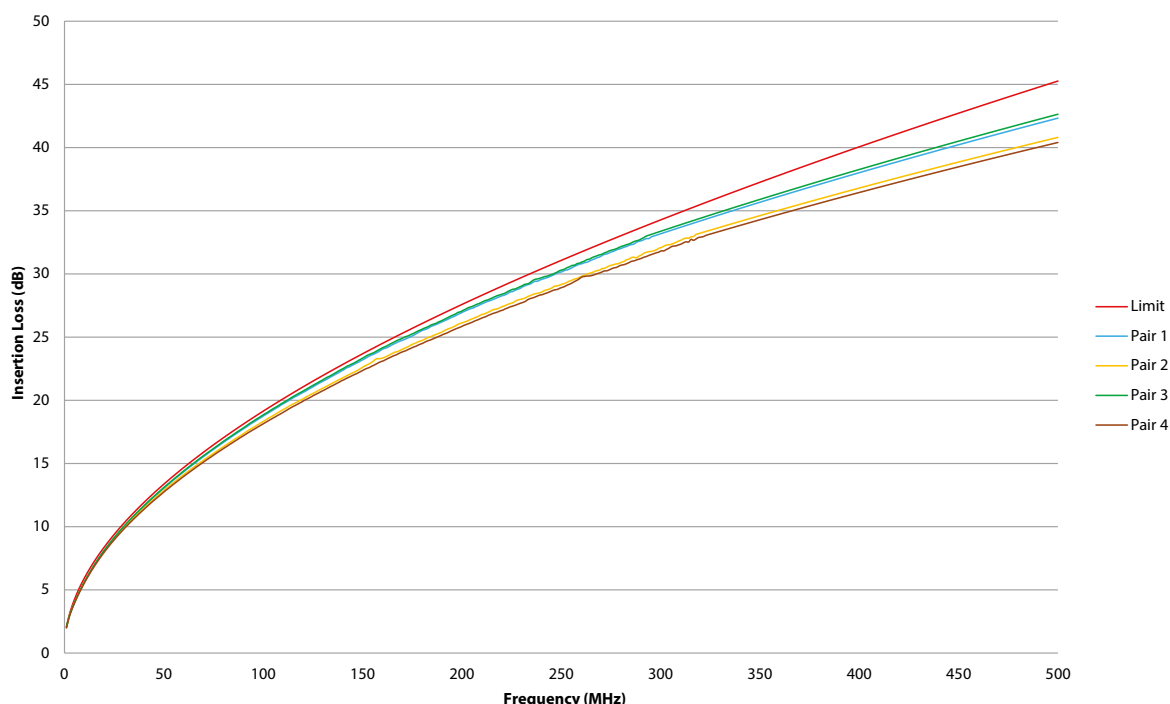


Excel Category 6_A Typical Performance Charts

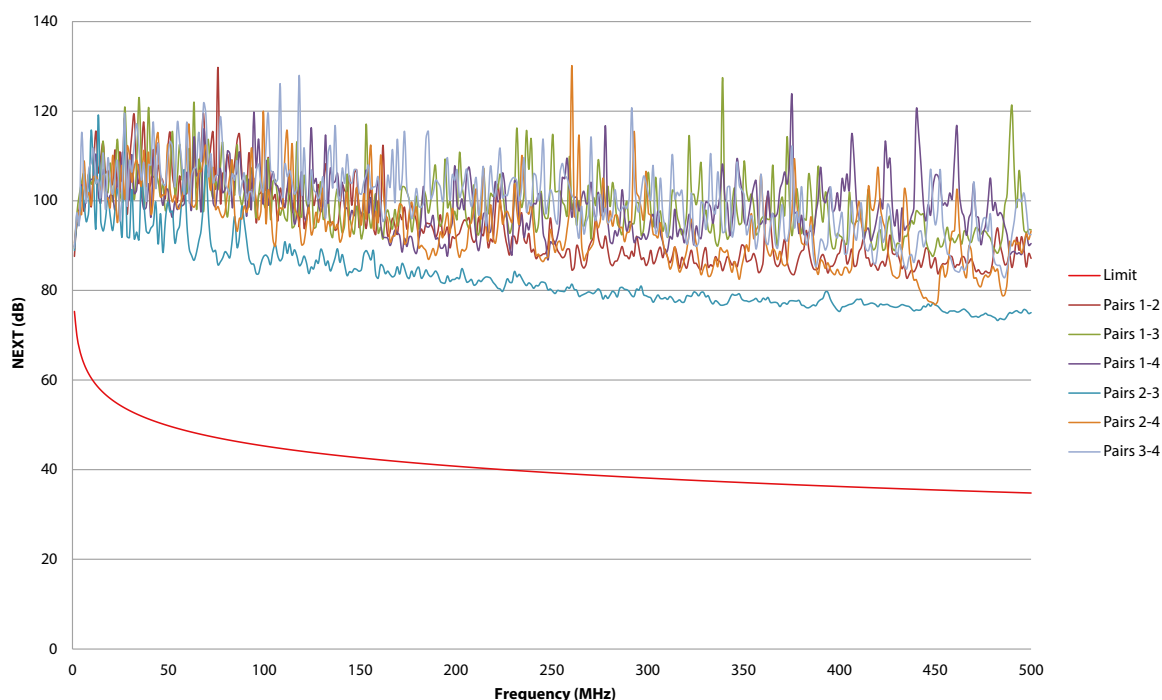
100-196 Excel Category 6_A Screened (F/FTP) S-Foil Cable - LSOH

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/Amd 2:2010 Edition 2(Ed 2.2). 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

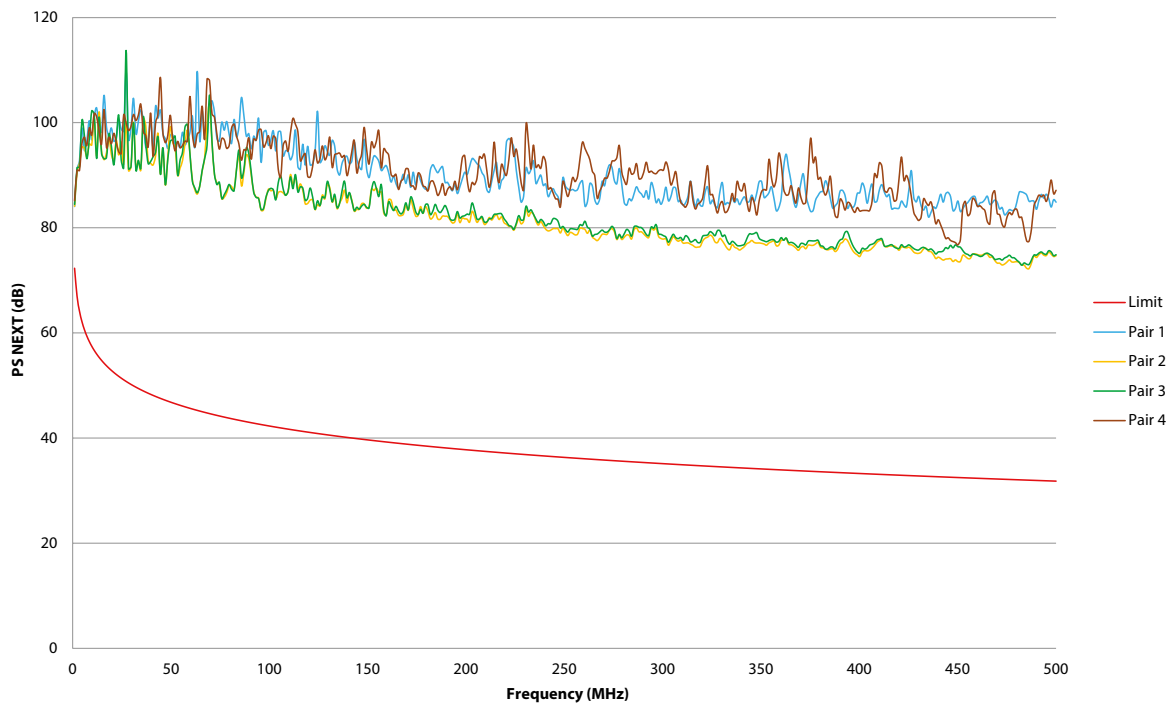
Insertion Loss



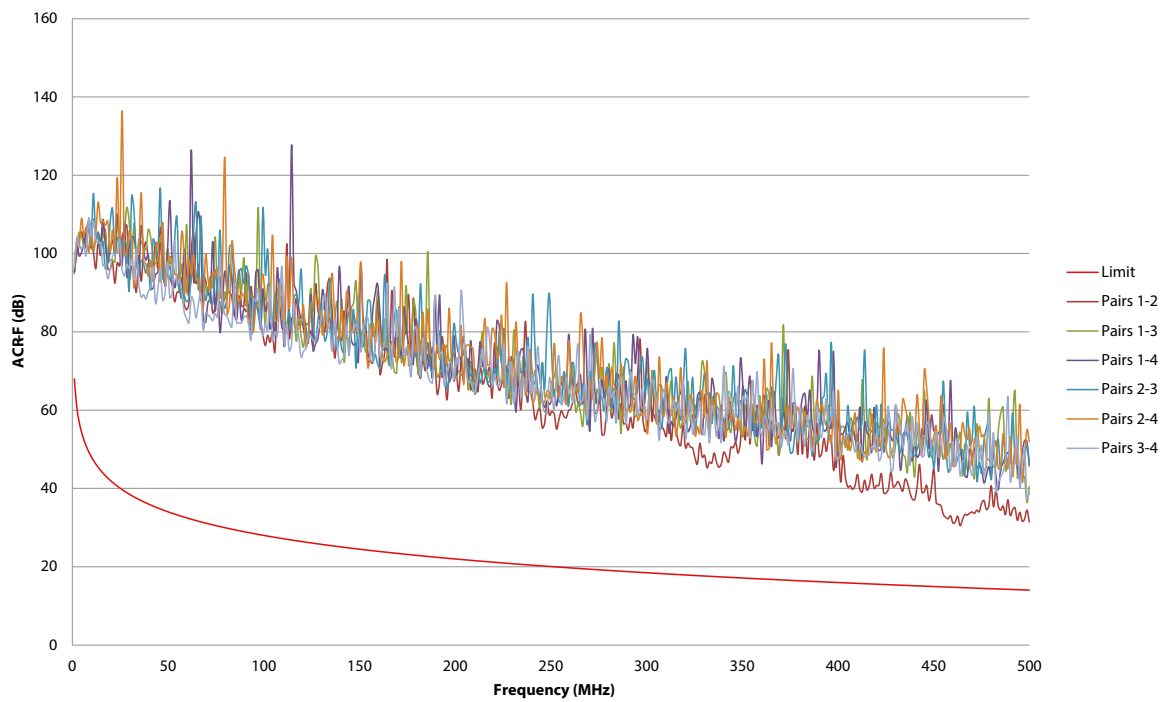
NEXT



Power Sum NEXT

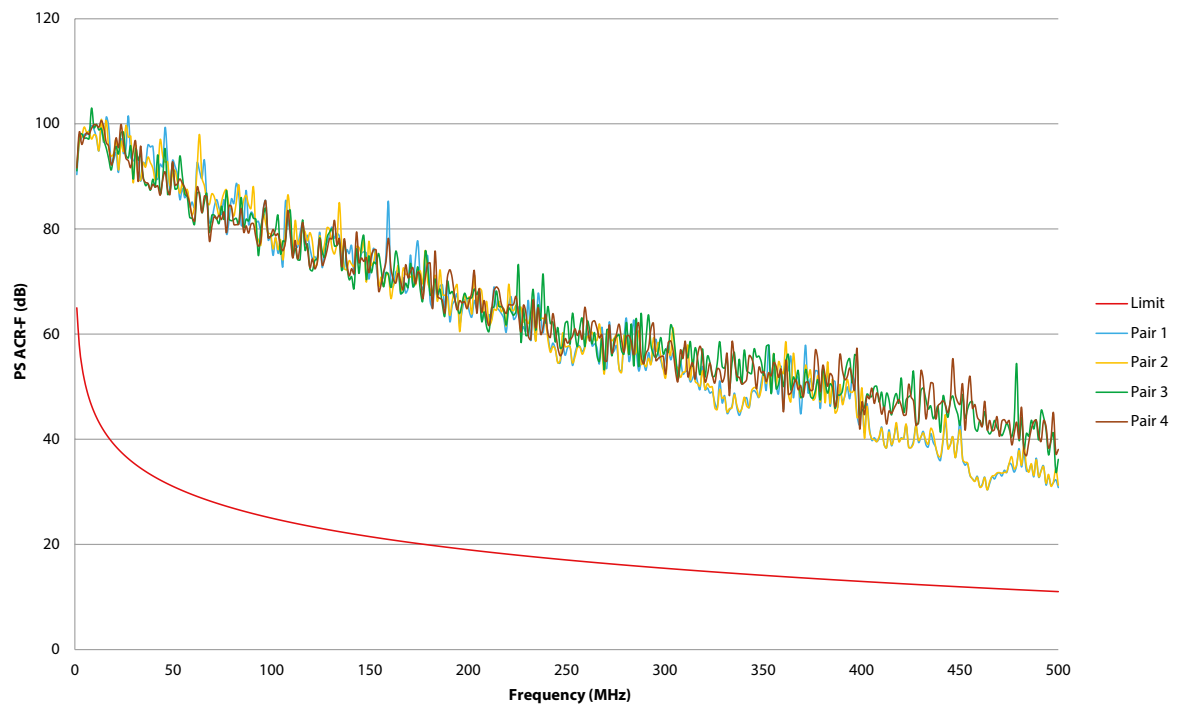


ACR-F

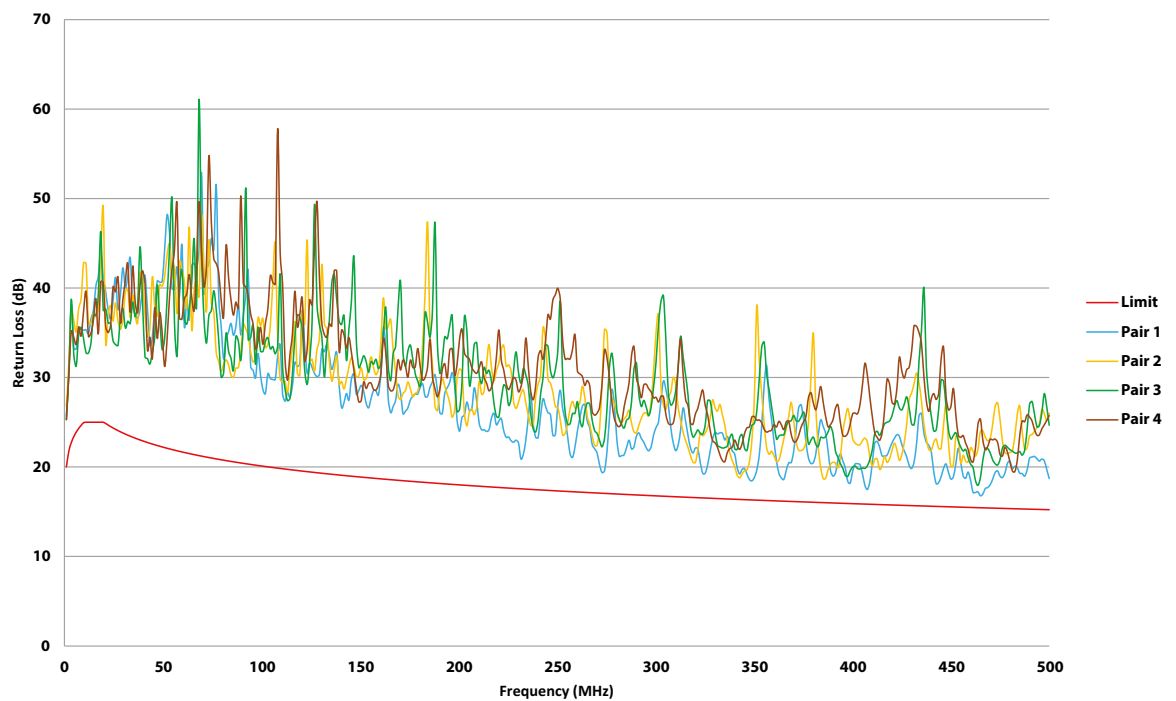




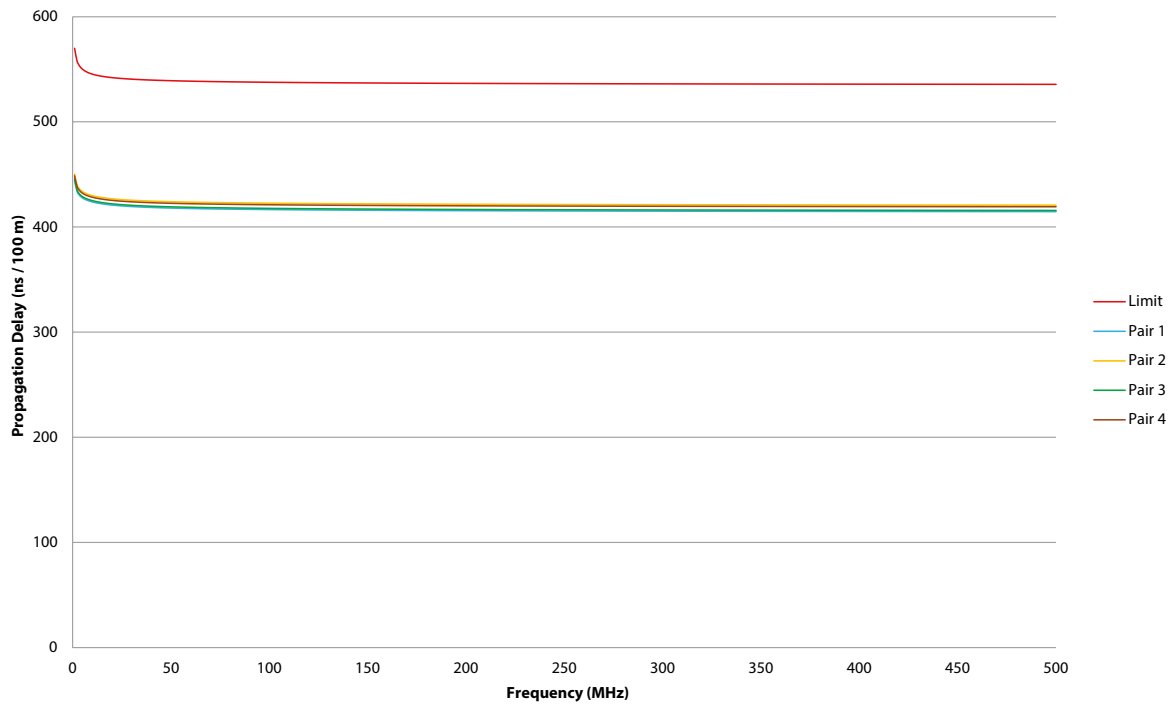
Power Sum ACR-F



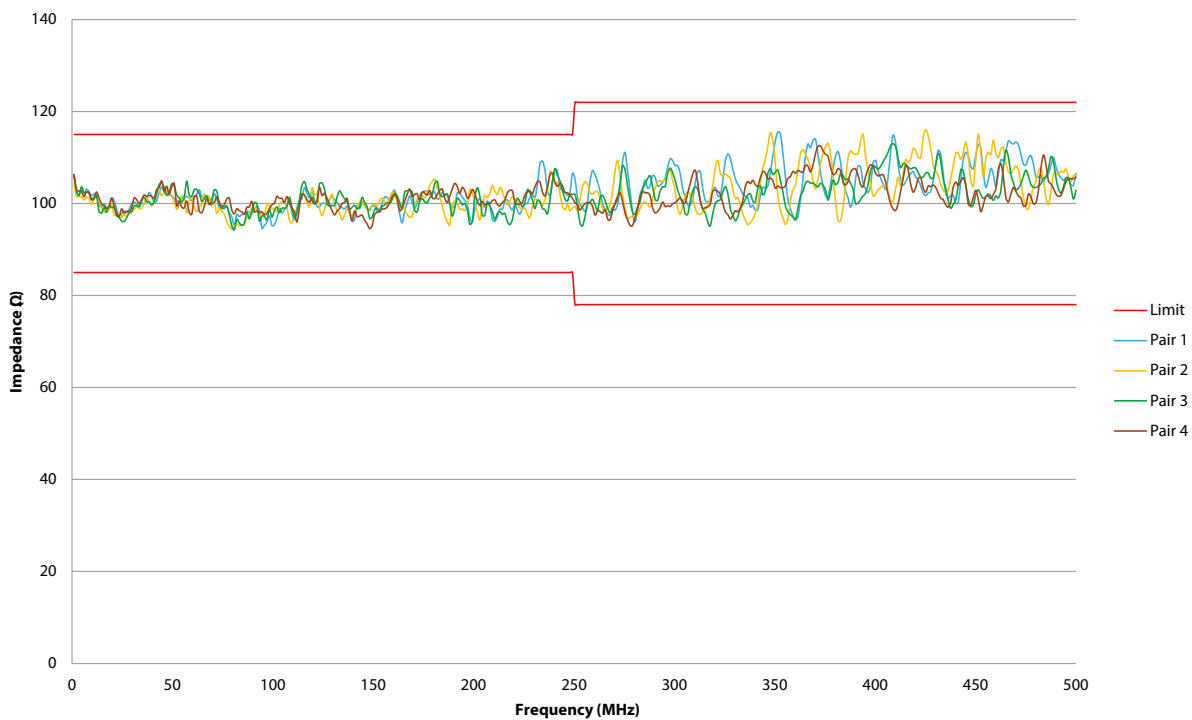
Return Loss



Propagation Delay



Impedance



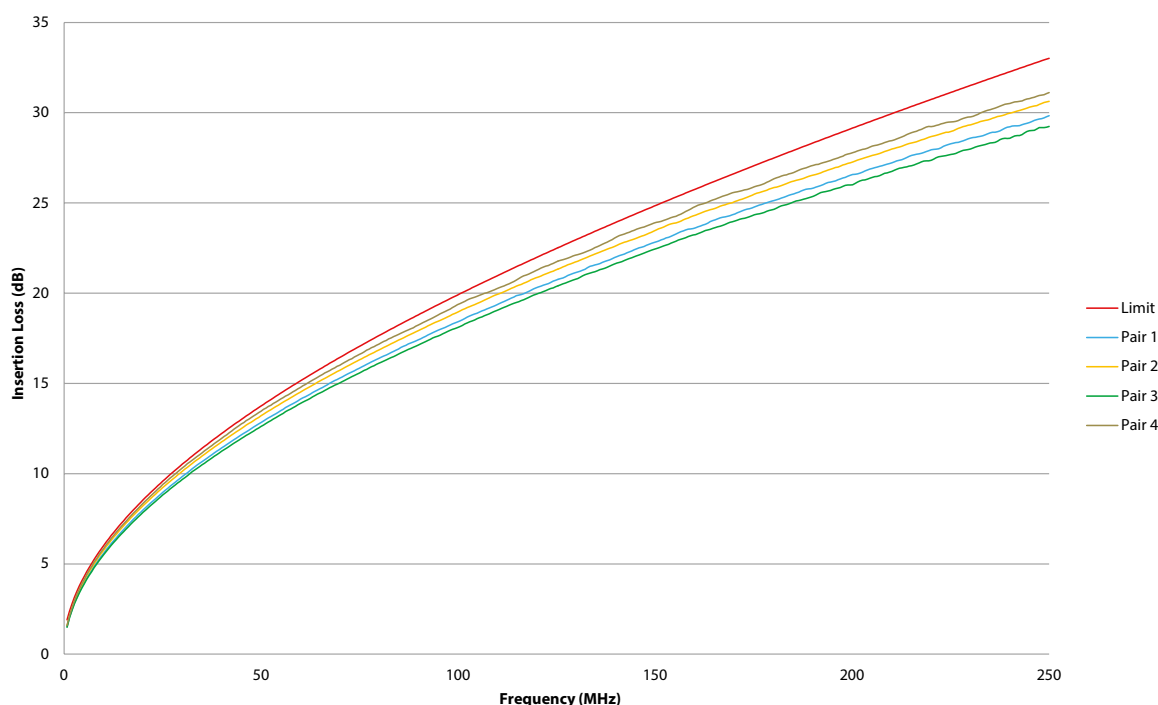


Excel Category 6 Typical Performance Charts

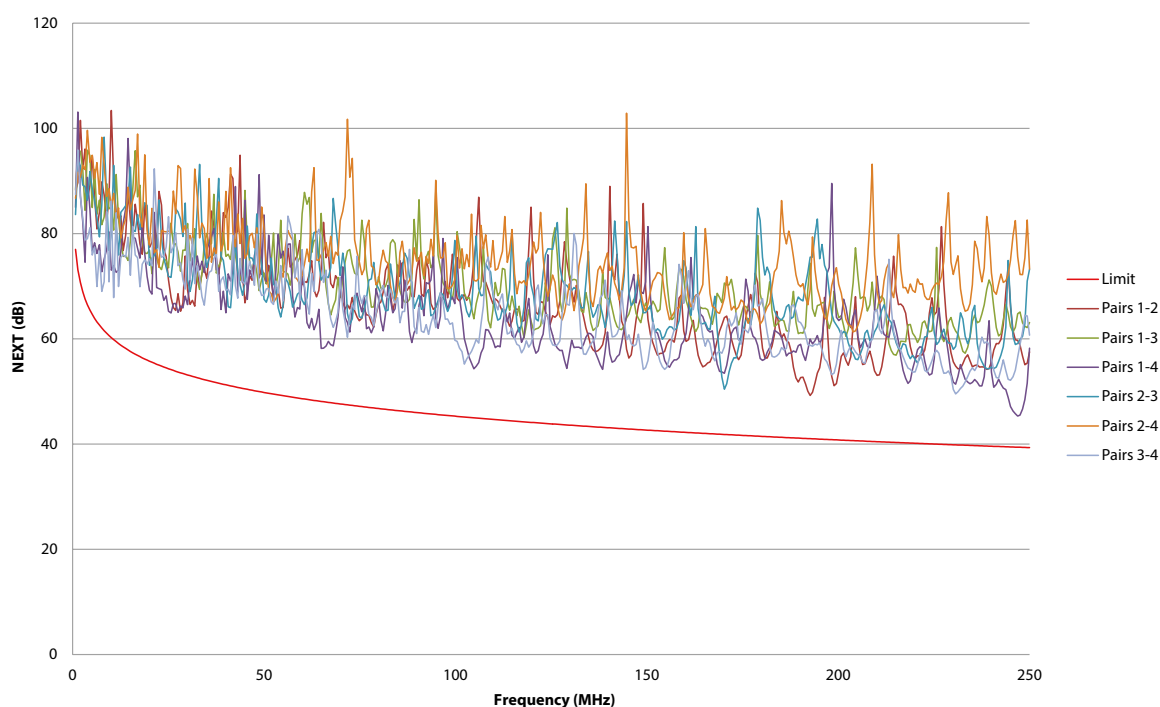
100-071 Excel Category 6 U/UTP LSOH Cable

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/Amd 2:2010 Edition 2(Ed 2.2).. 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



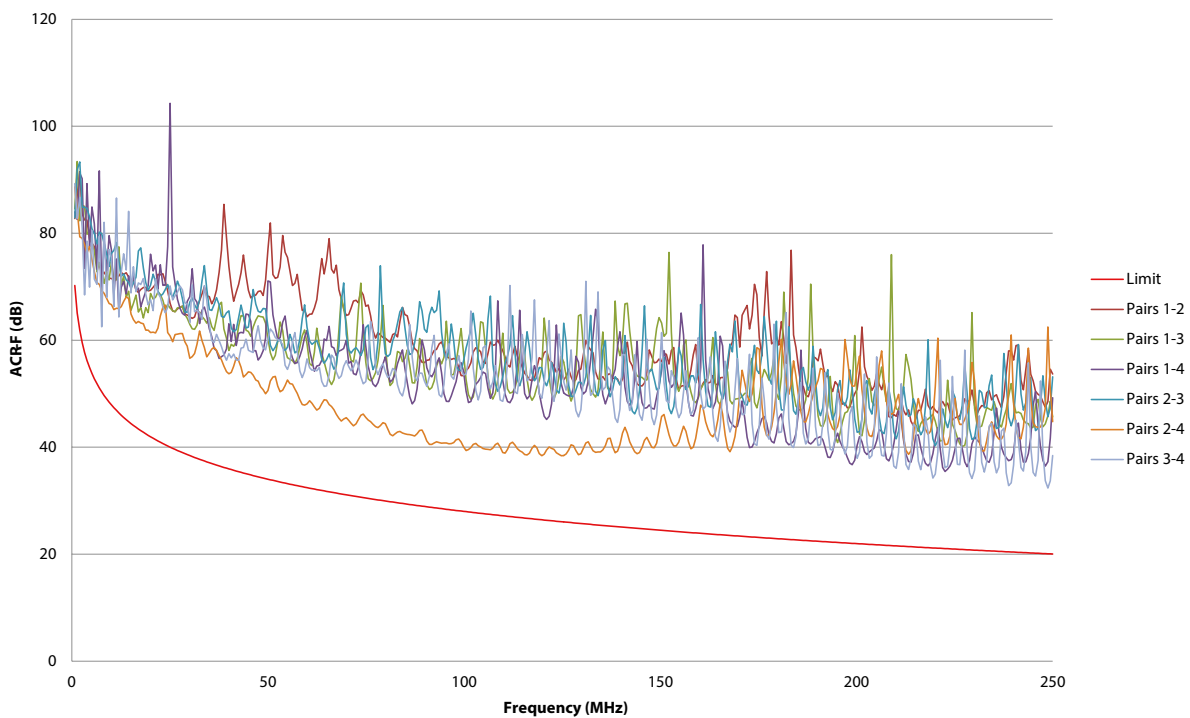
NEXT



Power Sum NEXT

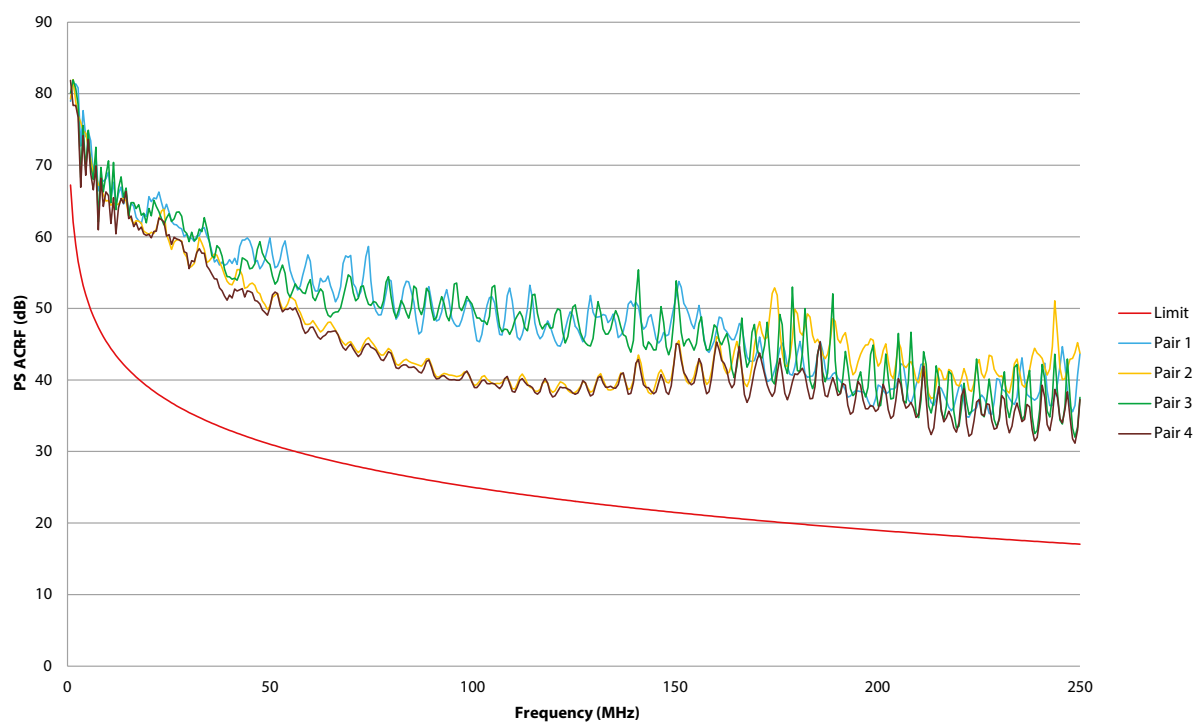


ACRF

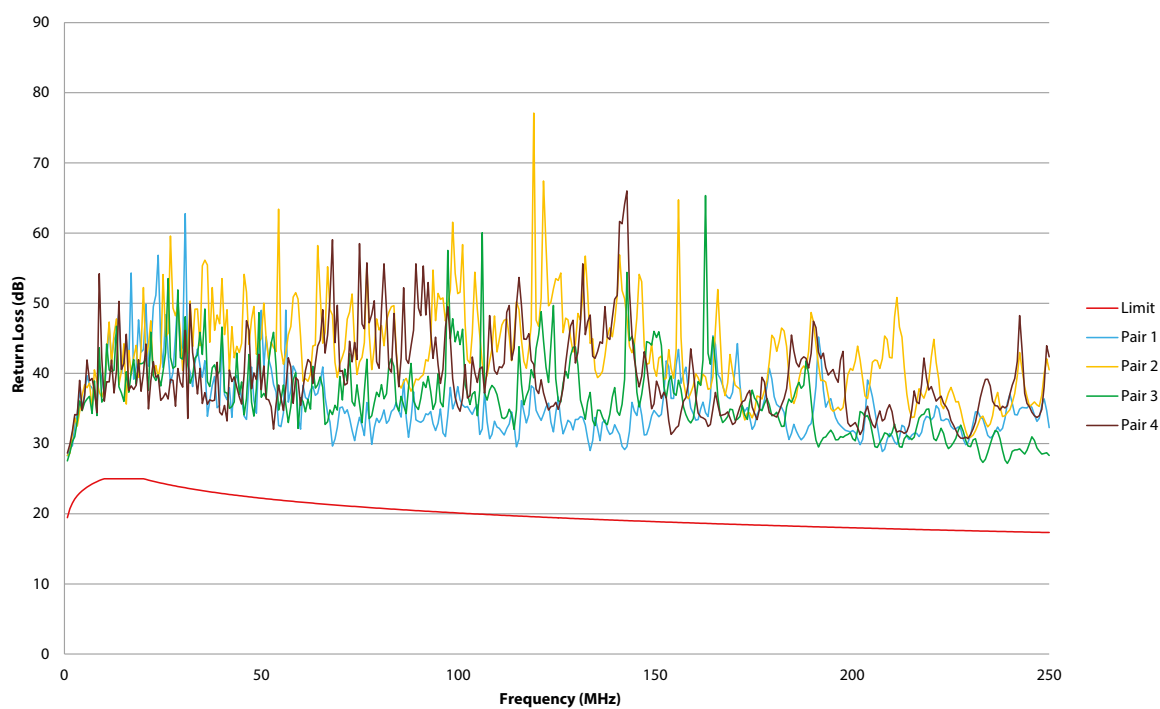




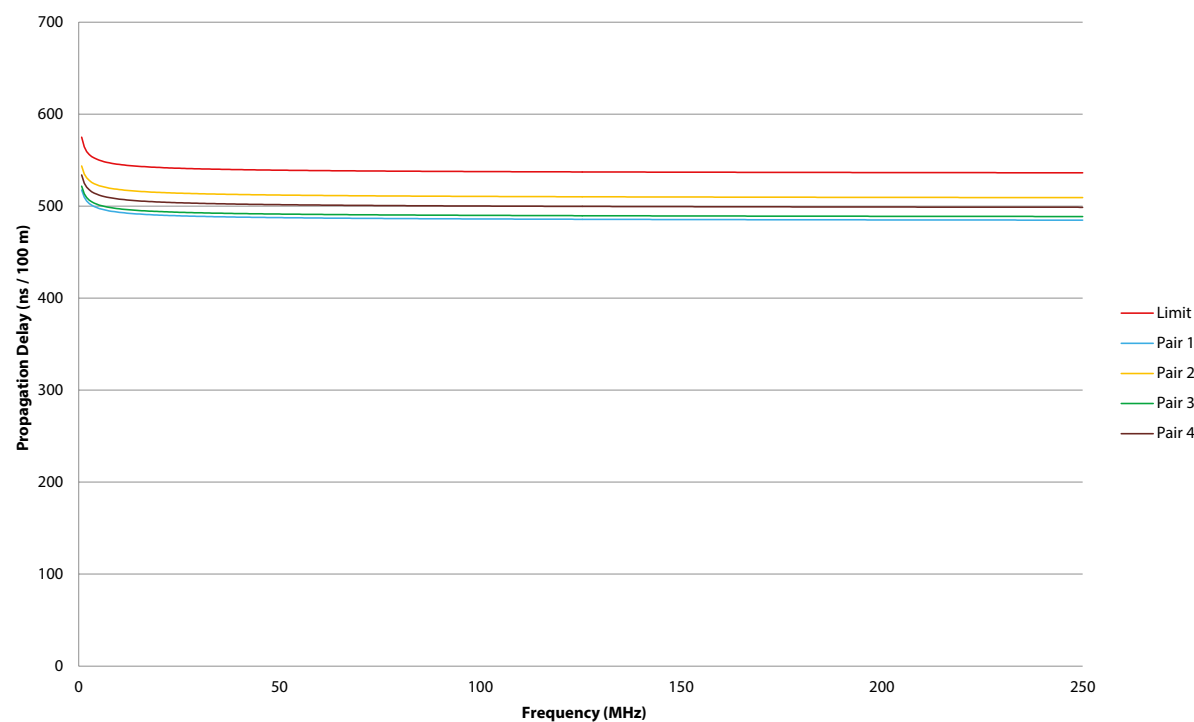
Power Sum ACRF



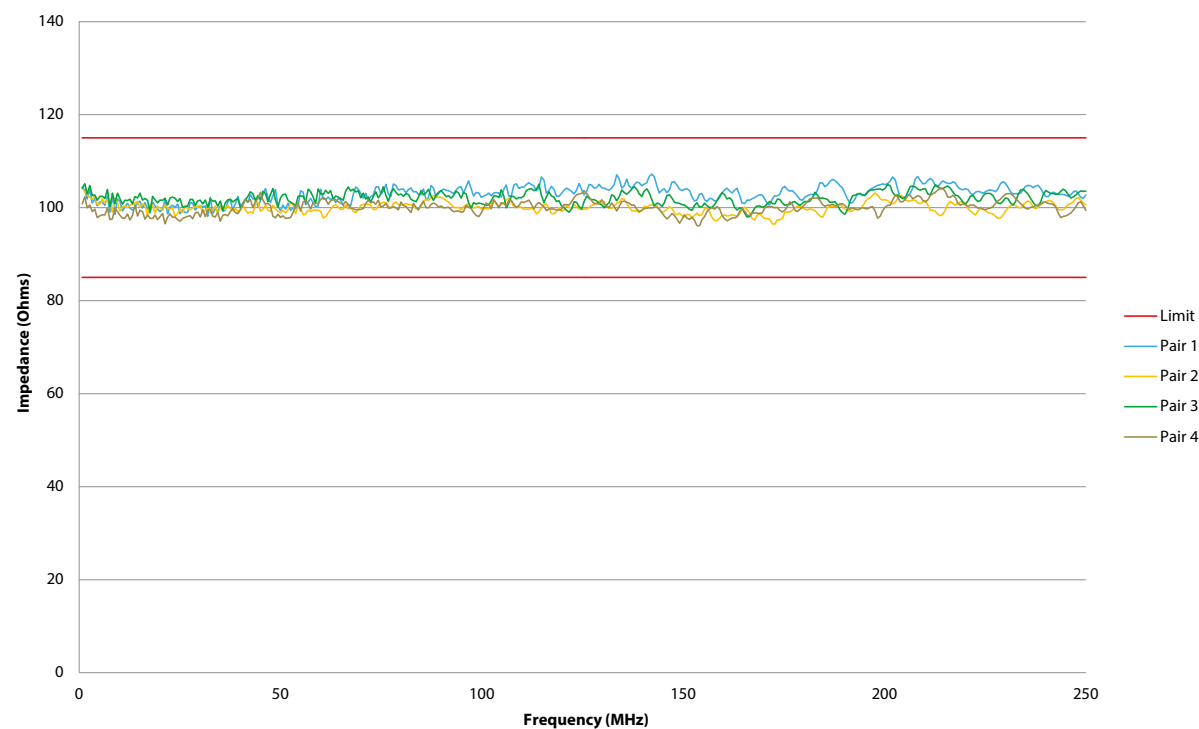
Return Loss



Propagation Delay



Impedance





Excel Patch Panel - Product Selector







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

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 100-304 24 port - Black P/N 100-306 48 port - Black		✓		✓	✓
Excel Category 6 Unscreened Right Angle Panel P/N 100-302 24 port - Black P/N 100-394 48 port - Black		✓		✓	✓
Excel Plus Category 6 Unscreened P/N 100-372 24 port - Black P/N 100-380 48 port - Black			✓	✓	✓
Excel Plus Category 6 Unscreened Modular Panel - Loaded P/N 100-016 24 port - Black		✓			✓
Excel Category 6 Screened P/N 100-013 24 port - Black		✓		✓	✓
Excel Category 5e Unscreened P/N 100-720 16 port - Black P/N 100-726 24 port - Black P/N 100-722 32 port - Black P/N 100-728 48 port - Black				✓	✓
Excel Category 5e Unscreened Through Coupler P/N 100-309 24 port - Black				✓	✓
Excel Category 5e Unscreened P/N 100-450 24 port - Blue P/N 100-451 24 port - Red P/N 100-452 24 port - Green P/N 100-453 48 port - Blue P/N 100-454 48 port - Red P/N 100-455 48 port - Green				✓	✓
Excel Category 5e Unscreened P/N 100-470 24 port - Black P/N 100-480 48 port - Black			✓	✓	✓
Excel Category 5e Unscreened Right Angle Panel P/N 100-460 24 port - Black P/N 100-497 48 port - Black		✓		✓	✓
Excel Plus Category 5e Unscreened Right Angle Panel P/N 100-490 24 port - Black		✓	✓	✓	✓
Excel Category 5e Screened Right Angle Panel P/N 100-736 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.

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



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	Excel 12-port MicroLan Keystone Patch Panel Frame
P/N 100-025	P/N 100-026	P/N 100-027	P/N 100-028	P/N 100-023	P/N 100-024	P/N 100-040	P/N 100-041	P/N 100-753
								
				✓ ✓	✓ ✓			
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓			✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	
✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓			✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓	
✓ ✓	✓ ✓	✓ ✓	✓ ✓			✓ ✓	✓ ✓	✓ ✓



Excel Residential A/V Keystone Adaptors										
P/N 100-805 1 Port 'F Type' Sat Coax Adaptor White		✓	✓	✓	✓			✓	✓	✓
P/N 100-806 HDMI V1.4 Adaptor White		✓	✓	✓	✓			✓	✓	✓
P/N 100-807 1 Port USB 3.0 Adaptor White A Type		✓	✓	✓	✓			✓	✓	✓
P/N 100-809 1 Port USB 2.0 Adaptor White A Type		✓	✓	✓	✓			✓	✓	✓
P/N 100-811 3.5mm Audio Input Adaptor White		✓	✓	✓	✓			✓	✓	✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of www.excel-networking.com.

Excel Mounting Hardware - Product Selector Modules - 6c






















		Face Plate	
		Excel Single Gang 6c Faceplate	Excel Double Gang 6c Faceplate
		P/N 100-670	P/N 100-671
Keystone			
Excel Category 6 Unscreened RJ45 Module P/N 100-301 - White		✓	✓
Excel Category 6 Unscreened Low Profile RJ45 Module P/N 100-297 - White		✓	✓
Excel Category 5e Unscreened Low Profile RJ45 Module P/N 100-757 - White		✓	✓
Excel Category 5e Unscreened RJ45 Module P/N 100-758 - White		✓	✓
Excel Voice Module Secondary - 6c Style P/N 100-787		✓	✓
Excel Voice Module - PABX - 6C Style P/N 100-789 - White		✓	✓

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of 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



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

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of www.excel-networking.com.



Excel Mounting Hardware - Product Selector Modules - Euromod



Modules

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

For copies of the product specification sheets and Delta certificates, where applicable, please visit the downloads area of www.excel-networking.com.

Section 4

Pages

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<u>What's the difference between Component and Channel verification?</u>	63
<u>Who is Delta?</u>	63
<u>Excel Third Party Verification</u>	64
<u>Verification Certificates</u>	65



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 20 years, working closely with laboratories such as Delta and 3P based in Denmark, and ETL in America.

What's the difference between Component and Channel verification?

Excel Category 6 and Category 6_A 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.

Who is ETL?



The ETL Verified Mark from Intertek helps manufacturers differentiate their products and brands in competitive markets. Product differentiation is an ongoing issue all manufacturers struggle with. Intertek's ETL Verified Mark is a symbol of performance integrity of the products that bear the mark.

Who is 3P?



3P Third Party Testing is an independent testing laboratory serving the international cabling and electronic industries. Their main product is certification testing of components for communication cabling, i.e. cables, connecting hardware, patch cords, and permanent links and channels. Other core activities are CPR fire and safety testing of cables, and quality evaluation and failure analysis of printed wiring boards and electromechanical components.

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 is continually updated on a regular basis to ensure the most recent certificates are available directly from Excel.

Certificates are currently available for the following categories:

Category 7 _A	Category 6 _A	Category 6	Category 5e	Class E/EA
Cables	Cables	Cables	Cables	Channel
	Patch cords	Patch cords	Patch cords	Permanent link
	Connecting hardware	Connecting hardware	Connecting hardware	
		Channel connectors		

** At the time of going to print, Third Party Verification Certificates were unavailable for Category 8 Copper Cable and as such are not included in the above table, however the most up to date certificates can be downloaded from www.excel-networking.com.*

Click on the links above to view the latest certificates. Certificates are also shown against each product on the Excel Online Catalogue - click on the downloads tab to see the [latest certificates](#).

[Click here to view our Third Party Certificates](#)

**Ask us about our new
bespoke laser engraved
labels for patch panels
and outlets.**

Excel helps you add value.





Compliance Statement

No. 2017-924

Data communication cable, Category 7_A to 1200 MHz

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 cable (S/FTP) characterised up to 1200 MHz*
Horizontal floor wiring cable, 100 Ω
4 individually foil screened twisted pairs with overall braid screen
Flame retardant, halogen free

Product identification

100-912
100-913

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

Generic cabling and cabling components standards - Category 7_A cable requirements to 1200 MHz

- ISO/IEC 11801:2011 (Ed. 2.2)
- IEC 61156-5:2012 (Ed. 2.1)
- IEC 61156-7:2003 (Ed. 1.0)
- EN 50173-1:2011
- EN 50173-2:2007 including amendment A1:2010
- EN 50288-4-1:2013

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

Standards for flammability, halogen acidity, and smoke performance

- IEC 60332-1-1:2015 (Ed. 1.1) / IEC 60332-1-2:2015 (Ed. 1.1)
- IEC 60754-1:2011 (Ed. 3.0) / IEC 60754-2:2011 (Ed. 2.0)
- IEC 61034-1:2013 (Ed. 3.1) / IEC 61034-2:2013 (Ed. 3.1)

Check - is certificate valid.

Technical report

DELTA-T735776, DANAK-19/18532

EC Cabling product ID

5930

CS valid until

17 November 2018

*Transmission parameters comply with IEC 61156-7 and with extended Cat. 7_A limits up to 1200 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.

Check - Regular maintenance schedules ensure ongoing Third Party Check Ups

Hørsholm, 7 November 2017

Lars Lindskov Pedersen
Test Manager

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Compliance Statement

No. 2017-837A

Connecting Hardware, Category 6 4 Pair Power over Ethernet (4PPoE)

(Un-mating connectors under electrical load of up to 2 A per conductor)

Company

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

Check - does the product
cover PoE?

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
- IEC 60512-99-002 (draft 48B/2531/CD)

Technical report

DELTA-T734881-02, DANAK-19/18413

EC Cabling product ID

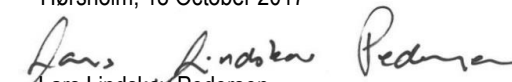
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CS valid until

20 October 2018

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. This compliance statement has been revised.

Hørsholm, 18 October 2017


Lars Lindskov Pedersen
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Excel Enbeam Fibre Optic Cabling Systems

Section 5

S5

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[Fibre Cabling Standards - Overview](#)

[Enbeam Fibre Optic Cabling Systems](#)

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[Excel Mixed Use Patch Panel Frames](#)

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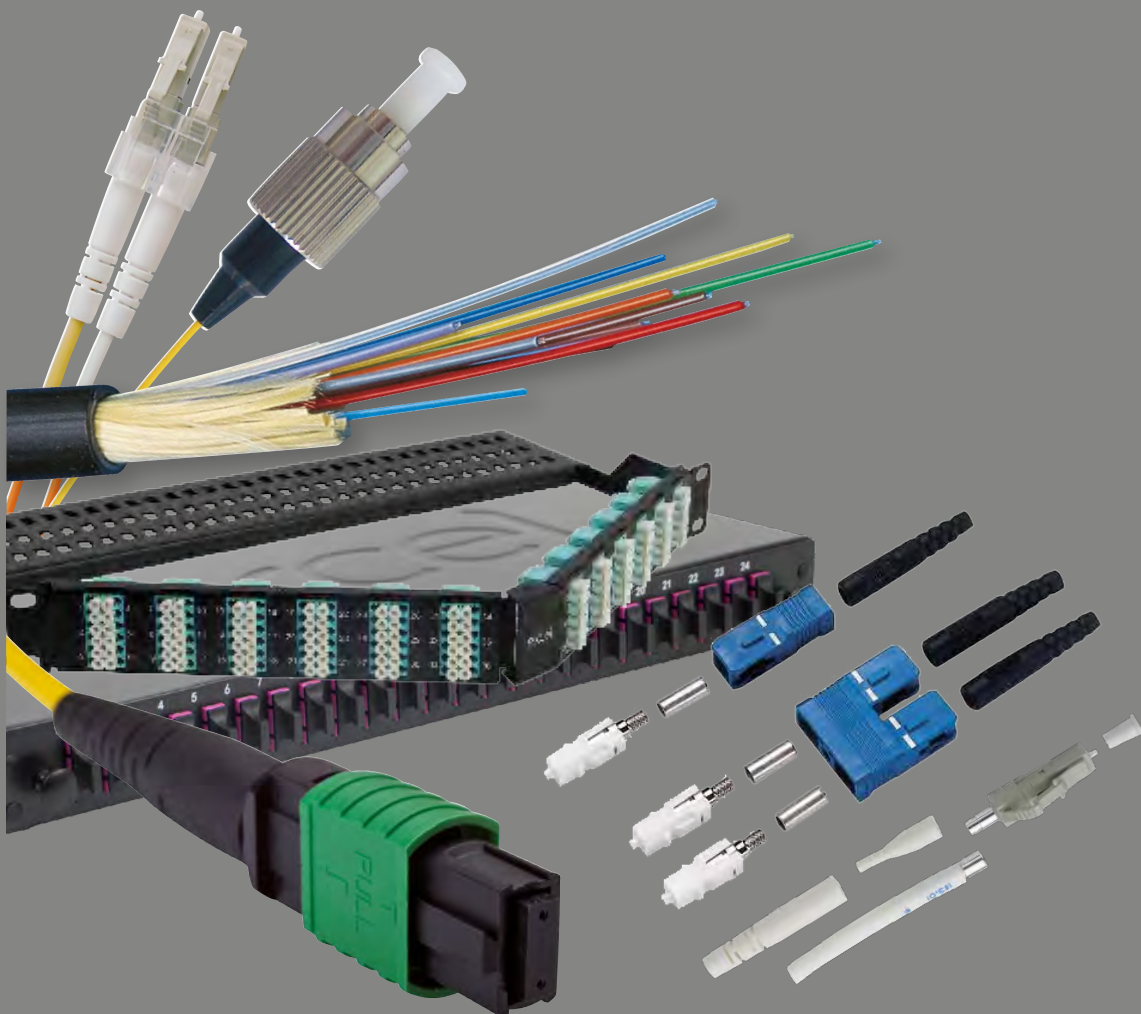
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Overview of Fibre Optics

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.

Fibre optic systems have the benefit over copper with respect to the maximum achievable distance. For a standards compliant installation, copper is generally limited to a maximum of a 100m channel, whereas fibre may support some applications for many kilometres. For this reason fibre optics have traditionally been used in the backbone - typically linking telecommunications rooms - and copper is traditionally used 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-conductivity. This mitigates the need for 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 blockers 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).

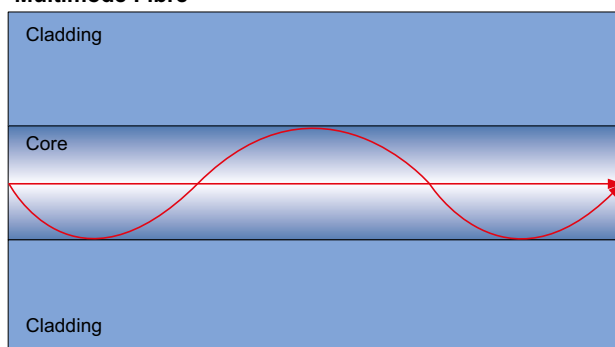
Multimode & Singlemode

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.

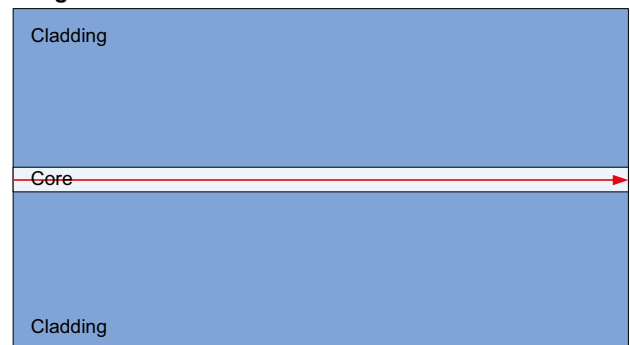
Multimode can use the less expensive LED and VCSEL light sources to transmit the signal. This is referred to as 'overfilled' as the source is broad and floods the modes (and some of the cladding, hence overfilled). The core is manufactured with a graded index. This means that the central light path is '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

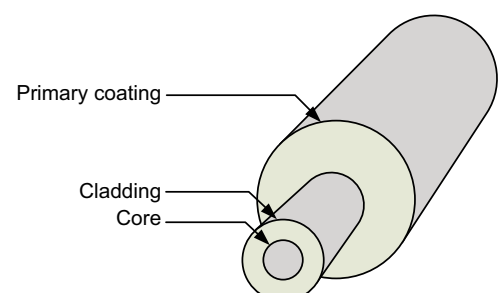


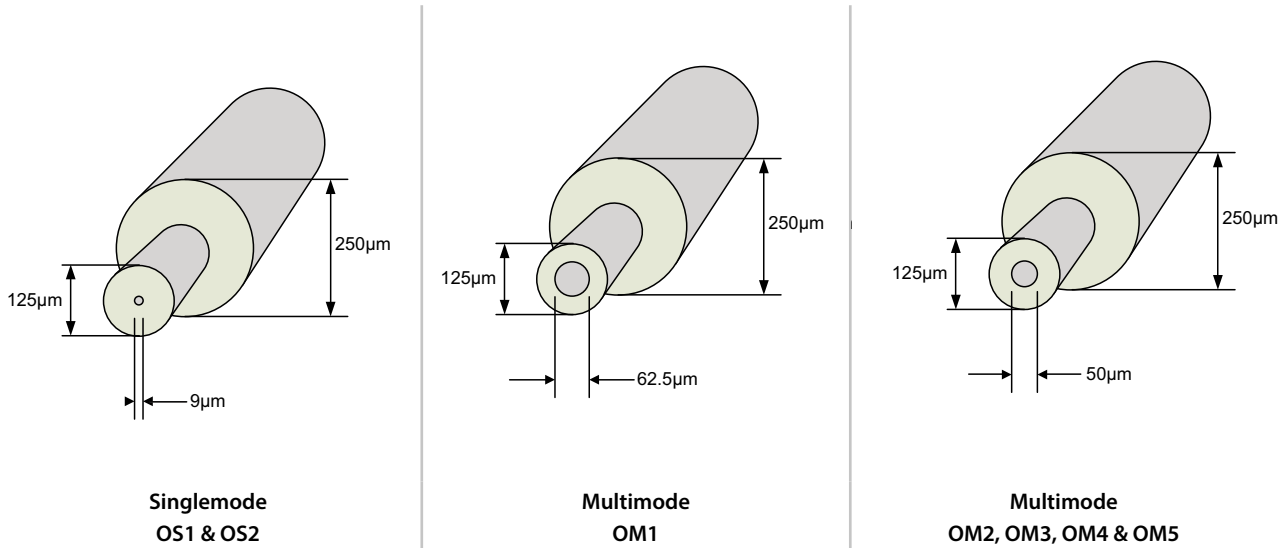
Singlemode Fibre



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 125µm. Likewise, the primary coating is usually 250µm for both multimode and singlemode. The primary coating can be coloured to differentiate between the cores within a cable.





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 buffed 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 buffed singlemode fibre supports OS2. 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 the transmitting source being 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.

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.

Multimode

Two common dimensions exist for multimode, 62.5/125µm and 50/125µm. For new installations the recommendation is to standardise on OM3, OM4 or OM5. Consideration should be given to OM4 and OM5 for support of the emerging 40 & 100 Gigabit Ethernet standards. These will be accomplished with parallel optics which will influence the connector selection. With the release of Enbeam OM5 now allowing 40 & 100 Gigabit to be transmitted over 2 Multimode fibres by transmitting over 4 wavelengths (850, 880, 910 and 940nm) by short wave division multiplexing (SWDM). All Enbeam OM5 is backward compatible with all Enbeam OM3 and OM4 installations.

µm

1µm (or 1 micrometres) is 0.000001m or 1x10⁻⁶m. Although the correct name is micrometres it is often referred as microns which is the 'slang' term.

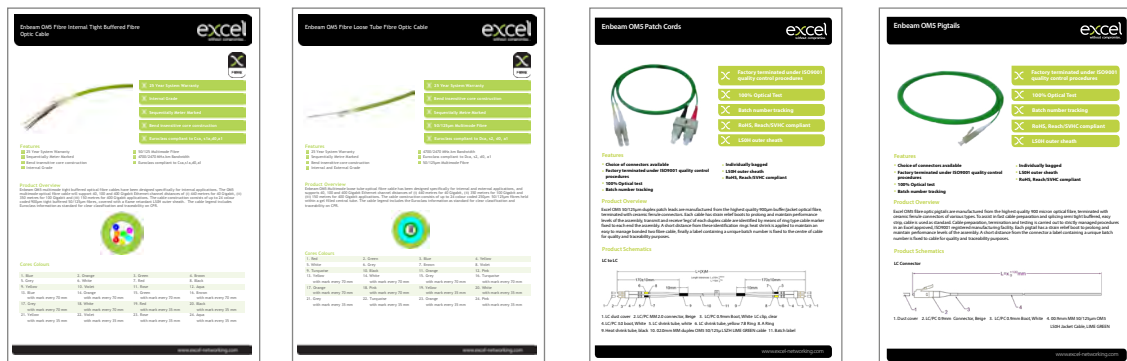
History of OM5

Over the past thirty years, multimode fibre has evolved from OM1 to OM5 fibre. With OM1 and OM2 fibre being released at the end of 20th century, which have now become the legacy 125µm multimode fibre, continues to work well in 10Mb/s, 100Mb/s and 1000Mb/s cabling solution. With the increasing demand for high speed data rate like 10Gb/s, 40Gb/s, 100Gb/s, OM1 and OM2 cannot meet the requirements, so OM3 and OM4 was developed. OM4 fibre cable, with its internal construction, gives higher modal bandwidth than OM3 fibre, which is commonly used as a medium for 40G/100G connection. This causes issues in 40G applications, fibre optic installations had to use one MTP fibre and 4 OM4 duplex fibres (a total of 8 fibres), which causes cable congestion in high-density networks.

The TIA initiated a working group in 2014 to develop guidance for Wideband Multimode fibre (WBMMF) to support Short Wavelength Division Multiplexing (SWDM) transmission, As OM3 and OM4 fibre bandwidth is typically only specified at 850 nm these were not up to the levels needed.

The TIA-492AAAE standard for WBMMF was published in June 2016 and as a result specification for a WBMMF was called for, WBMMF is effectively a type of OM4 fibre, as the WBMMF still has to meet the OM4 bandwidth criteria of EMB ≥ 4700 MHz-km at 850 nm and with the additional EMB specification at 953 nm of ≥ 2470 MHz-km.

An international vote in October 2016 gave WBMMF a three-digit designation, and OM5 fibre was born.



Loose Tube & Tight Buffer Cable Construction

The traditional use of fibre was in external environments. The cable is made up of a central 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 24) 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 strength member, 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 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.

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 fibres are surrounded with aramid yarn and an overall jacket sheath. The jacket is offered in various materials depending upon the environment.

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.





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.

Connectors – ST, SC, LC, MTP

A more compact version of the patch cord uses 2 fibres within a single jacket of 2-3mm diameter. These are referred to as uniboot patch cords and are particularly useful for LC connections in high density applications.

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

	<p>LC – 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.</p>
	<p>SC – 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.</p>
	<p>ST – 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.</p>
	<p>MTP – also referred to as MPO a Multiple fibre Push On, Pull Off connector which presents 8, 12, 16 or 24 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).</p>

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 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 intensive 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 end 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 fibre cores and splices 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".

Cable containment

Over the years and ever-expanding networks of today, cable containment is a key part to the performance of all Data cabling regardless of whether it is fibre optics or a Copper based solutions.

Incorrect selection of containment can result in loss of signal, damage to cables, overcrowding which in copper based installations where POE (Power over Ethernet) is in use could result in excessive heat generation.

Types of containment available:

Type	Primary Use	Secondary use	Environment
Galvanized Metal Box Trunking	Electrical	Copper/Fibre	Industrial
Cable Tray	Electrical	Copper/Fibre	Industrial, Data Center and Co-Location
Basket Tray	Electrical	Copper/Fibre	Industrial, Data Center and Co-Location
Ladder Rack Raceway	Copper	Fibre	Industrial, Data Center and Co-Location
Plastic Duct System	Fibre Optics		Data Center and Co-Location

Galvanized Trunking

Galvanized Trunking is often used for Electrical cabling within the industrial environment and you will find copper and fibre based installations using the same containment, however it is important to note any copper / fibre based product should be kept separated from any power often achieved by using three compartment trunking this stops any electrical magnetic interference (EMI) being transferred across to the data cabling. Fibre is not affected by EMI but it is best practice to keep all three separated at all times for clear demarcation & serviceability and also reducing any chance of the fibre cables being Crushed under the weight of copper cables.

Cable Tray

Cable Tray is common in many installations. The down-side of cable tray is the inability to separate cabling types as with the galvanized trunking. Each cable type should have its own containment path.

The down-side to cable tray is the need to use cable ties to first secure the cables into bundles and then to secure each bundle to the tray, this can also have an effect on cable performance due to cable ties being pulled too tight altering the construction within copper cable or causing macro bends and losses in fibre.

Basket Tray

Basket Tray is very similar to the above, designed to be more cost effective and quicker to install but with the same limitations as cable tray in separating cable types and the use of cable ties.

An additional issue is cable sag were the weight of the cable installed fall down between the bars of the tray causing macro bends that again cause signal loss of construction changes within the cable. A solution to the macro bend issue is to lay cable matting along the basket to allow a flatter surface to mount cable on.

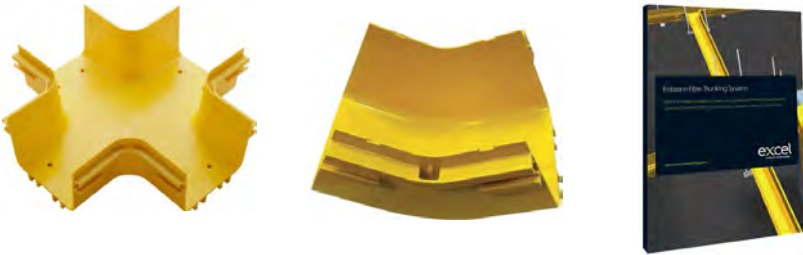
Ladder Rack Raceway

Ladder Rack Raceway is similar to the cable tray and basket tray in having limitations in the separation of cable types and the macro bend issue. Having the same solution in having to lay extra matting to eliminate macro bends, all three also have limitations on the amount of cable that can be stored due to the depth of the solution being used.

Dedicated Plastic Duct System

With the above systems offering partial solutions for cabling pathways, dedicated systems come into play. As the amount of fibre optic cabling being used in the networks of today has increased, the need to have dedicated containment is apparent, the yellow duct systems seen today in some of the largest datacentres and co-location sites offer a well-controlled bend radius for fibre, along with the depth needed to install multiple fibre optic cables without the need to install restrictive and sometimes damaging tie wraps to secure cables. For example - the Enbeam 240mm x 100mm deep ducting system at 75% capacity can hold above 2866 x 2mm cables. This system can also be installed with covers to eliminate contamination, keeping the network free from dust.

This also offers a good visual identification for fibre optic pathways. Whilst all of the above carry electrical and copper based solutions keeping the fibre optics away from heavy cables eliminating the possibility of damage.



[Watch our Video](#)

Testing

Testing of the installed fibre optic network is vital as it assures compliance with the design. Please refer to Section 12 – 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 connections 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 meter.

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 is 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. The 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.

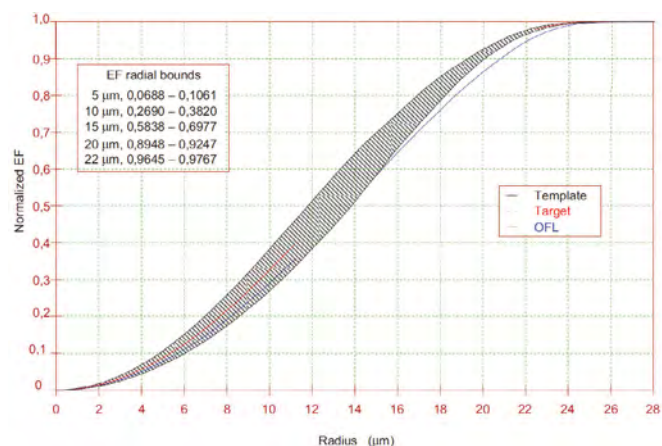
Multimode, on the other hand, has many paths. Modern fibre optic equipment uses a VCSEL (Vertical Cavity Surface-Emitting Laser), which is a low power device designed for use with multimode fibre. As the device is a form of laser it does not use all of the modes for the transmission of the signal. Therefore, 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 below.

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 wave length used. The graph is an example of 50 μ core fibre at a wavelength of 850 nm.



EF requirements

50 μ Core – OM2, OM3, OM4 & OM5

850 nm			
Radius μ 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 μ 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 μ Core – OM1

850 nm			
Radius μ 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 μ 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, due to 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.

EN50346 – Information technology – Cabling installation – Testing of installed cabling and 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-8000



S5

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.

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, OM5, OS1, OS2	2.55	1.95	1.80	1.80
OF-500	OM1, OM2, OM3, OM4, OM5, OS1, OS2	3.25	2.25	2.00	2.00
OF-2000	OM1, OM2, OM3, OM4, OM5, 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	850 nm	953 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	-
OM5	50/125µm	3500 MHz.km	500 MHz.km	4700 MHz.km	2470 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.

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	OM5
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	440m (40 Gigabit)
100GBASE-SR10 (100 Gigabit)			100 m	150 m	350m (100 Gigabit)
100GBASE-SR4 (100 Gigabit)				100 m**	150m (400 Gigabit)

* distance specific to Excel fibre

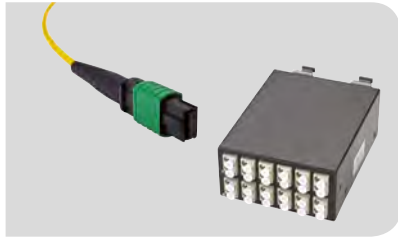
** under development, correct at time of publication

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

Excel Enbeam Fibre Optic Cabling Systems

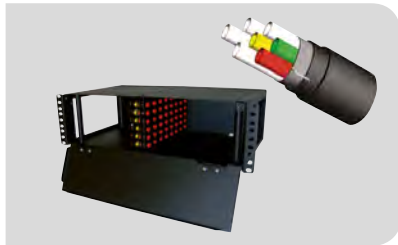
When installed by an accredited Excel Partner the Enbeam fibre range is covered by a 25-year system and application warranty.

The Excel Enbeam Fibre Optic Cabling Systems range includes:



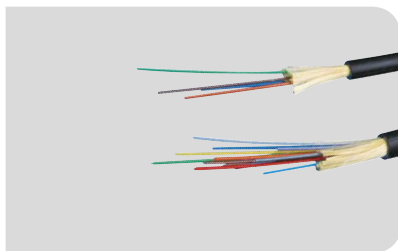
Enbeam Excelerator MTP System

- Provides a reliable, rapidly deployed solution to high density fibre cabling
- Choice of OM3, OM4 and OS2 systems
- Unloaded HD panel accepts up to 12 fibre optic cassettes
- Various panel & cassette options available
- MTP® Trunk cables offer pre-terminated factory tested optical fibre
- Uses the US Conec MTP® Elite connector



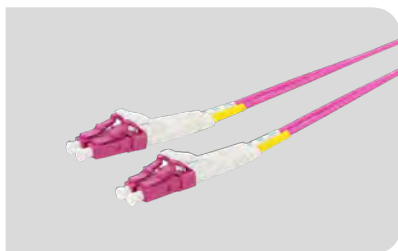
Blown Fibre System

- 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 Enbeam Internal/External Grade Fibre Cables

- Available in a choice of loose tube or tight buffer
- Available in OM1/OM2/OM3/OM4/OM5/OS2
- CST Fibre cable available
- SWA Fibre cable available
- Core counts from 4 to 96



Excel Enbeam Fibre Optic Patch Cords

We have all heard the term 'it's only a patch cord', however money spent installing multi millions worth of infrastructure in data centres, and even smaller installations running high dependency equipment can fail quite quickly buy cutting costs on these areas.

Enbeam patch cords are manufactured from high quality materials and are 100% factory tested.

- Available in OM1/OM2/OM3/OM4/OM5/OS2
- Connector types include ST, SC, LC and FC
- All connectors are polished to UPC/APC quality
- All patch cords come with an LSOH outer sheath
- Supplied with a test report detailing insertion loss
- Individually bagged and labelled



Enbeam Pull Tab uni-boot patch cord

As industries change to High density patching, some changes to the patch cord industry also has to change, there are many solutions in the market that offer LC patch cords with pull tabs. These tabs are used to remove and install patch cords into high density patching fields where finger access is limited.

Another change is the use of Uni-boot housings on the connector. This allows the use of a single cable with 2 fibre cores removing the need for the traditional dual zip cord cable. This reduces the overall cabling volume by 50% and is key to a reducing congestion within frames and racks.

Other key features also used within uni-boot patch cords are the ability to reverse the polarity, often needed within fibre installations, depending on which polarity technique is used "A-to-B" patch cord for "straight-through" wiring and "A-to-A" patch cord for "crossover" wiring.

The Enbeam Pull Tab uni-boot patchcords have been designed to accommodate all the above features with an additional feature being the pull tab can be removed, limiting removal of the patchcords in error or as a deterrent within the high-density field.



Excel Enbeam Pigtailed

- Available in OM1/OM2/OM3/OM4/OM5/OS2
- Pigtail types include ST, SC, LC, FC – all UPC and APC
- Choice of 1m or 2m lengths
- Available as tight or loose construction
- Supplied with a short strain relief boot
- Supplied with a test report detailing insertion loss

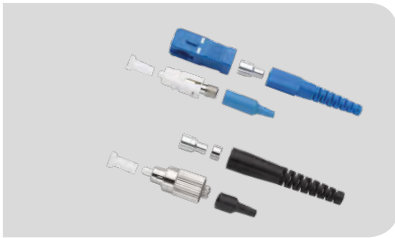
Unlike fibre optic patchcords (cable terminated with fibre connectors on both ends), fibre optic pigtailed are single fibres terminated with connectors at one end, while leaving the other side with no connector, so that the connector side can be linked to the equipment and the other side can be spliced with the live incoming fibre cables by fusion splicing or via a mechanical type of splice. High quality pigtailed with correct fusion splicing practices offer the best performance for cable terminations. They are usually used within a fibre optic patch panel or Optical Distribution Frame (ODF) and most applications requiring connectors to be installed to multiple fibres in one area.

LC Fibre Optic Pigtail: LC connector features a low loss, high precision 1.25mm ceramic ferrule. LC fibre optic pigtailed are suitable for high-density installations.

SC Fibre Optic Pigtail: SC connector is a pull/push connector with a 2.5mm ceramic ferrule. It is light weight, robust and economical to use in different applications such as CATV, LAN, WAN, test and measurement.

FC Fibre Optic Pigtail: the pigtail uses the metallic body FC optic connectors. FC connectors have a screw type structure and high precision ceramic ferrules. FC fibre pigtailed are not so widely used in networks due to the changes in infrastructure.

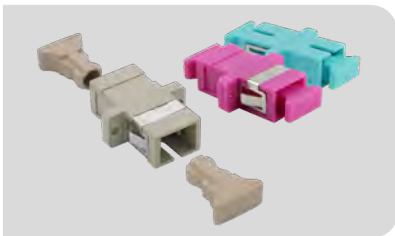
ST Fibre Optic Pigtail: ST fibre optic connectors have a 2.5mm diameter ceramic ferrule, with alloy or plastic bodies. ST fibre pigtailed are not so widely used in networks due to the changes in infrastructure.



Excel Enbeam 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 ferrules
- Both 900µm pigtail and 2 or 3mm cable boots included

Single mode OS1 & OS2 = Blue
 Single mode Angle polished (APC) = Green
 Multi-mode OM1 & OM2 = Beige
 Multi-mode OM3 = Aqua
 Multi-mode OM4=Heather Violet
 Multi-mode OM5 = Lime Green/ Beige



Excel Enbeam Fibre Optic Adaptors

- Available in ST, SC, LC, FC and MTP
- Choice of singlemode or multimode on SC, SC/APC, LC, LC Quad and FC Adaptors
- Choice of aligned-key or key-up/key-down on MTP adaptors

As development in data speeds increase we have seen several changes especially in Multi-Mode, as these changes occur the industry needs a way to clearly identify different types of cabling visually rather than performance, this is why you now see multiple colours of adaptors on the market, these colours have been designated by the TIA standards body to enable clear visual identification of all connection types.

Single mode OS1 & OS2 = Blue
 Single mode Angle polished (APC) = Green
 Multi-mode OM1 & OM2 = Beige
 Multi-mode OM3 = Aqua
 Multi-mode OM4= Heather Violet
 Multi-mode OM5 = Lime Green/ Beige



Excel Enbeam Shuttered Adaptors

Within the Industry you will hear a lot of people talking about shuttered adaptors and the way in which they protect the connector from dust, this is in fact a secondary result of having a shutter. The main reason for a shutter is the power of the laser used in single mode applications can seriously damage your eye sight if looked at directly; shuttered adaptors use a sprung loaded cover that falls in front of the adaptor blocking the laser signal when unplugging the patch cords. With the increasing need to install Fibre to the home, within datacentres and co-location it removes the change of injury and protects the engineer when performing maintenance tasks such as cleaning.

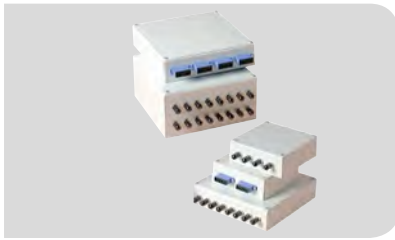
This forms a very important solution to today's ever-growing health and safety policies as it removes the need to replace dust caps in adaptors when patching and un-patching and protects the public from injury.

The secondary benefit is it limits dust ingress.



Excel Enbeam 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 Enbeam Fibre Optic Patch Boxes

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

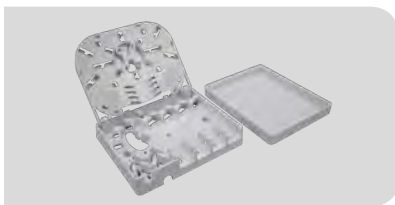
Patch boxes come in various sizes and adaptor types but offer a lower cost solution to installations requiring small fibre counts to be distributed into remote areas or floors of a building.



Excel Enbeam Fibre Optic Wall Mounted Enclosures

- Designed for high-density, secure terminations
- Available in ST, SC Duplex, FC and LC in-line adaptor plates

Wall mounted fibre optic boxes have a wide range of applications from small office environment to medical and industrial applications, the double door versions are normally used to segregate splicing areas from the patching fields allowing restricted access to the splice area normally controlled by the service suppliers.



Excel Enbeam FTTX Solutions

Fibre optic cabling is becoming the leader in the access network FTTX. This can be split down into different architectures: Fibre to the Home (FTTH), Fibre to the Building (FTTB), Fibre to the Kurb (U.S. spelling 'Curb' - FTTC) and Fibre to the NODE (FTTN)

FTTH: Fibre is distributed from the Central Office Optical Line Terminal (OLT) to residential areas via distribution points and splitters to feed off into the end users' home. This solution does not use copper cabling in the outside plant and can typically provide speeds from 30 to 100Mbps.

FTTB: Fibre is distributed using a point to point architecture in outside plant giving a dedicated connection to each building or blocks of buildings. This is achieved by the use of remote terminals, however these need power and are normally situated in a secure area such as basements or communication rooms, and will then use the existing building infrastructure to distribute the signal.

FTTC: Fibre is distributed to remote terminals located at the road side between 150 and 300m from the end user, where existing copper infrastructure - normally existing Copper based Phone lines are used to bring the signal into the residence.

FTTN: The same as FTTC but the remote terminal is further away - around 1500m from the residential area and service between 300 to 500 users. This method also uses existing copper infrastructure to continue the signal onto the end user.



Excel Enbeam FTTH customer outlets

Enbeam have a range of FTTH customer outlets aimed to feed the FTTH market offering dedicated internal fibre management to protect the incoming fibre. Shuttered adapters can be installed to requirements for customer safety.



Excel Enbeam MDU Boxes

Whist Multi Dwelling Units (MDU) are used to distribute fibres into dwellings and individual properties, it is not the sole application. These types of boxes are suitable for any application requiring multiple connections distributed within a particular area. These units are normally manufactured to be installed internally and externally with wall and pole mounting options. The box allows easy access for connectivity or disconnect and are normally lockable for security. The Enbeam MDU can be installed in all applications, giving a flexible solution to numerous installations.

- LC Duplex
- SC Simplex
- ABS Material ensures a strong lightweight enclosure
- Water resistant for outdoor and internal use
- Designated splitter area



Excel Enbeam Splice Enclosure

Fibre Optic Splice Closures (FOSC) - also known as Dome Enclosures, are used in the network to distribute network feeder cables in different directions to enable coverage of a wider area. This is achieved by breaking into the feeder cable and splicing to another cable going in a different direction to the main feeder cable (Branching). Key features to these enclosures should include:

- Ability to re-enter multiple times
- High IP Rating against dust and water (IP68)
- Pole or wall mounting
- Multiple cable entry points

Enbeam Enclosures now offer mechanical sealing methods rather than the old heatshrink method to seal the unit. This allows the enclosure to be reworked multiple times without the need to cut heatshrink or the use of a flame against fibre optical cables.

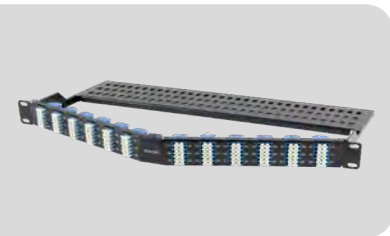
Most other enclosures in the market will only include the enclosure - then all other installation parts will need to be purchased separately increasing the overall cost of these types of enclosure. The Enbeam Enclosure includes all materials needed to fix the unit to a pole or wall and all termination material to splice to a cable, making the Enbeam Enclosure cost effective and easy to order.



Excel Enbeam high density patching solutions

Expanding network and the volume of connections needed in the industry, and the need to utilize all existing space to save costs throughout all installations has pushed the terminology known as High Density or Ultra High-Density patching to the top of the list in datacentre and telecommunication designs. The use of high density patching has pushed the design of panels toward MTP and LC connectivity, which in turn creates its own problems to overcome.

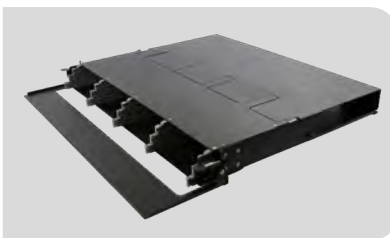
The main issue in high density patching is finger access for engineers to be able to patch and un-patch connections. As connections become closer, space is limited not only for the engineers but also the ability to label the panels adequately to identify the connections.



Excel Enbeam 1U 144 Fibre Angled Panel

Excel has designed the Enbeam 1U 144 fibre LC angled panel. In conjunction to the angled panel a new 12 fibre LC adaptor has been developed to enable good finger access and labelling to be applied.

The panel has been designed for pre-terminated connection to the rear of the panel with rear cable management included. The angled design of the panel reduces the bend radius of the patchcords at the front of the panel and allows the fibre to enter cable management at the side of the installed panel with no stress being applied to the patch cord. No separate patchcord managers are needed, further saving U space within the cabinet.



Excel Enbeam 1U 144 High Density Cassette Panel

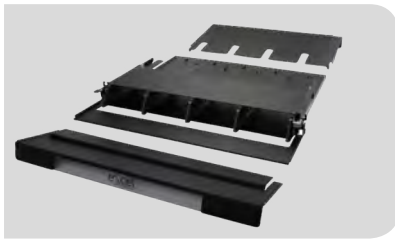
Excel has designed the Enbeam 1U 144 high density cassette panel to enable horizontal LC patching in groups of 12 fibres per cassette. The panel holds 12 cassettes which gives it 144 fibre capacity. These cassettes have several options available to give total flexibility in any situation, splice, pre-termination and MTP pre-configured cassettes are available.

The use of magnets within the design of the cassettes and cable management offer a unique flexible solution to installations and management of fibre.

The modular design allows the installation to grow as the network grows by adding cassettes when required. Each cassette can be installed from the front or rear of the panel giving greater flexibility.

Each panel is supplied with magnetic covers front and rear to protect fibre from damage, along with hinged cable management allowing access to the panels below or above.

There are several areas where 1U high density panels are used, Top of Rack (TOR), End of Row (EOR).



Top of Rack: The term has been adopted for the way in which switches are installed into Racks. Although switches can be installed anywhere in this application - middle or even bottom of the rack, top of rack is the most common method. In this configuration, the rack cable management is easier to manage and more accessible. This is adopted to enable each rack to be modular in its construction, reducing copper connections to short lengths, giving better cable management and allowing servers and switches to be changed or upgraded, with limited disruption to the network. Each rack is then connected to the core via fibre, reducing the high congestion and routing problems caused by copper infrastructure. It reduces the number of racks and patch panels needed for patching.

Top of Rack advantages:

- Copper stays "In Rack". No large copper cabling infrastructure required.
- Lower cabling costs. Less infrastructure dedicated to cabling and patching.
- Cleaner cable management.
- Modular and flexible
- Future proofed fibre infrastructure
- Short copper cabling to servers

Top of Rack disadvantages:

- More switches to manage.
- More ports required in the aggregation.
- Potential scalability concerns
- Unique control plane per 48-ports (per switch),
- Higher skill set needed for switch replacement.

End Of Row: The term "End of Row" describes a rack or cabinet placed at either end of the "server row" for the purpose of providing network connectivity to the servers within that row. Each server cabinet's design has a bundle of copper cabling (typically Category 6 or 6A) containing as many as 48 (or more) individual cables routed to the "End of Row". For a redundant design there might be two bundles of copper to each rack, each running to opposite "End of Row" network racks. These bundle of copper cables are typically terminated on one or more patch panels fixed to the top of the cabinet and connected to the server by short patch cords. Copper bundles are routed underneath a raised floor or overhead on basket or ladder racking. Depending on how much copper is required, it is common to have a rack dedicated to patching all the copper cable next to the rack that contains the "End of Row" network switch. RJ45 patch cables are used to link a port on the network switch to a corresponding patch panel port that establishes the link to the server. With this design the large amount of Copper patching can become un-manageable. Another variation of this design can be referred to as "Middle of Row" which involves routing the copper cable from each server rack to a pair of racks positioned next to each other in the middle of the row. This approach reduces the extreme cable lengths from the far end server cabinets, however potentially exposes the entire row to a localised disaster at the "Middle of Row" (such as leaking water from the ceiling) that might disrupt both server access switches at the same time.

End of Row advantages:

- Fewer switches to manage.
- Potentially lower switch costs,
- Lower maintenance costs.
- Fewer ports required in the aggregation.
- Longer life,
- High availability,
- Modular platform for server access.
- Unique control plane per hundreds of ports (per modular switch),
- Lower skill set required to replace a 48-port line card, versus replacing a 48-port switch.

End of Row disadvantages:

- Requires an expensive, bulky, rigid, copper cabling infrastructure.
- Cable management challenges.
- More infrastructure required for patching and cable management.
- Long copper cabling limits the adoption of lower power higher speed server I/O.
- More future challenged than future proof.
- Less flexible "per row" architecture.
- Platform upgrades/changes affect entire row.



Excel Enbeam Fibre Optic Patch Panels

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

Sliding fibre trays are one of the main components in most fibre optical installations, used to distribute fibre across the network. Any fibre tray should be designed in such a way to allow high quality protection of incoming fibre.

Most industry standard panels will be manufactured from steel, giving a strong housing to protect the fibre. It is important that these panels provide adequate room for fibre to be routed around the panel and respect the bend radius of the fibre optic cable being installed. Smooth operation when opening and closing the panel is key as poor operation can cause fibres to become trapped and broken if the panel does not function correctly. Provisions for splicing should be made and give adequate positions for splice protectors to be held securely, either by the way of a splice bridge or dedicated splice tray.

Another feature sometimes overlooked is a clear area for labelling as this has an effect on the running of any network. Without clear labelling, re-patching and maintenance carried out over time will cause network issues.

The Enbeam panel has been designed to take all the above issues into account plus more. It offers one of the best designed panels in the market

- Ball-bearing sliding drawer for smooth operation
- Recessed adaptors provide larger labelling field and better bend radius for patch cords
- Optional patch cord management bar with additional labelling options
- Greater range – OS2, OM3 and OM4
- Blue (OS2), Aqua (OM3) and Heather Violet (OM4) adaptors
- High quality zirconia ceramic alignment sleeves
- Options for pre-loaded splice cassettes
- Options for pre-loaded 12-colour pigtailed
- Full installation kit included
- 24-way splice holders included
- Ideal for both splicing and pre-terminated cables




The Enbeam Fibre Optic patch panels come in a range of configurations. This includes different adaptor types and quantities. Each patch panel is supplied with an accessory kit. Special panel configurations can also be supplied, such as hybrid panels with a mix of adaptors etc.




Excel Enbeam 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.

Key	
Singlemode	Multimode
OS2 OS2-APC	OM1/OM2 OM3 OM4

Excel Fibre Optic Patch Panel Configurations

ST - Simplex				SC - Simplex			SC - Duplex		
									
Adaptors	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode
4	4	200-377	200-427				8	200-401	200-480
6							12	200-405	200-481
8	8	200-378	200-428				16	200-406	200-482
12	12	200-379	200-429	12	200-486	200-484	24	200-407 203-530 204-530	200-483
16	16	200-382	200-430						
24	24	200-384	200-431	24	200-487	200-485	48	200-408 203-532 204-532	200-411
Empty	-	200-950		-	200-952		-	200-951	

LC - Duplex				Quad - Duplex			LC - Duplex shuttered		
									
Adaptors	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode	Fibres	Multimode	Singlemode
4	8	200-460	200-470	8			8		
8	16	200-462	200-472	16			16		
12	24	200-464 203-540 204-540	200-474	24			24	203-550 204-550	
24	48	200-466 201-622 201-626 203-542 201-623 201-627 204-542	200-476 201-620 201-624 201-621 201-625	48			48	203-552 204-552	
24	96			96	200-489	200-488	96		
Empty	-	200-952		-	200-951				

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_A Screened, Category 6 Screened and Unscreened, LC fibre with traditional termination or to MTP connector. Pre terminated options are also available.



Watch our Video

The Excel Mixed Panel is suitable for installations from data centres, where the 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 finish and comes in a choice of a 4 or 8 module panels 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 _A Screened Module
100-232	Excel Mix Use Blank - Pack of 5

Blown Fibre Overview

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 burial 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.

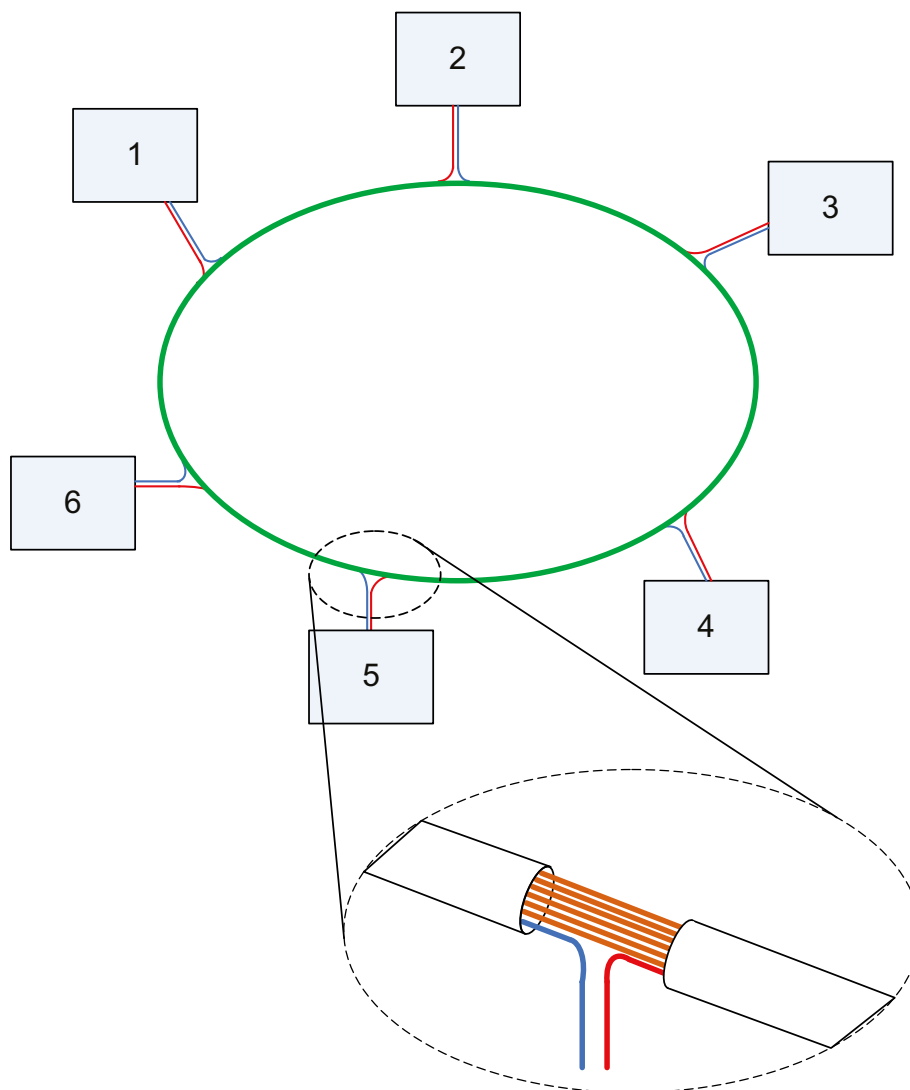
The need for maintenance in itself is greatly reduced by using blown fibre. Blowing fibre is a smooth process as the cable travels effortlessly down a tube, with no interference. In comparison, using the more traditional pulling method can cause damage to the cable which may shorten its life and may 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.



Duct	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).
Fibre Unit	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, OM4 & OS2 and a combination thereof if required. Fibre units can be made with any fibre optic core.
Dark Fibre	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.

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 Excel 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.

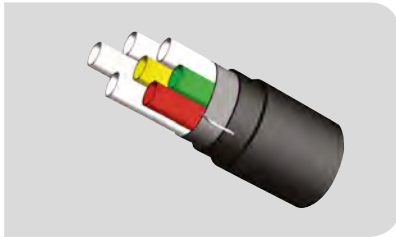
Blown Fibre Systems provide a simple solution to manage evolving network demands without the need for high initial capital expenditure or extensive network planning. The system enables optical networks to adapt to changing business requirements and allows optical fibres to be deployed on demand from 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, can provide a flexible, low total life cost and 'peace of mind' solution.

Just some of the key benefits include:

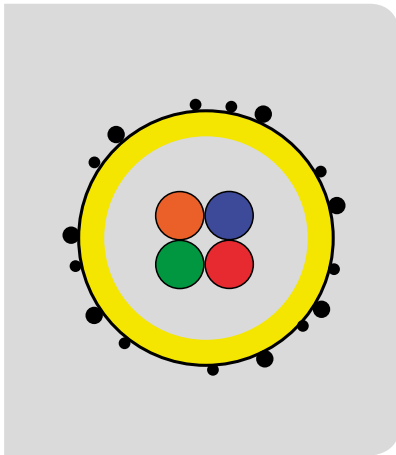
- It uses new, innovative technology and state of the art equipment
- It uses multiple fibres
- Fibres that are blown out can be reused
- The blows can be cascaded
- It is a total cable solution
- It offers integrity and extra length
- The tube can be tested before the fibre is blown in

Blown Fibre Systems are 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)

- 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 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 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)
- Available in OS2 singlemode, OM3 and OM4 multimode constructions



Connectivity

The system provides an extensive range of connectivity products including:

- Full range of 19" 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 system including:

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



Installation Equipment

- Blowing Head - used in conjunction with the compressor to blow in the EPFU
- Compressor - available as an electric or petrol version
- Stilt - tests the 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.



Service at the core.

ENBEAM

Flexible, scalable, ultra high performance fibre optic systems from Excel

Enbeam from Excel introduces unrivalled levels of technical and service support when selecting and purchasing fibre optic systems for LAN and DC environments. From online ordering, next day delivery, in house termination facilities, through to free technical support, white papers and national demonstration centres, you can be assured of peace of mind by choosing Enbeam.

DISCOVER ENBEAM:
excel-networking.com

excel
without compromise.

Excel Labelling Solutions

Section 6

In this Section:

[Bespoke Laser Engraved Labelling Solution](#)

[Availability](#)

[The Sharpmark Labelling Solution](#)

[Why choose labelling from Excel?](#)

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S6



Labelling

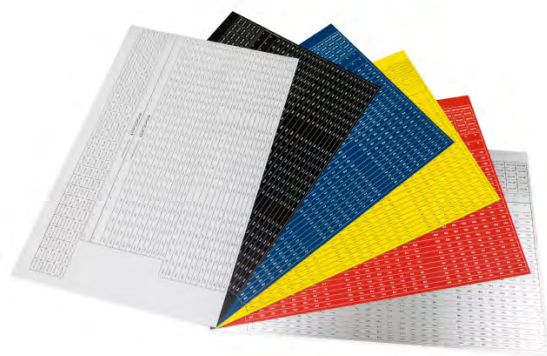
Excel's comprehensive range of labelling solutions ensures that every application is professionally labelled from the moment it is installed.

Excel offers a variety of labelling services to suit any requirement. Whether you are installing cabinets, patch panels, GOPs, outlets or cable, labelling is a crucial stage of the project to ensure the finished product is as efficient as possible for the end user. With specialised laser engraved technology and access to Sharpmark software, Excel has the capacity to offer a bespoke, "made-to-measure" service, even down to whether the labels are pre-affixed to your equipment or sent as standalone label sheets.

S6

Bespoke Laser Engraved Labelling Solution

Using laser-engraved technology and specially developed materials, Excel offers a cost-effective solution to your labelling needs. Our range of templates is continuously evolving as the service develops, so we can offer an infinite array of labels in a number of colours to suit any cabling solution. The labels are printed in a sheet format, and with the provision of customer specification, we can provide them as individually printed adhesive sheets or already attached to the equipment ordered. The laser cuts in a direct straight line meaning there is no border around each label. For smaller label sizes, this means we can make the most of every millimetre of printing space. We are able to cut any shape of label required, although primarily our service will revolve around networking infrastructure. With that said, thanks to the accuracy and precision of the laser printing technology, we are able to engrave company logos onto the labels for enhanced aesthetics, making the installation individual to the customer.



How does it work?

The label sheets are made using a plastic base sheet covered with a micro-thin layer of ink which is protected by a specialised coating. The laser essentially vaporises the top colour coating to reveal the colour of the base sheet, which ultimately explains the colour of the label text. The rear is then coated in a high-performance 3M adhesive, which has been tested to operate within a temperature range of minus 30 to over 70 degrees Celsius.

Features

- 2-colour laminate sheets
- Acrylic composition
- Strong adhesive backing
- Range of colours, shapes & sizes
- UV resistant
- Laser engraved
- High quality
- Same day despatch

Technical Specifications

- Material - Acrylic
- Thickness 0.9mm nominal
- Adhesive back - 3M 467MP
- Maximum sheet size: 300mm x 450mm
- Temperature range: -30C to +70C
- Fire classification UL94 HB
- Electrical insulator
- RoHS compliant



Watch our Video

Availability

L-FP-10-XX/XX	Full panel (24-way) up to 450 x 10mm high
L-FP-15-XX/XX	Full panel (24-way) up to 450 x 15mm
L-FP-44-XX/XX	Full panel mask label - up to 450 x 44mm
L-HP-10-XX/XX	Half panel (12-way) up to 225 x 10mm high
L-HP-15-XX/XX	Half panel (12-way) up to 225 x 15mm high
L-HP-44-XX/XX	Half panel mask label - up to 225 x 44mm
L-OT-XX/XX	Outlet label (up to 20mm x 15mm)
L-RK-S-XX/XX	Rack label - Small (up to 20mm x 50mm)
L-RK-M-XX/XX	Rack label - Medium (up to 30mm x 80mm)
L-RK-L-XX/XX	Rack label - Large (up to 50mm x 100mm)
L-RK-XL-XX/XX	Rack label - Extra Large (up to 75mm x 100mm)
L-LM-S-XX/XX	Loom Label (with 4 holes) - Small (up to 10mm x 50mm)
L-LM-M-XX/XX	Loom Label (with 4 holes) - Medium (up to 15mm x 80mm)
L-LM-L-XX/XX	Loom label (with 4 holes) - Large (up to 20mm x 100mm)
L-LM-XL-XX/XX	Loom label (with 4 holes) - Extra large (up to 30mm x 150mm)

XX/XX denotes colour

BLUE BL/WT	WHITE WT/BK	ORANGE OR/WT
YELLOW YW/BK	BLACK BK/WT	VOILET VT/WT
RED RD/WT	SILVER SR/BK	GREEN GN/WT

How to Order?

- Place your order as normal with your local sales team.
- In a spreadsheet format, provide your sales rep with:
 - The part number(s) for the item(s) to be labelled (if Excel products) or exact dimension details of third party items
 - Label size and colours required, including full/half panel and specific height requirements – according to Excel Networking part codes (see above and insert the colour code as required)
 - Quantity of labels required
- Details of specific printing required, in accordance with job specifications
- We will pass this information to our labelling specialists who will produce your labels to either be shipped as label sheets, or to be affixed to other items in your order prior to it being delivered.

The Sharpmark Labelling Solution

You can use the free web-based software to create your labels. The software can be accessed here:-

<http://cloud.sharpmark.com/>



Things you can do with the Sharpmark labelling solution:

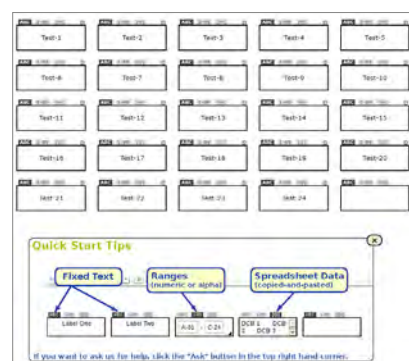
- Choose coloured backgrounds and / or text for your labels
- Import from Excel (or other spreadsheets)
- Run both simple and complex numbering sequences by simply entering start and end points of sequence
- Build up your job using number sequences, fixed text, random labels or a mixture of all three
- Choose any layout with any part number
- Import graphics

Sharpmark's [SharpCloud Labelling Software](#) is free, simple and quick to use. It requires no contact details and it will store all your jobs for future reference, so you can build up a portfolio of labels suitable for a range of installations.



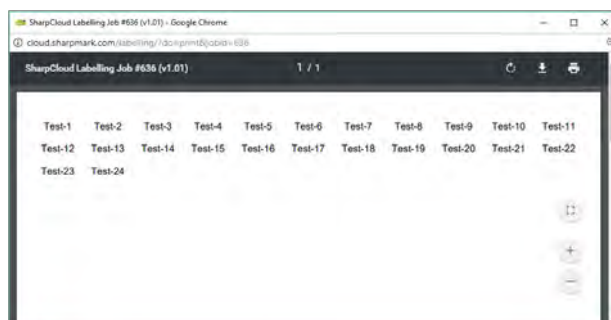
1. Once you have set up a username and password, you can log in. Once logged in, you are presented with three options.

2. By selecting "Find the right labelling product for you", you will be presented with a full list of Excel cables and patch panels by part code, so you will be ready to start creating your labels.



3. On-screen instructions are provided throughout the process to help make sure your labels are right the first time, every time. Simply start by typing in the text or sequence you want printed on your labels.

4. When you are happy with your labels for this product, you can choose to save and preview it to check before you print. Once you are happy with your results, you can output your project into a PDF document for printing.



5. This document can then be printed using a standard office laser printer, reducing the need for expensive custom printers. Combined with Sharpmark's high quality printable label sheets, which are available from Excel you can print a well organised sheet of labels quickly and easily, with minimum hassle.



View the full range of Sharpmark Labels

Why Choose Labelling from Excel?

Service & Support

Our dedicated sales and technical support teams are on hand to help with the production of labels to ensure the results are accurate first time, every time.

As part of our engraved labelling value added service, all labels commence printing in-house on the day we receive the specification, with a view to despatching them on the same day* for next day delivery within the UK. Our dedicated sales and technical support teams are on hand to help with the completion of any spreadsheets or technical information, to offer a hassle-free, quick and efficient process.

**If purchased before 12 noon.*

Flexibility

With a range of colours, sizes and materials as well as the ability to customize the label text, the service is flexible to suit the needs of all customers. Whether you choose the Sharpmark solution or Excel's laser engraved labelling, the range of options is plentiful to ensure you achieve the labelling solution you and your end-user require.

The added benefit of choosing Excel's engraved labelling service is that it is offered either as standalone printed and cut label sheets for application after equipment installation, or pre-affixed to the equipment according to the specification provided, meaning you don't even have to think about labelling whilst on-site. There is also a vast array of colour options available, even beyond the standard eight - for details about alternative colour availability, please contact the sales team.

Time Saving

By eliminating the need to think about labelling during installation, or fiddle around with a pen and narrow slips of paper on-site, the labelling solutions we offer are proven to save a considerable amount of project time, reducing overall cost.

Long-Term Quality & Reliability

Sharpmark Software is convenient and cost effective, there is no need for custom printers to produce professional-looking labels that are durable and easy to read. Combined with high quality printable labels from Sharpmark, the software allows you to organise and label installations clearly, minimising downtime for regular maintenance or trouble-shooting.

To ensure the highest quality, long-term durability and top performance, Excel's engraved labelling solution uses the best quality materials on the market. The acrylic material is fadeproof, retaining it's bold colour for many years after engraving and installation. The laser technology eliminates the risk of diminishing ink visibility, by cutting through the top acrylic layer to reveal crystal clear text in the chosen colour.

Bespoke Service

Our labelling solutions 100% bespoke services, printed to the needs of the individual. This 'made-to-measure' nature means that you are able to choose anything to appear on your labels to meet the requirements of the end-user; specific destination locations, particular equipment, company logos - the options are endless.

Please contact the sales team for more information about the capabilities of our service –

sales@excel-networking.com, or 0121 326 7557.





WORLD LEADING TECHNOLOGY TAKES OFF

Airports Powered by Excel

Where speed, security and performance are paramount. Choose Excel.

Excel's world-class premium performance end-to-end infrastructure solution is powering some of the most exciting and innovative new projects in the world.

Excel. Designed, manufactured, supported and delivered without compromise.

[Read the case study](#)

Excel Pre-terminated Solutions

Section 7

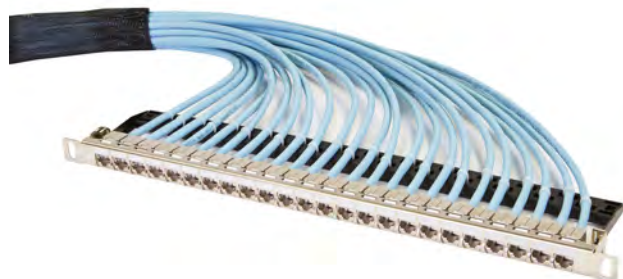
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Pre-terminated Solutions

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 on site. The installation is typically programmed to fit in with all other project works. Projects may be 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.



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 full traceability and tracking through the manufacturing process. The serial number label is attached to each end of the cable assembly.

Laminated (Traffolyte type) labels can be engraved and attached to the shutters, modules, GOPs, panels etc as required. These are available in a wide range of colours and configurations.

Manufacturing process

The pre-terminated assemblies are manufactured in the Excel facility under controlled conditions and to ISO9001 procedures, using the latest equipment, assuring the highest quality of product, matching the customer's specification and configuration. Fibre optic assemblies are terminated using heat-cure epoxy, machine polished, 100% inspected and geometry checked using an interferometer.

Testing

The pre-terminated assemblies are 100% inspected and optically 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.

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 12.



Logistics

Excel is more than aware that successful projects rely on seamless logistics. 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. If it is difficult to establish exact lengths, don't worry as we have several solutions to manage overlength and allow some flexibility.

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.



View our Pre-Terminated
Solutions Video

Excel Copper Pre-terminated Solutions Introduction

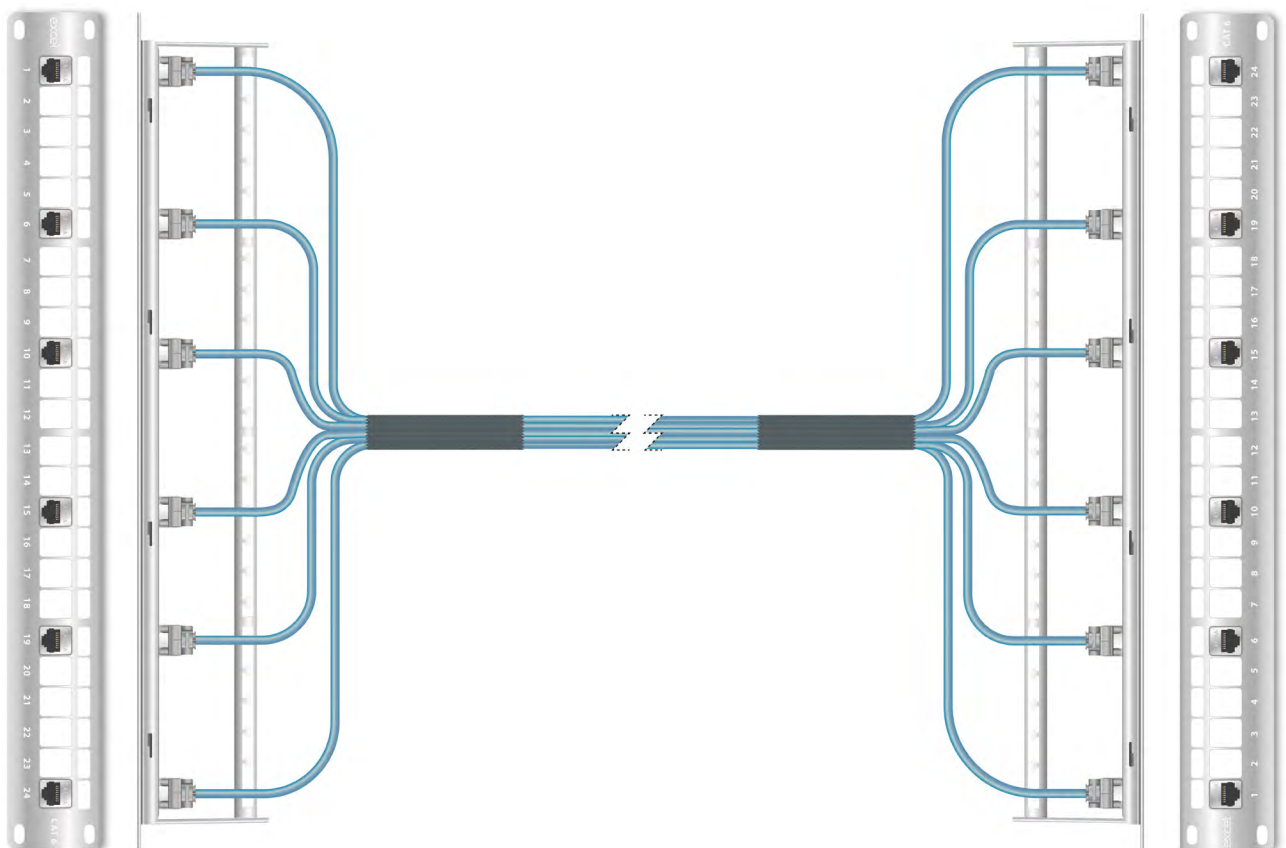
Excel is able to offer pre-terminated solutions from across the entire range. This covers components from the Category 5e, 6, 6_A, and 7_A portfolio in either unscreened or screened variants. The cables may be bundled in quantities to suit the installation (using either hook & loop ties or braided sleeving) 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

[View our brochure](#)



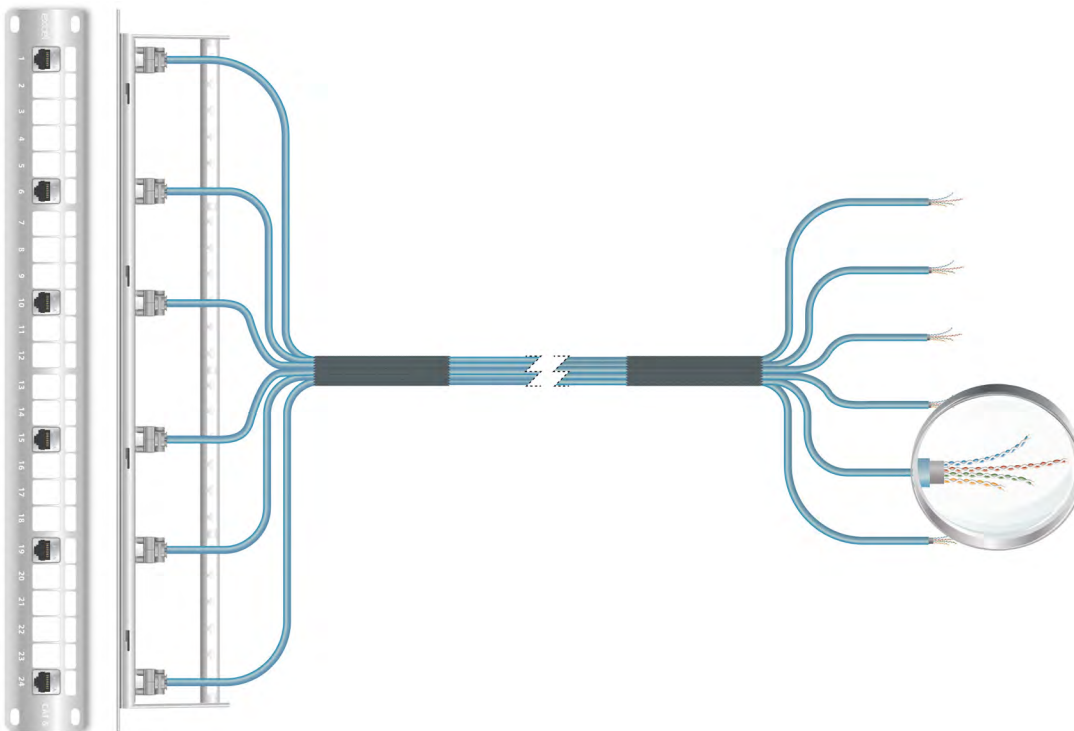
Panel to Panel

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. If lengths allow, we will make the assembly double length and double-ended to allow a full test to be carried out. Then the assembly is cut in half and supplied single-ended to the specified length. 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

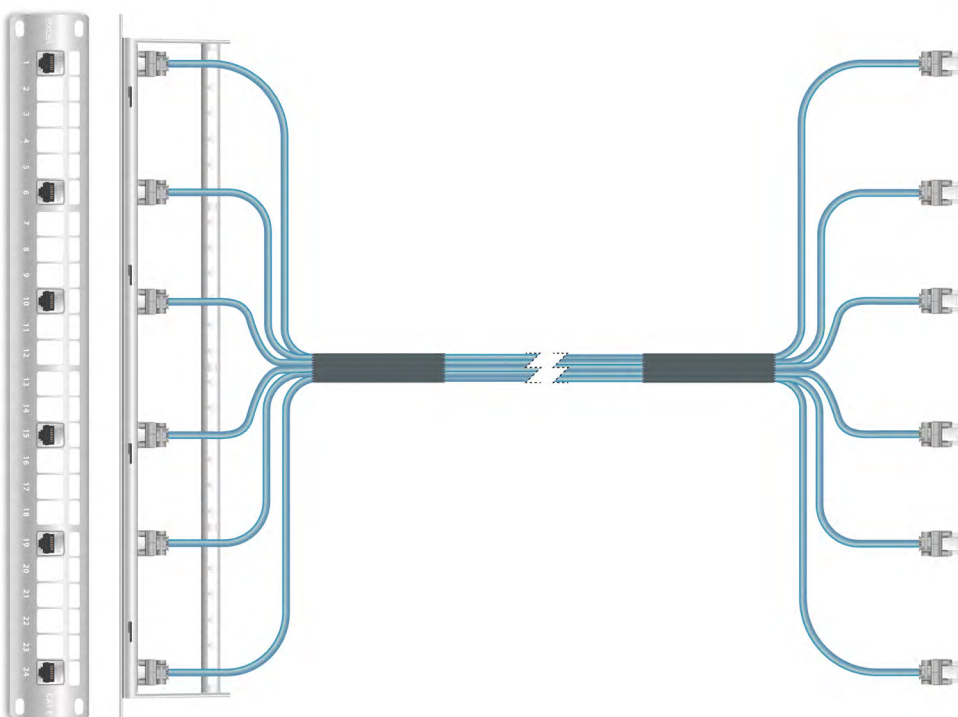
Panel to Open allows for the remote connector or panel to be terminated in the field.



S7

Panel to Jack

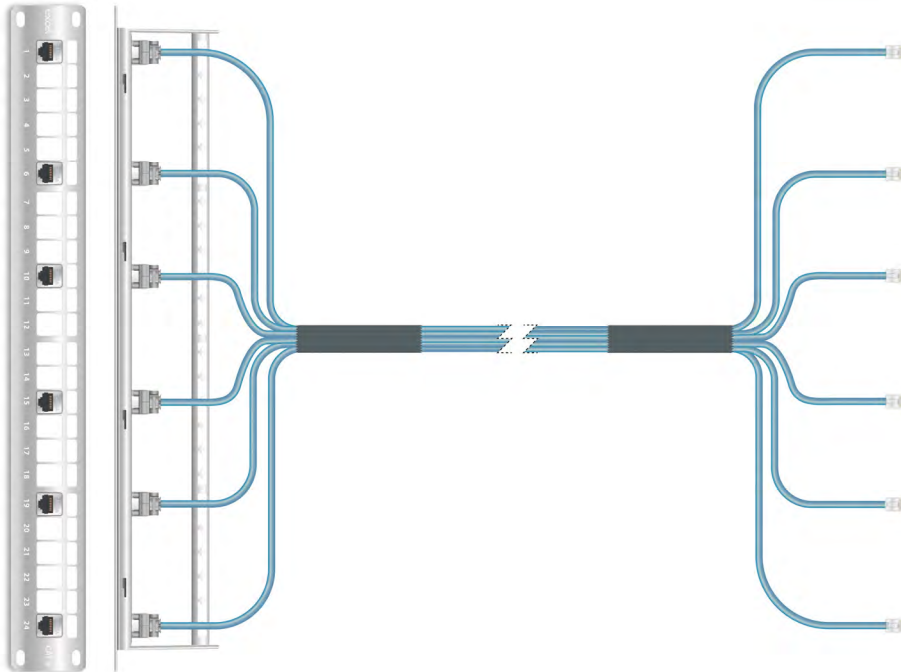
When deploying data outlets from a patching field via horizontal distribution out to the work area in a inter-connect configuration and the site allows for accurate measurement of runs to be calculated, this can be the ideal solution to use. The remote terminated jacks can then be housed and presented in dado [trunking](#), [floor boxes](#) or [GOP boxes](#) where desired with the use of [Excel mounting hardware](#).



Switch / Harness Links

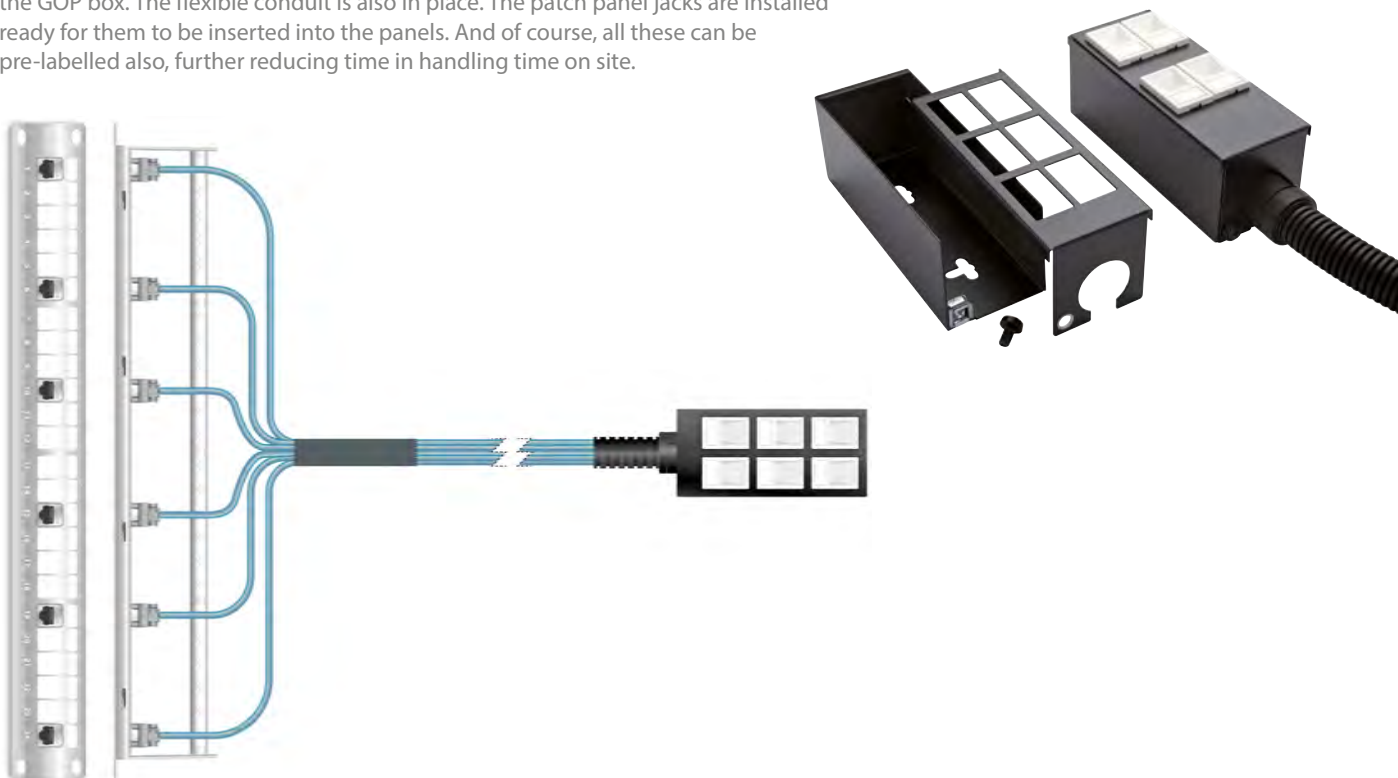
The switch/harness link configuration is made up of a panel-to-plug link, the links are then dressed together to create a loom. This solution is deployed mainly in the Main Equipment Rooms allowing for a cross-connect deployment.

Solid core RJ45 to RJ45 leads can be supplied when there is the need to create switch harness links on site.



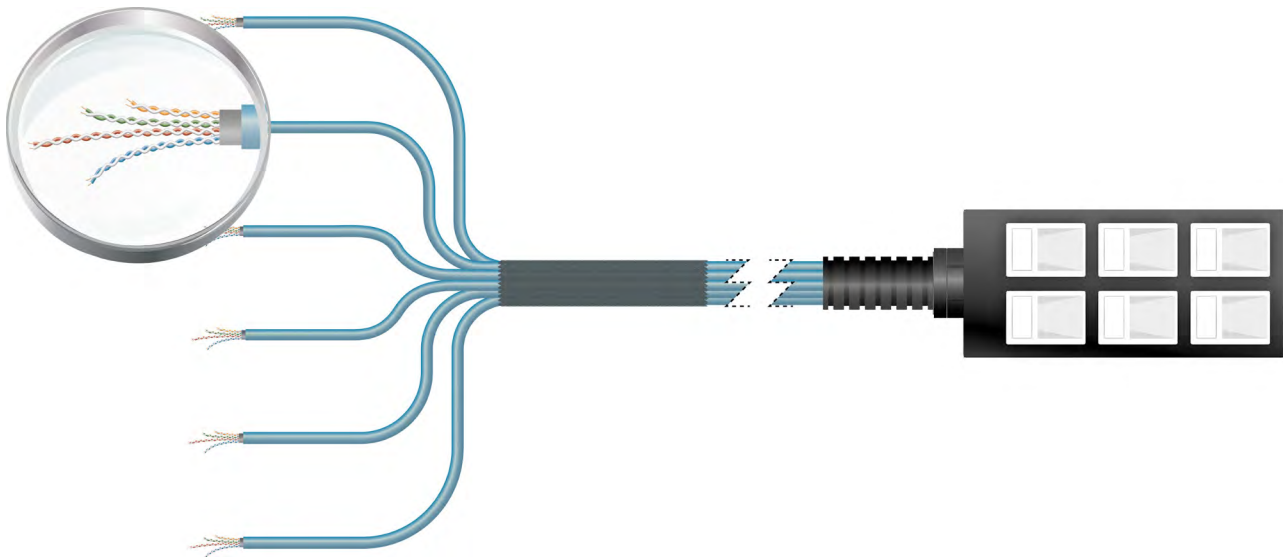
Panel to GOP Box

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. And of course, all these can be pre-labelled also, further reducing time in handling time on site.



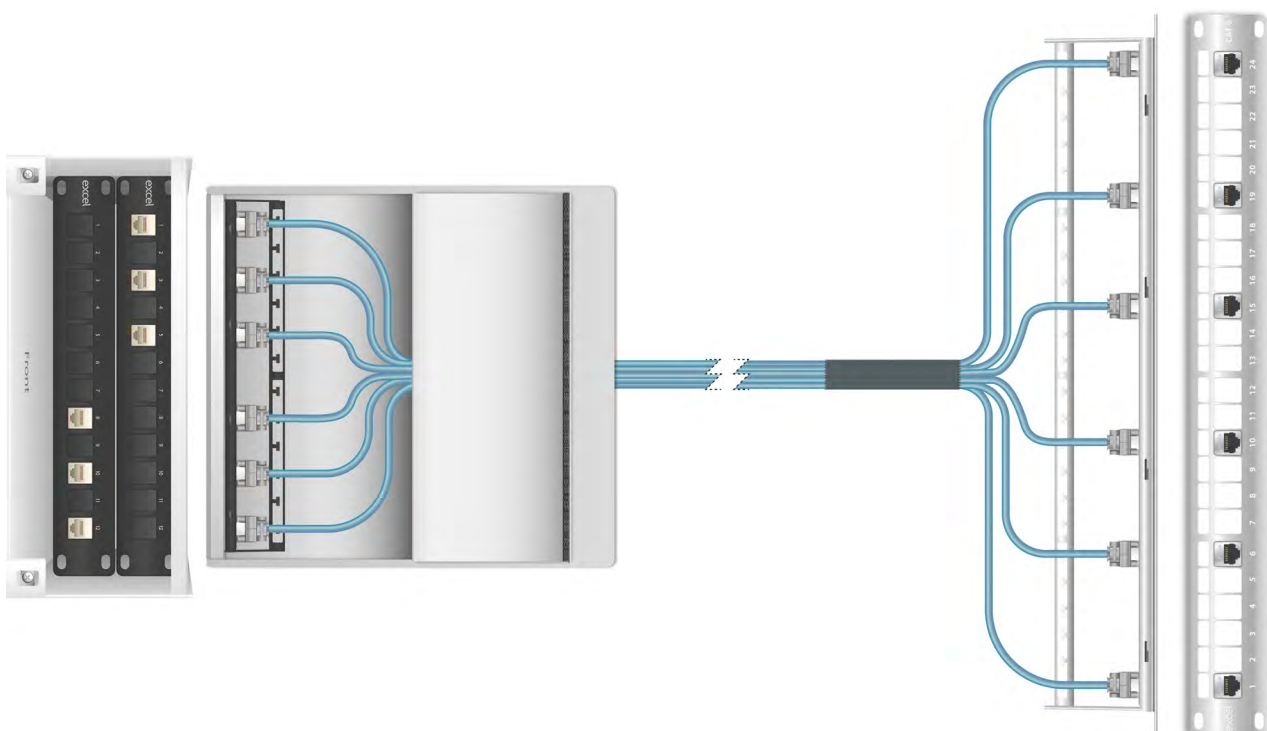
GOP Box to Open

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.



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 7_A, 6_A or 6 in U/UTP, F/UTP, U/FTP, F/FTP or S/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. If fitted to a panel, are the cables to be dressed to the left or right?
5. Are there any specific labelling requirements for the cables or the panels?
6. Are the looms to be held with hook & loop ties (approx 1m apart), or braided sleeving?
7. Where do they need to be delivered?
8. 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 6 <input type="checkbox"/>	Category 6 _A <input type="checkbox"/>	Category 7 _A <input type="checkbox"/>
	U/UTP, U/FTP, F/FTP <input type="checkbox"/>	Unscreened <input type="checkbox"/>	

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		GOP Size 2/3/4/6	
(spares will be covered by rubber blanks)		Outlet Number 2/3/4/6	
Keystone – Keystone			
GOP – Keystone			
GOP – Mixed Use Module (only available in Category 6 and 6 _A)			
Mixed Use Module – Keystone (only available in Category 6 and 6 _A)			
Cable Bundle Size			
4/6/12 etc			
GOP Umbilical Length			
(Flexible Conduit Length, standard is 5M)			
Bundle Wrap Method			
Insulating Tape <input type="checkbox"/>		Hook & Loop <input type="checkbox"/>	Braided Sleeve <input type="checkbox"/>



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	

Cable Label Location**Note:** All Labels will be positioned 50mm from each end of the cable

Cable label scheme required

Panel/GOP/Module label scheme required

Packaging

Stillage Cages

Yes ☐No ☐

Spinners Required

Yes ☐No ☐**Note:** Standard Packaging below 10M coiled in a Bag and Boxed. Above this length choice of; Drum or Coiled in Bag.

EXCELERATOR

Excel Excelsator Fibre Pre-terminated Solutions

The [Excelsator 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 specific staggered fan outs we will use the furthest distance from connector tip to connector tip, as the overall cable length.



Conventional Fibre

Distribution, Breakout, Loose Tube & Armoured Cables

Excelsator pre terminated cables are constructed from customer defined multi core 900µm micron tight buffered distribution cable or 250 micron LT, CST & SWA cable. We also offer Loose Tube unarmoured and CST and SWA armoured cables as a pre-terminated solution, all with up to 24 fibre cores. Standard options available are designed to meet most requirements and include choices of multimode and singlemode, core counts and connector styles.

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 approx. 950mm 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. Any length can be manufactured from 2.2m up to 2km.

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. We can also pre-terminate our range of fibre cassettes for the mixed-use panels and HD panels.

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.

Excelsator Pre-Terminated cables are extremely robust, yet compact and flexible in design. This together with the range of core counts and connectivity 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.



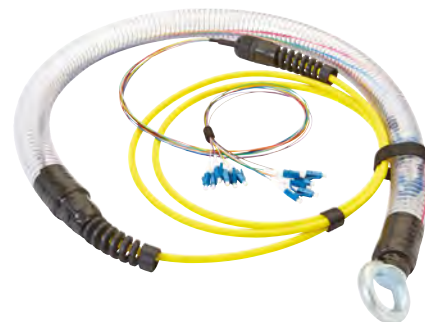
Distribution, Loose Tube, CST & SWA Cables

All cable are available from 2 core through to 24 core in OM3, OM4, OM5 and OS2, specification terminated with ST, SC or LC connectors. This makes this option ideal for backbone panel to panel and intra-building links.

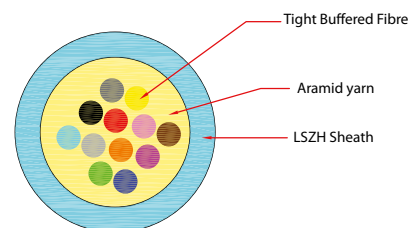
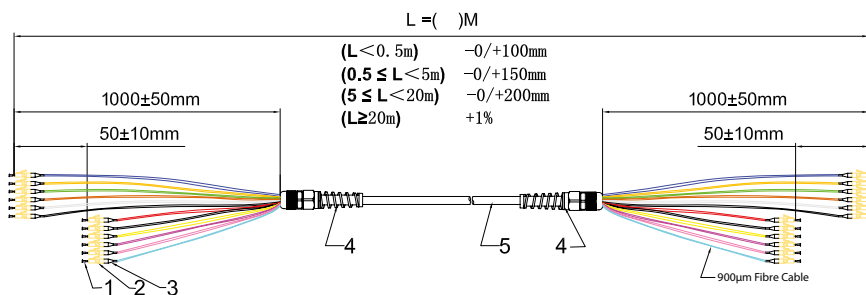
Distribution cables contain buffered (900 micron) coated fibres, typically from 4 to 24 cores.

Loose Tube, CST (Corrugated Steel Tape) and SWA (Steel Wire Armoured) cables vary in construction, but all are loose tube, and gel filled. They utilise from 4 to 24 number 250 micron (primary coated) fibres within the gel-filled tube. When pre-terminated, we fit a small manifold and sleeve the primary coated fibres with 900 micron tubes (all 12 colours).

All pre-terminated cables use the TIA-598 colour coding standard.



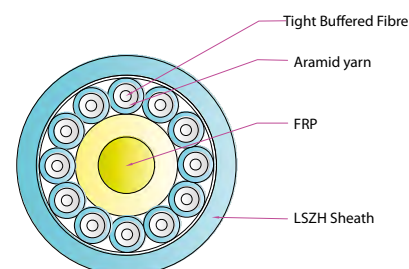
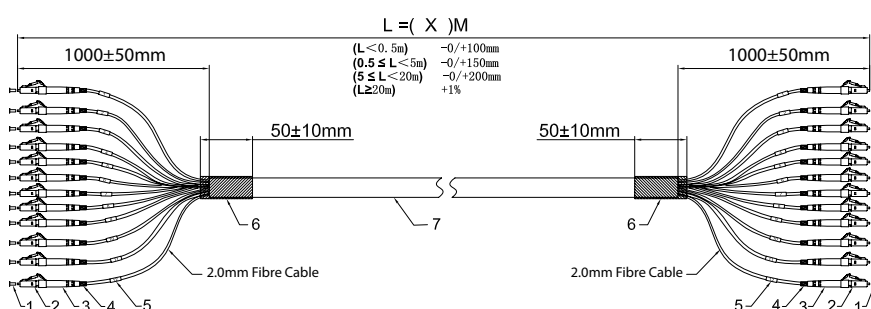
Blue
Orange
Green
Brown
Slate
White
Red
Black
Yellow
Violet
Rose
Aqua



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 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 primary coated fibres within a miniature ruggedised 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 styles 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.

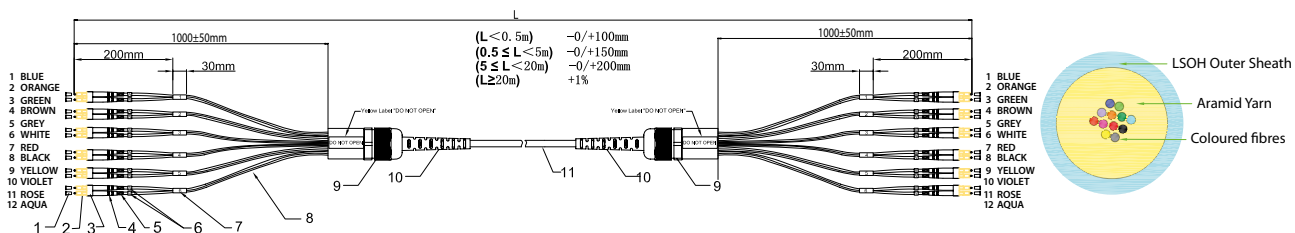
As standard, the length of each fan out for all core counts between 8 and 48 core cables is 1 metre +/- 50mm, whether 2.0mm diameter tight buffered cable or 900 micron tubes.

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 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 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.

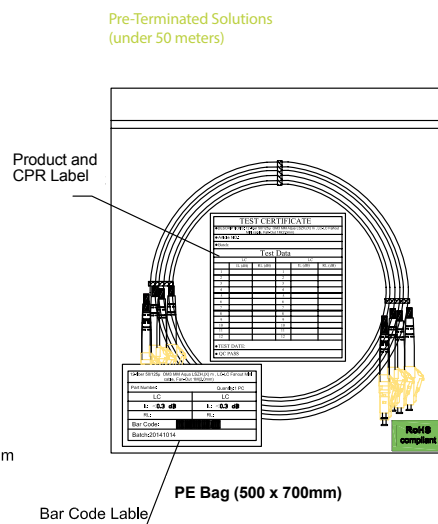
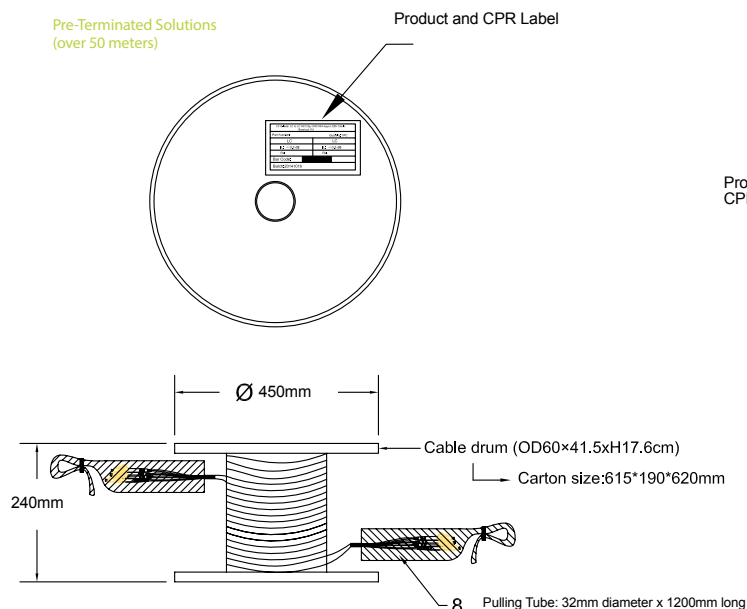
Excelerator Pre-Terminated Mini Break-out cables are extremely compact, lightweight and robust. This together with the range of core counts, and connectivity available make them ideal for use as link from patch panel to equipment, patch panel to patch panel, patch panel to consolidation points, or rack to rack links.



Packaging

The Excelerator Pre-terminated solutions are packaged and labelled as follows:

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



TEST CERTIFICATE					
• DESCRIPTIONS: 12-fiber 50/125µm OM3 MM Aqua LSZH (X) m, LC-LC Fanout Mini cable, Fan-Out 1M(2.0mm)					
• Article NO.:					
• Batch:					
Test Data					
LC			LC		
	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 50/125µm 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.



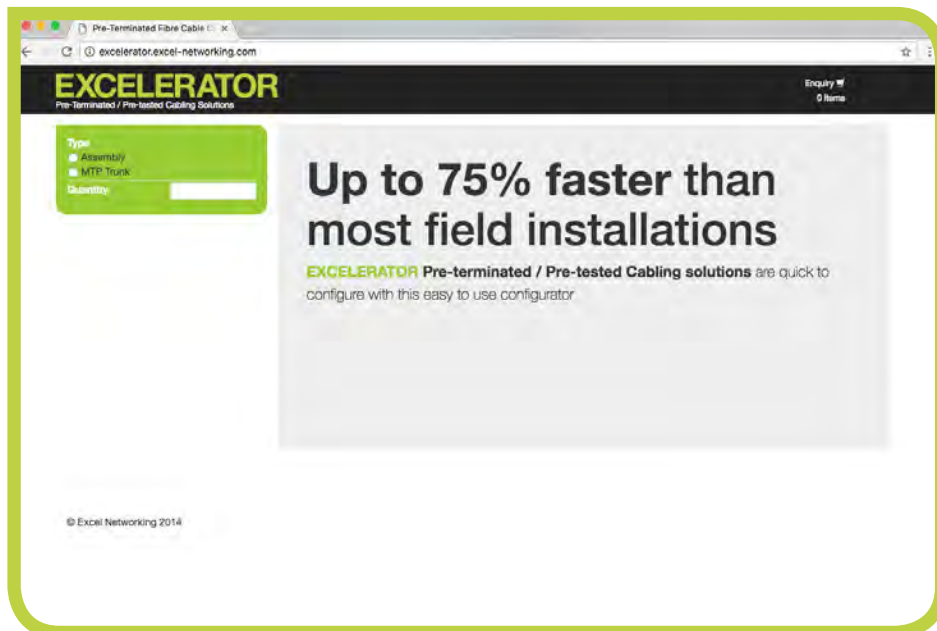
Enquiring couldn't be simpler!

We've developed an online Excelerator configurator that helps you to choose exactly what you need by selecting the relevant criteria.



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



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.	
Loose Tube:	<input type="checkbox"/>		
CST:	<input type="checkbox"/>		
SWA:	<input type="checkbox"/>		

Category: OM3, OM4, OM5, 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:

LC	<input type="checkbox"/>
SC	<input type="checkbox"/>
SC/APC	<input type="checkbox"/>
LC/APC	<input type="checkbox"/>
FC	<input type="checkbox"/>
ST	<input type="checkbox"/>
6 x LC Duplex Fibre Module	<input type="checkbox"/>
HD cassette	<input type="checkbox"/>

Connector B, Type

LC	<input type="checkbox"/>
SC	<input type="checkbox"/>
SC/APC	<input type="checkbox"/>
LC/APC	<input type="checkbox"/>
FC	<input type="checkbox"/>
ST	<input type="checkbox"/>
6 x LC Duplex Fibre Module	<input type="checkbox"/>
HD cassette	<input type="checkbox"/>

Note: (For use with Distribution Cable and Multi-Use Panel)

Cores: 4, 8, 12, 16, 24, 48, 72, Other:	
---	--

Staggered/Non Staggered:

Note:

Standard product is up to 24-cores, but higher core counts are available. Please enquire.
 Stagger on Distribution Cable is 50mm and the connectors are grouped in bundles of 6. 4 (for LC) and 2 (for SC/ST/FC).
 -Breakout and Mini Breakout cables are Non-Staggered as standard.

Packaging:

Note:

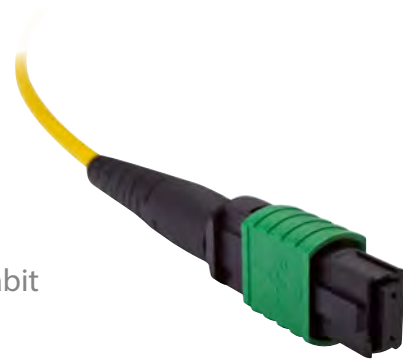
- All Trunk and Distribution Cables will be supplied with Protection Tubes at both ends and pulling eye on one.
- All Break out and Mini break out cables <10m will be supplied bagged and boxed above this length all assemblies will be supplied on a reel.
- Standard protection tube is 32mm diameter. 25mm is available if required.

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, OM5 and OS2 requirements, with the trunk cables offered in 8, 12, 24, 36, 48, 72, 96 or 144 configurations. They have been designed and manufactured to support both the pre-terminated and 40/100 gigabit Ethernet fibre optic installations.

Using the US Conec MTP Elite® connector the Excel MTP system ensures the superior performance with low loss properties. All Multimode MTP connectors have flat ferrules and are polished using the latest techniques to ensure that all 12 fibres protrude to ensure proper contact. All singlemode Excel MTP's are polished at an angle (APC) using the same processes to ensure fibre protrusion and ensure contact, with the added advantage of extremely high return loss – critical in singlemode applications.

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.



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 outermost 8 cores of the MTP with the central 4 left unused.

100 Gigabit Ethernet (SR10) will use ten cores to transmit and ten to receive. This in turn will require 2 MTP links, each having 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.

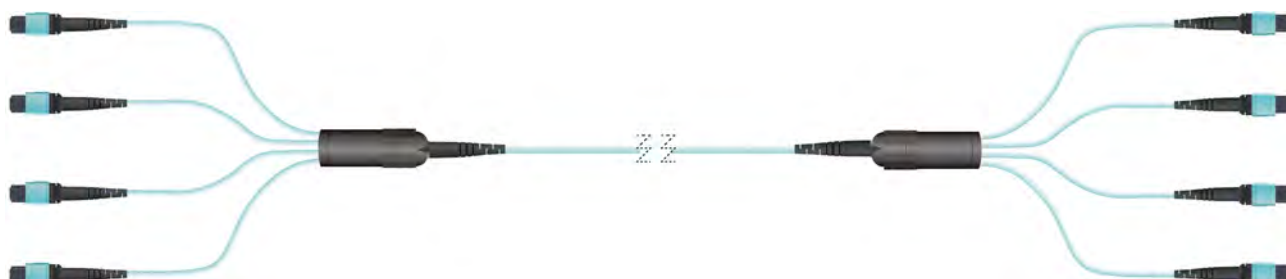
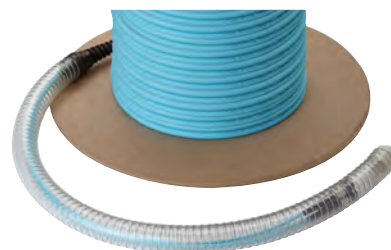
The MTP Elite® connector is manufactured with or without pins. The connection must be between one of each to ensure correct alignment of the fibre therefore the trunk cables will be provided with pins, any future MTP® patch leads (used to connect the equipment to the patch panel) will be provided without 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

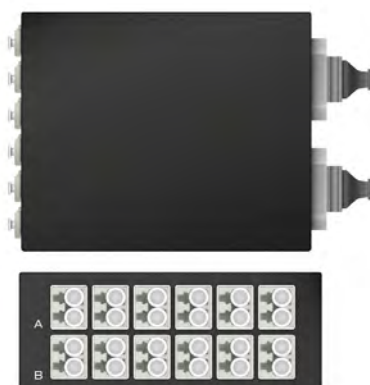
8, 12, 24, 36, 48, 72, 96 and 144 core assemblies are available. This corresponds to 1, 2, 3, 4, 5, 6, 8 or 12 MTP® connectors at each end contained within an additional outer sheath: Trunk cables are always pinned.

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

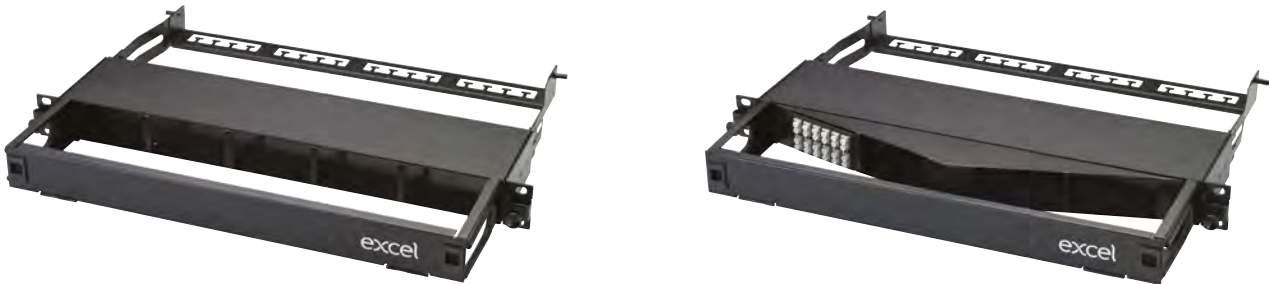
The MTP cassettes come in either 12 or 24 core LC and OM3, OM4, OM5 and OS2(APC) variations. The different Polarity method such as Method A and Method C is achieved with alternate cassettes at each end. However you don't need to worry about how this is achieved by answering some simple questions the Excel Sales Team can propose the correct solution for your needs.



Excelerator MTP® Patch Panel Frames

There are four options for mounting cassettes. We have a range of platforms to suit requirements. These include the traditional metal cassettes and associated panels, the mixed use panel & cassette system, which can house a variety of cassette-based products, both copper and fibre, and the High density range which can accommodate up to 144 LC/MTP connections or 48 MTP through connections (576 fibres) in 1U of space.

The angled frame can accept 4 and the straight panel accepts up to 5 of the metal MTP-LC cassettes. These cassettes are available with either one or two MTP's (12 or 24 fibre). When populated with the 24 core LC cassette provides density of 120 fibre cores in 1U.



The mixed-use platform can accept up to 8 cassettes.

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.



The HD (High Density) platform consists of a 1U panel which can house up to 12 cassettes. These cassettes each contain one MTP to 12 LC fan out arrays inside. The panel provides up to 144 fibres in 1U of rack space.



All 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 a number of options for mounting through couplers for use with the MTP-LC Fanouts depending on the platform selected. There are 2 versions of the through couplers:

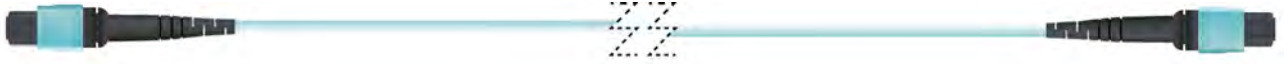
Multimode couplers are aligned key couplers, whilst singlemode couplers are opposite key couplers (otherwise known as Key up/key down couplers).





Excelerator MTP® Patch Leads

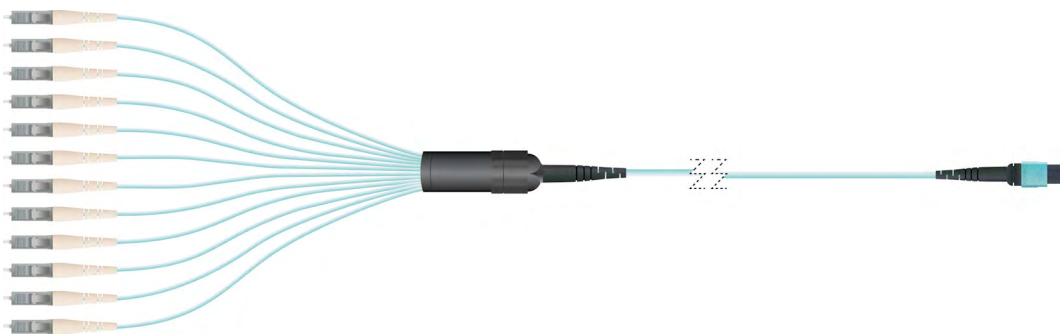
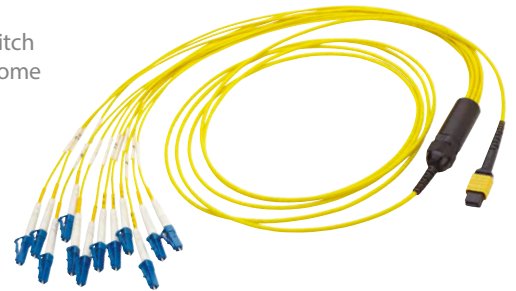
The MTP patch Leads are used for direct connection of equipment, they are available in both standard and custom lengths. Patch Leads are always unpinned.



Excelerator MTP® – LC Fanout

These are used to connect from a through coupler panel directly into LC switch ports. They are available in OM3, OM4, OM5 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 lengths, however the actual length of the fanout is always 500mm.



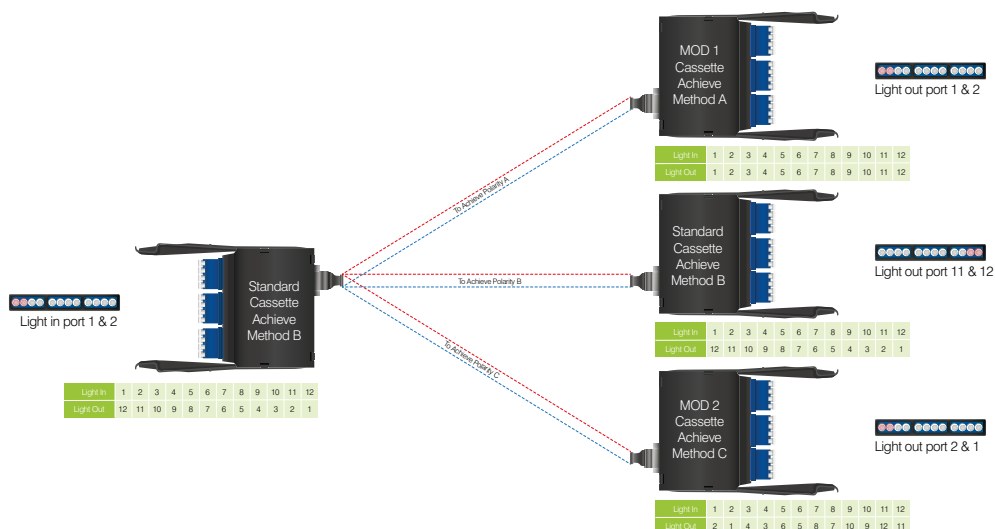
MTP Polarity Methods

If you are unsure; if you put light in Core 1 where do you expect the light to come out?

Answer:

Method A = Core 1. Method B = Core 12. Method C = Core 2

NB. You need a cassette at both ends to achieve the desired polarity output.



Excelerator MTP Pre-terminated Checklist



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	<input type="checkbox"/>
		Method B (EN50174-1/ISO 14763-3)	<input type="checkbox"/>
		Method C	<input type="checkbox"/>

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 both ends to achieve the desired polarity output.

Category: OM3, OM4 OM5, OS2(APC)	
----------------------------------	--

5 Cassette Straight/4 Cassette Angled Panel:

Cassettes Required – Original 12 Core:		24 Core:		6 x LC Duplex Fibre Module:	
		12 Core:			

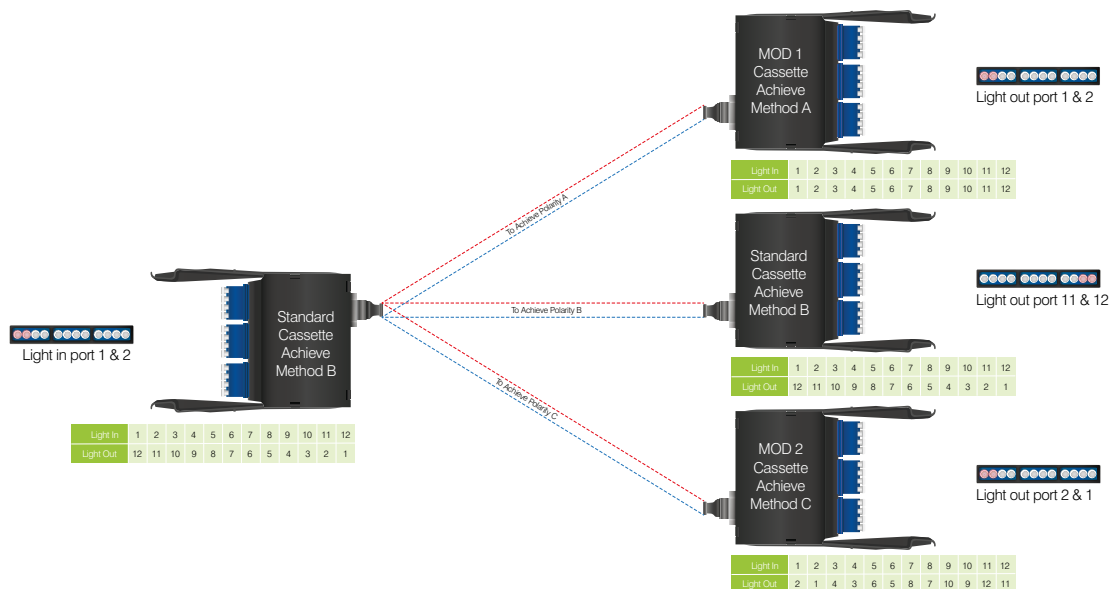
(For use with Multi-Use Panel)

12 Cassette HD Panel:

--

Mixed Use Panel:

--



Note: Either individual 12 core or multiple 12 core cables contained within outer sheath

MTP Cassette panels:

MTP to MTP Patch Leads:

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, OM5, OS2		Category: OM3, OM4, OM5, OS2	
Connector: LC, LC/APC		Connector: LC, LC/APC	
Length:		Length:	

Qty:		Qty:	
Category: OM3, OM4, OM5, OS2		Category: OM3, OM4, OM5, OS2	
Connector: LC, LC/APC		Connector: LC, LC/APC	
Length:		Length:	

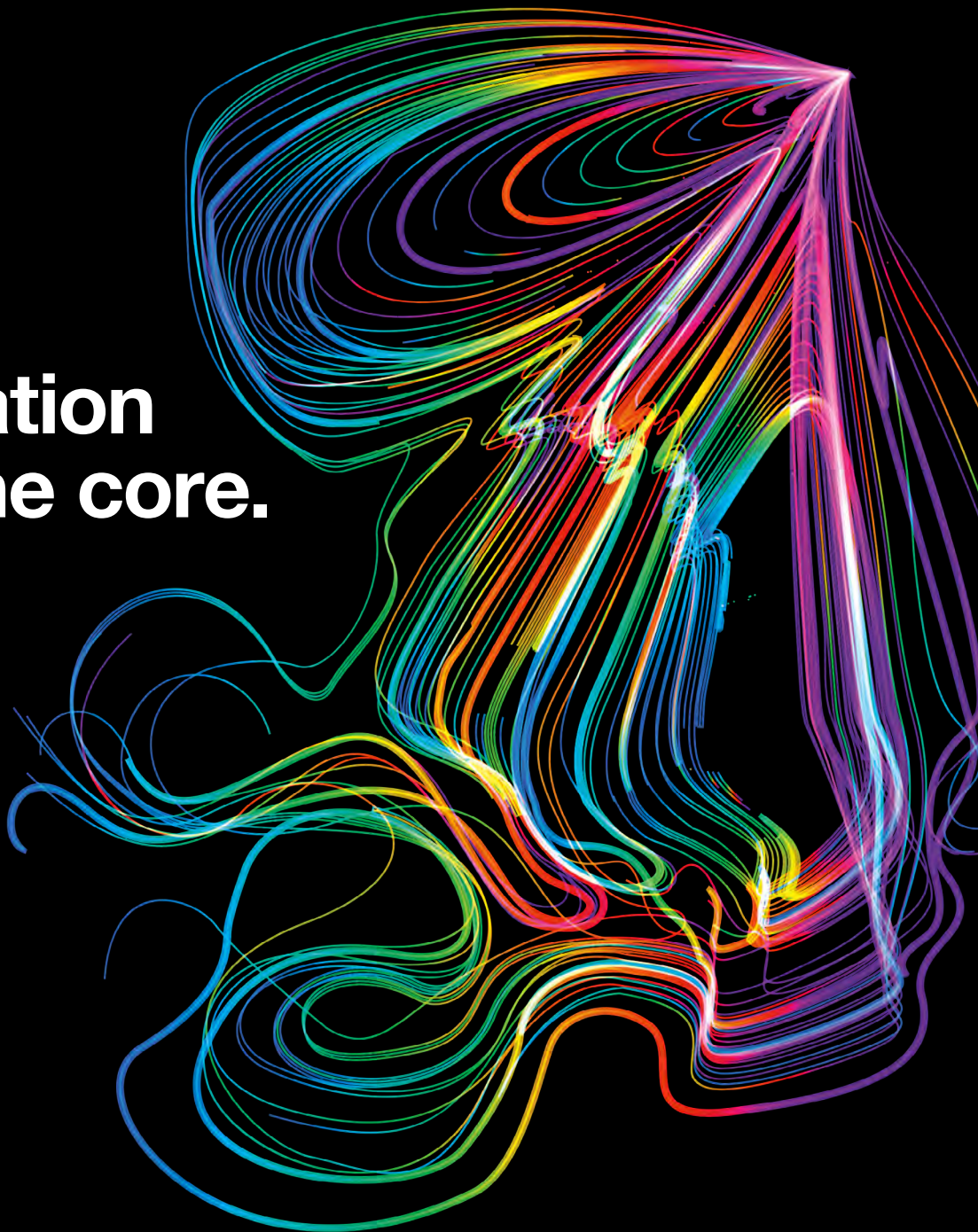
Qty:		Qty:	
Category: OM3, OM4, OM5, OS2		Category: OM3, OM4, OM5, OS2	
Connector: LC, LC/APC		Connector: LC, LC/APC	
Length:		Length:	

Qty:		Qty:	
Category: OM3, OM4, OM5, OS2		Category: OM3, OM4, OM5, OS2	
Connector: LC, LC/APC		Connector: LC, LC/APC	
Length:		Length:	

Note: Fanout section are 500mm
Singlemode MTP connector will be Angled/APC

Innovation at the core.

S7



ENBEAM

Flexible, scalable, ultra high performance fibre optic systems from Excel

Enbeam from Excel introduces unrivalled levels of innovation to fibre optic product design and functionality in the LAN and DC environment. The new HD Uniboot range of cables for example are ideal for patching applications where space is at a premium, but loss of features is not an option. 2mm micro duplex cables Uniboot low loss LC connectors with ability to switch polarity in the field and bend insensitive glass mean you can have innovation as standard by choosing Enbeam.

DISCOVER ENBEAM:
excel-networking.com

excel
without compromise.

Excel Environ® Racks and Open Frames

Section 8

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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								
		U Size	Available Widths	Available Depths	Number of Compartments	Load Capacity	Colour	19" Profiles	1U height markings	19" Profiles - adjustable position
 Comms Rack		15U 20U 24U 29U 33U 42U 47U	600 mm 800 mm	600 mm 800 mm 1000 mm	1	600 kg	GW BK	Front & Rear	✓	✓
		29U 42U 47U	600 mm 800 mm	600 mm 800 mm 1000 mm	1	600 kg	GW BK	Front & Rear	✓	✓
		42U 47U	600 mm 800 mm	1000 mm	2 or 4	600kg	GW BK	Front & Rear	✓	✓
		29U 42U 47U	600 mm 800 mm	1000 mm 1200 mm	1	1300 kg	GW BK	Front & Rear	✓	✓
		42U 48U 52U	514 mm	75 mm	N/A	1500 kg	BK	Front	✓	
		6U 9U 12U 15U 18U 21U	600 mm	390 mm 500 mm 600 mm	1	63 kg - 390 60 kg - 500 60 kg - 600	GW BK	Front & Rear		✓
 Open Rack										
 Wall Rack										

GW = Grey White BK = Black

Click here to visit the
Online Configurator



Quick release doors	Swing lock handle on front door	Multi-point locks	Front door	Rear door	Removeable side panels	150 mm Cable Tray	High capacity vertical cable management	Jacking feet & load bearing castors as standard	Available flat pack	Available from stock
✓	✓		Glass	Single steel	✓		800 mm width only	✓	✓	✓
✓	✓	✓	Wave Vented full width	Double Vented	✓		800 mm width only	✓	✓	✓
✓	✓		Vented	Vented	✓		800 mm width only	✓		✓
Secure lift off doors	✓	✓	Wave Vented full width	Double Vented	✓	800 mm width only	800 mm width only	✓	✓	✓
							Optional Accessories		✓	✓
✓			Glass		✓				✓	✓

GW = Grey White BK = Black

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.



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® CL](#) Co-Location Rack takes the existing qualities of the Environ range but with the added benefit of having secure, lockable compartments. The CL series is designed specifically for applications where equipment security is a priority, or where space is being used by different enterprise departments or clients with a shared facility. The CL series is perfect for Cloud deployments and co-location data centre facilities.



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 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® CR Series

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.



As our best selling range we ship large numbers of racks out on a daily basis across Europe. In the UK all of our next day deliveries are sent **free of charge** – however big the rack.



Watch the video to find out more about the Environ CR Rack



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Watch the video to find out how the CR rack is built.



The Environ CR range is available as a 600mm or 800mm wide with a choice of many heights and depths – see the following pages for further details.

Environ® CR Series

The Key features of the Environ CR range include:



- Swing handle cam lock fitted to glass front door



- 19" profiles marked with U height position



- Full height front and rear adjustable 19" profiles



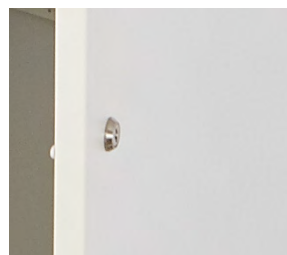
- Side panels are lockable and racks can be bayed with or without side panels



- Jacking feet and castors can be fitted simultaneously



- Large cut out in base for cable entry



- Barrel lock fitted to steel rear door



- Multiple brush strip cable entry in roof



- High density vertical cable management – 800 series only



- 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
- 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

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® CR600 - 600mm Wide Comms Rack

600 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
15U	600 mm	600 mm	870 mm	542-1566-GSBN-GW	542-1566-GSBN-BK
20U	600 mm	600 mm	1090 mm	542-2066-GSBN-GW	542-2066-GSBN-BK
24U	600 mm	600 mm	1270 mm	542-2466-GSBN-GW	542-2466-GSBN-BK
29U	600 mm	600 mm	1490 mm	542-2966-GSBN-GW	542-2966-GSBN-BK
33U	600 mm	600 mm	1670 mm	542-3366-GSBN-GW	542-3366-GSBN-BK
42U	600 mm	600 mm	2070 mm	542-4266-GSBN-GW	542-4266-GSBN-BK
47U	600 mm	600 mm	2230 mm	542-4766-GSBN-GW	542-4766-GSBN-BK

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800 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
24U	600 mm	800 mm	1270 mm	542-2468-GSBN-GW	542-2468-GSBN-BK
29U	600 mm	800 mm	1490 mm	542-2968-GSBN-GW	542-2968-GSBN-BK
33U	600 mm	800 mm	1670 mm	542-3368-GSBN-GW	542-3368-GSBN-BK
42U	600 mm	800 mm	2070 mm	542-4268-GSBN-GW	542-4268-GSBN-BK
47U	600 mm	800 mm	2230 mm	542-4768-GSBN-GW	542-4768-GSBN-BK

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	1000 mm	1490 mm	542-29610-GSBN-GW	542-29610-GSBN-BK
33U	600 mm	1000 mm	1670 mm	542-33610-GSBN-GW	542-33610-GSBN-BK
42U	600 mm	1000 mm	2070 mm	542-42610-GSBN-GW	542-42610-GSBN-BK
47U	600 mm	1000 mm	2230 mm	542-47610-GSBN-GW	542-47610-GSBN-BK

The racks above are supplied fully built, if you require a flat pack option then please add **-FP** to the end of each code.

Racks without side panels are also available on request.

For part numbers of racks without side panels please refer to the relevant specification sheet or via the online catalogue.

Environ® CR800 - 800mm Wide Comms Rack



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
- 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® CR800 - 800mm Wide Comms Rack

600 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
24U	800 mm	600 mm	1270 mm	542-2486-GSBF-GW	542-2486-GSBF-BK
29U	800 mm	600 mm	1490 mm	542-2986-GSBF-GW	542-2986-GSBF-BK
33U	800 mm	600 mm	1670 mm	542-3386-GSBF-GW	542-3386-GSBF-BK
42U	800 mm	600 mm	2070 mm	542-4286-GSBF-GW	542-4286-GSBF-BK
47U	800 mm	600 mm	2230 mm	542-4786-GSBF-GW	542-4786-GSBF-BK

800 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
24U	800 mm	800 mm	1270 mm	542-2488-GSBF-GW	542-2488-GSBF-BK
29U	800 mm	800 mm	1490 mm	542-2988-GSBF-GW	542-2988-GSBF-BK
33U	800 mm	800 mm	1670 mm	542-3388-GSBF-GW	542-3388-GSBF-BK
42U	800 mm	800 mm	2070 mm	542-4288-GSBF-GW	542-4288-GSBF-BK
47U	800 mm	800 mm	2230 mm	542-4788-GSBF-GW	542-4788-GSBF-BK

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	1000 mm	1490 mm	542-29810-GSBF-GW	542-29810-GSBF-BK
33U	800 mm	1000 mm	1670 mm	542-33810-GSBF-GW	542-33810-GSBF-BK
42U	800 mm	1000 mm	2070 mm	542-42810-GSBF-GW	542-42810-GSBF-BK
47U	800 mm	1000 mm	2230 mm	542-47810-GSBF-GW	542-47810-GSBF-BK

The racks above are supplied fully built, if you require a flat pack option then please add **-FP** to the end of each code. Racks without side panels are also available on request.

For part numbers of racks without side panels please refer to the relevant specification sheet or via the online catalogue.

Environ® ER Series

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.



Watch the video to find out more about the ER Rack.



Watch the video to find out how the ER rack is built



The Environ ER range is available as a 600mm or 800mm wide with a choice of three heights and three depths – see the following pages for further details.

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 single point fitted to front door



- Multiple brush strip cable entry in roof



- 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



- Side panel latch plate

Environ® ER600 - 600mm Wide Equipment Rack



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 1 point lock fitted to front door
- Swing handle 2 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	1 point swing handle cam lock
Rear door lock	2 point swing handle cam lock
Side panels lock	Single point barrel lock



Environ® ER600 - 600mm Wide Equipment Rack

600 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	600 mm	1490 mm	542-2966-WDBN-GW	542-2966-WDBN-BK
42U	600 mm	600 mm	2070 mm	542-4266-WDBN-GW	542-4266-WDBN-BK
47U	600 mm	600 mm	2230 mm	542-4766-WDBN-GW	542-4766-WDBN-BK

800 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	800 mm	1490 mm	542-2968-WDBN-GW	542-2968-WDBN-BK
42U	600 mm	800 mm	2070 mm	542-4268-WDBN-GW	542-4268-WDBN-BK
47U	600 mm	800 mm	2230 mm	542-4768-WDBN-GW	542-4768-WDBN-BK

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	1000 mm	1490 mm	542-29610-WDBN-GW	542-29610-WDBN-BK
42U	600 mm	1000 mm	2070 mm	542-42610-WDBN-GW	542-42610-WDBN-BK
47U	600 mm	1000 mm	2230 mm	542-47610-WDBN-GW	542-47610-WDBN-BK

The racks above are supplied fully built, if you require a flat pack option then please add **-FP** to the end of each code. Racks without side panels are also available on request.

For part numbers of racks without side panels please refer to the relevant specification sheet or via the online catalogue.

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
- 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
- Wave design mesh front door
- Jacking feet and castors can be fitted simultaneously
- Swing handle 1 point lock fitted to front door
- Swing handle 2 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 High density vertical cable management
- 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	1 point swing handle cam lock
Rear door lock	2 point swing handle cam lock
Side panels lock	Single point barrel lock



Environ® ER800 - 800mm Wide Equipment Rack

600 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	600 mm	1490 mm	542-2986-WDBF-GW	542-2986-WDBF-BK
42U	800 mm	600 mm	2070 mm	542-4286-WDBF-GW	542-4286-WDBF-BK
47U	800 mm	600 mm	2230 mm	542-4786-WDBF-GW	542-4786-WDBF-BK

800 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	800 mm	1490 mm	542-2988-WDBF-GW	542-2988-WDBF-BK
42U	800 mm	800 mm	2070 mm	542-4288-WDBF-GW	542-4288-WDBF-BK
47U	800 mm	800 mm	2230 mm	542-4788-WDBF-GW	542-4788-WDBF-BK

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	1000 mm	1490 mm	542-29810-WDBF-GW	542-29810-WDBF-BK
42U	800 mm	1000 mm	2070 mm	542-42810-WDBF-GW	542-42810-WDBF-BK
47U	800 mm	1000 mm	2230 mm	542-47810-WDBF-GW	542-47810-WDBF-BK

The racks above are supplied fully built, if you require a flat pack option then please add **-FP** to the end of each code.

Racks without side panels are also available on request.

For part numbers of racks without side panels please refer to the relevant specification sheet or via the online catalogue.

Environ® CL Series

The Environ CL Co-Location Rack takes the existing qualities of the Environ range but with the added benefit of having secure, lockable compartments. The CL series is designed specifically for applications where equipment security is a priority, or where space is being used by different enterprise departments or clients with a shared facility. The CL series is perfect for Cloud deployments and co-location data centre facilities.



Then Environ CL range is available as a 600mm or 800mm wide with a choice of two heights and two or four compartments – see the following pages for further details.



• Vertical Management (CL800)



• Vertical Management (CL600)



• Mesh Compartment Doors



• Inside Compartment (CL600)



• Removable Side Panel



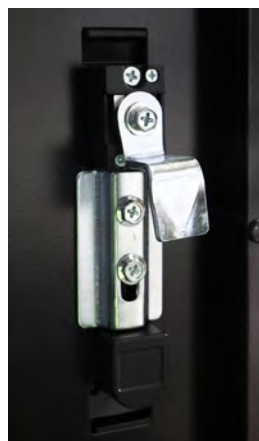
• CL800 Inner Rack



• Jacking feet and castors can be fitted simultaneously



• Optional Cable Management Rings (CL800 only)



• Inner door lock



• Key and 3 digit combination locks

Environ® CL Series



The Environ CL series of multicompartment floor standing racks are designed for co-location installations and applications that require enhanced levels of access security. The range is based on the proven and popular ER series chassis and is available in 42U or 47U heights, 600mm or 800mm wide, Grey White or Black and a choice of 2 or 4 compartments.

Each compartment is created by the use of a full depth dividing panel which runs from front to rear of the rack providing secure separation and a mounting shelf if so desired. Within each compartment are front and rear adjustable equipment mounting rails.

As standard front and rear doors are vented mesh and each are fitted with swing handles fitted with both a unique key and 3 digit combination lock. The entire range of Environ locking solutions is compatible with the CL series enabling customers to choose from digital key code, proximity card and biometric. To offer ultimate flexibility lock styles can be mixed within a rack if certain levels of security are desired for certain compartments either due to customer preference, or equipment stored within the compartment.

Cable entry and exit routes are provided via a full height multi section containment system mounted centrally between the equipment mounting rails. The system is designed to allow complete segregation of cables between compartments. Entry and exit points are located in both the roof and base and are protected by brush strip covers.

Within 800mm wide options patch leads can be managed within each compartment with optional cable management wire hoops mounted to the equipment mounting rails.



- Available in 42U and 47U heights
- 1000 mm deep
- Choice of 2 or 4 compartments
- Grey White or Black colour
- Jacking feet included
- Heavy duty lockable casters included
- 19" profiles marked with U height position
- Top and Bottom cable entry to each compartment
- Cable entry secure to each compartment
- Baying kit included
- 600 kg load capacity - total
- Brush strip cable entry in roof and base
- Jacking feet and casters can be fitted simultaneously
- Galvanised steel 19" mounting profiles
- 19" profile depth markings for easy adjustment
- Removable side panels
- Swing handle combination locks on all doors, with key lock
- Unique keys on all side panels

2 Compartment

CL 600 Series

U Size	Width	Overall Height	Depth	Available U Space Per Compartment	Part Number - Black	Part Number - Grey White
42U	600mm	2070mm	1000mm	20U	545-4261-2C-WBM-BK	545-4261-2C-WBM-GW
47U	600mm	2230mm	1000mm	23U	545-4761-2C-WBM-BK	545-4761-2C-WBM-GW

CL 800 Series

U Size	Width	Overall Height	Depth	Available U Space Per Compartment	Part Number - Black	Part Number - Grey White
42U	800mm	2070mm	1000mm	20U	545-4281-2C-WBM-BK	545-4281-2C-WBM-GW
47U	800mm	2230mm	1000mm	23U	545-4781-2C-WBM-BK	545-4781-2C-WBM-GW

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4 Compartment

CL 600 Series

U Size	Width	Overall Height	Depth	Available U Space Per Compartment	Part Number - Black	Part Number - Grey White
42U	600mm	2070mm	1000mm	9U	545-4261-4C-WBM-BK	545-4261-4C-WBM-GW
47U	600mm	2230mm	1000mm	11U	545-4761-4C-WBM-BK	545-4761-4C-WBM-GW

CL 800 Series

U Size	Width	Overall Height	Depth	Available U Space Per Compartment	Part Number - Black	Part Number - Grey White
42U	800mm	2070mm	1000mm	9U	545-4281-4C-WBM-BK	545-4281-4C-WBM-GW
47U	800mm	2230mm	1000mm	11U	545-4781-4C-WBM-BK	545-4781-4C-WBM-GW

Environ® SR Series

The **Environ SR** Server Rack range is designed to provide choice, functionality, and ease of use within high density server and equipment installations. With improved load bearing, split side panels, together with mesh design front and rear door options, the SR range is ideal for data centre and enterprise equipment room installations.



Watch the video to find out more about the Environ SR Rack



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Watch the video to find out how the SR rack is built.



The Environ SR range is available as a 600mm or 800mm wide with a choice of three heights and two depths – see the following pages for further details.

Environ® SR Series

The Key features of the Environ SR range include:



- Wave design mesh front door



- Swing handle front door



- Swing handle two 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 style cable entry in roof



- Full height front and rear adjustable 19" profiles



- Removable base panels for cable entry

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
- Multiple letterbox brush 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

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 slam latch lock

Environ® SR600 - 600mm Wide Server Rack

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	1000 mm	1422 mm	544-29610-WDBN-GW	544-29610-WDBN-BK
42U	600 mm	1000 mm	2000 mm	544-42610-WDBN-GW	544-42610-WDBN-BK
47U	600 mm	1000 mm	2223 mm	544-47610-WDBN-GW	544-47610-WDBN-BK

1200 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	600 mm	1200 mm	1422 mm	544-29612-WDBN-GW	544-29612-WDBN-BK
42U	600 mm	1200 mm	2000 mm	544-42612-WDBN-GW	544-42612-WDBN-BK
47U	600 mm	1200 mm	2223 mm	544-47612-WDBN-GW	544-47612-WDBN-BK

The racks above are supplied fully built, if you require a flat pack option then please add **-FP** to the end of each code.

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Management Solutions on

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without compromise.



Environ® SR800 - 800mm Wide Server Rack



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
- Multiple letterbox brush 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" mouting 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 slam latch lock

Environ® SR800 - 800mm Wide Server Rack

1000 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	1000 mm	1422 mm	544-29810-WDBR-GW	544-29810-WDBR-BK
42U	800 mm	1000 mm	2000 mm	544-42810-WDBR-GW	544-42810-WDBR-BK
47U	800 mm	1000 mm	2223 mm	544-47810-WDBR-GW	544-47810-WDBR-BK

1200 mm Deep Racks

U Size	Width	Depth	Overall Height	Grey White	Black
29U	800 mm	1200 mm	1422 mm	544-29812-WDBR-GW	544-29812-WDBR-BK
42U	800 mm	1200 mm	2000 mm	544-42812-WDBR-GW	544-42812-WDBR-BK
47U	800 mm	1200 mm	2223 mm	544-47812-WDBR-GW	544-47812-WDBR-BK

The racks above are supplied fully built, if you require a flat pack option then please add – FP to the end of each code.

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Environ® Wall Rack Series

The **Environ WR** range of wall mount racks have been designed with strength, ease of use and aesthetics in mind. 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 and AV equipment.



We hold large stocks for next day free delivery to the UK mainland and they are widely available through local distributors across Europe and the Middle East.

The Key features of the Environ WR range include:



S8

- Aesthetically pleasing framed safety glass front door



- Lockable, quick release side panes for maximum access into rack

- First fix mounting plate



- Cable entry cut out in top and base

- Angled vented roof

- Adjustable 19" mounting profiles

Environ® Wall Rack Series



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
- Available in 6 heights, 6U, 9U, 12U, 15U, 18U and 21U
- Available in grey and black
- Aesthetically pleasing framed safety glass front door
- Load carrying capacity 63kg on 390mm and 60kg on 500mm and 600mm depths
- Quick release doors
- Lockable, quick release side panels for maximum access into rack
- Angled vented roof
- Fully adjustable front and rear 19" mounting profiles
- Removable cable entry panel in top and base providing easy access to install cables and equipment. NB. The back is not removeable.
- Available as a flat pack
- First fix mounting plate included as standard

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 7035
Paint finish, black rack	RAL 9004
Paint finish, front door blue trim	RAL 5013
Glass door, safety specification	BS3193:1993
Surface treatment	Phosphate Coating

Environ® Wall Mounted Racks

WR390 Series – 390mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	390	WB6.390SG	WBFP6.390SG	WB6.390SG-BK	WBFP6.390SGB
9U	600	501	390	WB9.390SG	WBFP9.390SG	WB9.390SG-BK	WBFP9.390SGB
12U	600	635	390	WB12.390SG	WBFP12.390SG	WB12.390SG-BK	WBFP12.390SGB
15U	600	769	390	WB15.390SG	WBFP15.390SG	WB15.390SG-BK	WBFP15.390SGB
18U	600	901	390	WB18.390SG	WBFP18.390SG	WB18.390SG-BK	WBFP18.390SGB
21U	600	1037	390	WB21.390SG	WBFP21.390SG	WB21.390SG-BK	WBFP21.390SGB

WR500 Series – 500mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	500	WB6.5SG	WBFP6.5SG	WB6.5SGB	WBFP6.5SGB
9U	600	501	500	WB9.5SG	WBFP9.5SG	WB9.5SGB	WBFP9.5SGB
12U	600	635	500	WB12.5SG	WBFP12.5SG	WB12.5SGB	WBFP12.5SGB
15U	600	769	500	WB15.5SG	WBFP15.5SG	WB15.5SGB	WBFP15.5SGB
18U	600	901	500	WB18.5SG	WBFP18.5SG	WB18.5SGB	WBFP18.5SGB
21U	600	1037	500	WB21.5SG	WBFP21.5SG	WB21.5SGB	WBFP21.5SGB

WR600 Series – 600mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	600	WB6.6SG	WBFP6.6SG	WB6.6SGB	WBFP6.6SGB
9U	600	501	600	WB9.6SG	WBFP9.6SG	WB9.6SGB	WBFP9.6SGB
12U	600	635	600	WB12.6SG	WBFP12.6SG	WB12.6SGB	WBFP12.6SGB
15U	600	769	600	WB15.6SG	WBFP15.6SG	WB15.6SGB	WBFP15.6SGB
18U	600	901	600	WB18.6SG	WBFP18.6SG	WB18.6SGB	WBFP18.6SGB
21U	600	1037	600	WB21.6SG	WBFP21.6SG	WB21.6SGB	WBFP21.6SGB

FLAT PACK
excel

Now available for fast on site assembly

Please check with your local Excel Sales Office or distributor for in country product availability
NB: Speak to our sales team if you need steel doors

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, up to 52U are available in a standard 2 post 75mm deep rack. 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

Product Details and Contents

Standard specification	DIN 41494 compliant
Rack Material	Aluminium
Surface Treatment	Phosphate coating
Paint Coating	Black - RAL9005
Supply	Flat Pack
U Frames	2 pieces
Base Plates	2 pieces
Upper cross member	2 pieces

Environ® OR Series - 2 Post Open Rack

U Size	Description	In Stock	Part Number
42U	2 post 75mm deep - Profile to profile	✓	541-742
48U	2 post 75mm deep - Profile to profile	✓	541-745
52U	2 post 75mm deep - Profile to profile	✓	541-752

Environ OR Series - High Density Cable Management



- Lockable aluminium double hinge doors



- Cable spools in vertical design from 8" wide and above



- Rounded cable management fingers to avoid cable damage



- Pass through cut outs in vertical design from 8" wide and above

Accessories

Description	Part Number
Raised Floor Support Kit	540-950
Cage Nuts, pack of 50	M6CNU

Environ® OR Series - High Density Cable Management



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
- Vertical design available in range of 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
- Pass through 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® OR Series - High Density Cable

High Density Vertical Cable Management

U Size	Overall Height	Front or Front and Rear	Width (inch)	Width (mm)	Depth (inch)	Depth (mm)	In Stock	Part Number
42	1966	Front and rear	6	150	20	500	✓	541-040
42	1966	Front and rear	12	300	20	500	✓	541-011
42	1966	Front and rear	15	380	20	500	✓	541-013
48	2278	Front and rear	6	150	20	500	✓	541-041
48	2278	Front and rear	12	300	20	500	✓	541-019
48	2278	Front and rear	15	380	20	500	✓	541-021
52	2456	Front and rear	6	150	20	500	✓	541-042
52	2456	Front and rear	12	300	20	500	✓	541-027

Note - All part codes are for a single vertical cable management unit.

High Density Horizontal Cable Management

U Size	Front or Front and Rear	Width (inch)	Width (mm)	Depth (inch)	Depth (mm)	In Stock	Part Number
2	Front	19	483	6	150	✓	541-030
2	Front and rear	19	483	12	300	✓	541-031
3	Front	19	483	6	150	✓	541-032
3	Front and rear	19	483	12	300	✓	541-033

Note - All part codes are for a single horizontal cable management unit.



Measure, Monitor, Manage

Excel provides flexible, scalable solutions to help you maintain environmental conditions in your Data Centre.

Environ® Locking Solutions

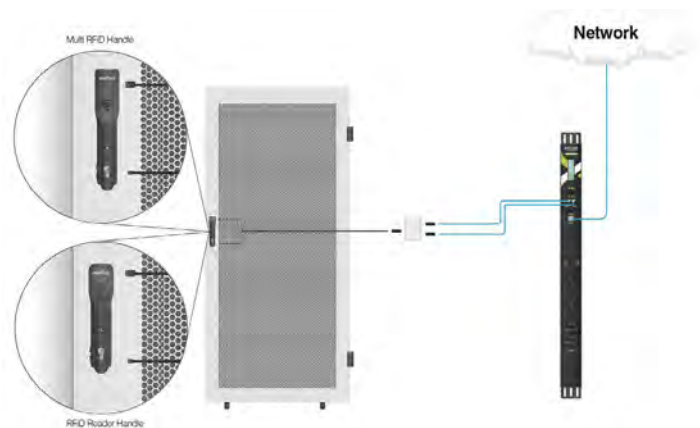
Environ Locking Solutions from Excel, in conjunction with Southco and Suprema, provide an ergonomic and stylish solution to environments where security is paramount. The solution can be standalone, networkable, integrate into Access Control systems, BMS and include Biometrics.

The Solution brings intelligence and monitoring right down to the lock level of a data rack, giving you ultimate control of access to the services and equipment within a comms room or data centre, making it perfect for co-location deployments and remote sites where access is restricted for authorised personnel only.

RFiD Intelligent

The Lock with built in RFiD reader is the ultimate in data rack security. This lock provides intelligence and monitoring, allowing for remote locking and unlocking, with built in integral key lock for manual over-ride.

This solution is offered as a fitted handle to a complete rack.



Biometric Intelligent

Remove the possibility of fraudulent access through mislaid keys or corrupt activity, with biometric readers within the lock.

The Solution is data centre centric with the market shift towards cloud, colocation and managed service offerings, where multiple clients are facilitated.

This solution is offered as a fitted handle to a complete rack.

Standalone Combination Lock

Have up to 20 unique combination codes on each lock with the standalone solution, on any of the latch mechanism doors with the CR, ER and CL series racks.

This self contained system is locally powered through a 3AA battery power pack. The system is easily programmed with a management key and has activation life cycle of circa 50,000 operations.

This solution is offered as piece part for retro fitting to a rack or can be supplied fitted.

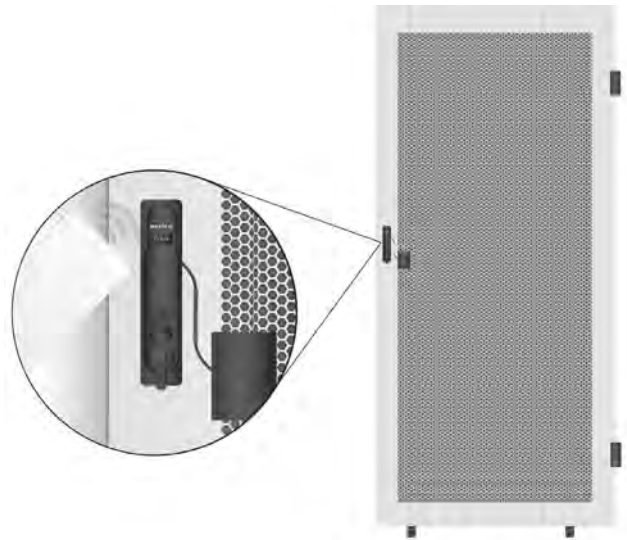


Standalone RfID lock

Have up to 20 cards programmed on each lock with the standalone solution on any of the latch mechanism doors within the CR, ER and CL series racks.

This self contained system is locally powered through a 3AA battery power pack. The system is easily programmed with a management key and has activation life cycle of circa 50,000 operations.

This solution is offered as piece part for retro fitting to a rack or can be supplied fitted.



Integration options

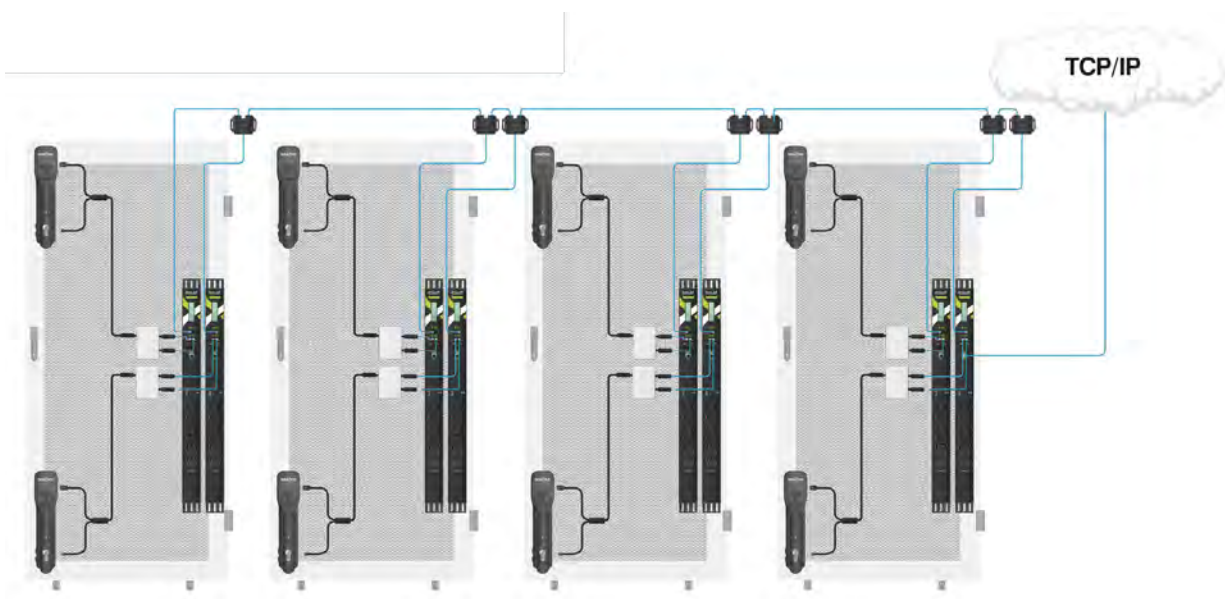
The intelligent versions of the lock range are easily integrated in to various systems to create a totally intelligent solution. With this function the locks can become networkable, allowing for remote access activation. Alarm outputs can be configured to give notification of door open requests.

Excel Intelligent PDU

The locks can be powered and integrate with the Excel Intelligent PDU solution. By using a junction box, the tin open ended wire harness loom can be split into two RJ22 cables, allowing for the 12VDC to power the unit and the other receiving the Wiegand outputs from the integrated reader. The PDU can activate 2 locks, with simultaneous operation.



2 Door setup in row of racks through Excel Intelligent PDU's



The PDU's can be daisy chained together to create a series of intelligent networkable handles that can be opened locally or remotely through the free software.

How to obtain a quotation for an Intelligent Lock Solution

Before we can quote for an intelligent lock solution we require a few basic facts from you:

1. What rack do you require the lock to be fitted on
2. Which door do you wish to have the locks fitted on – Front/rear (please note all locks are not compatible with all door styles – See table below)
3. Do you wish the system to be standalone – Select the SC style handle
4. Do you wish the system to have networkable functionality – select the H3 style handle
5. Do you require keypad, RFID or biometric authentication – if RFID what reader technology

Once we have this information we will be able to provide you with a full quotation.

SC: This solution is provided with a battery pack that activates the lock circa 50,000 times.

H3: This solution is operated by 12 VDC and is not provided within the lock kit.

See integration options for more information.



Biometric authentication: only available on H3 series.

To help understand what locks can be fitted to what doors please see below compatibility chart.

These locks are only sold as part of Environ rack and will come fitted complete with the open ended Y cables fitted to the doors (on H3 range) to allow for final fitting into power source and Wiegand output receiver.

Intelligent handle / door compatibility chart

Door	Lock style	
	SC	H3
SR - Front door	x	✓
SR - Rear door	x	✓
CL - Front door	✓	x
CL - Rear door	✓	x
ER - Front door	✓	✓
ER - Rear door	x	✓
CR - Front door	✓	x
CR - Rear door	x	x
WR - Front door	x	x

Pre-Configured Racks

At Excel our reputation is founded on our dedication to providing a quality service in every aspect of our business. Our range of Environ Racks provide a solution to meet every installation requirement, which is further enhanced with our configuration services which save installation time on site.

Our Value Added Services include Configured Racks for the Environ Floor and Wall Racks, where we install the majority of kit that you need and we deliver it ready configured to site.

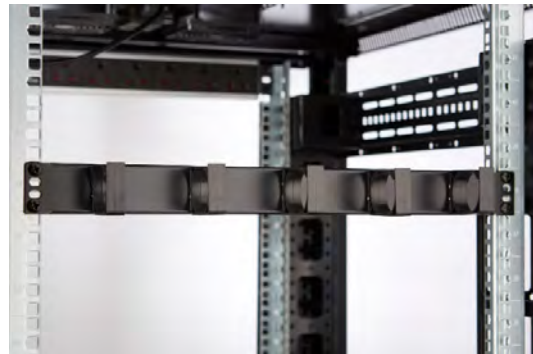
What are the benefits of Pre-Configured Racks?

- Reduces installation costs
- Reduces installation times
- Reduces equipment and specialist labour costs
- Fast turnaround - typically 2 days
- Covered by the 25-year Excel system warranty when installed by an accredited partner
- Environmentally friendly – reduces waste onsite

Features

We pre-install items, exactly where required – including:-

- PDU's - horizontal & vertical
- Fan trays
- Patchcord/cable management
- Shelves - all types
- Cable tray/basket
- Pre-loomed cabling - patchcords, power etc.
- Pre-approved layout drawing/specification
- Pre-labelled



 View The Brochure

Onsite Rack Assembly Service

Our Onsite Rack Assembly service is perfect for where access to the installation site is restricted or you have limited time on site.

How it Works

The Environ racks (flat packed), together with any additional accessories that you've ordered, including shelves, cable management, PDUs etc would be delivered to site by our normal delivery service the day before.

Our experienced team of rack builders will visit the location the day after and will position the rack(s) and build them to the agreed specification.

Features

- Save time on site for your installation team
- We can fit shelves, cable management and PDUs if required
- We will provide a full Q.C. inspection of the built rack(s) and provide a handover to the customer
- We can provide method statements and risk assessments, including an advance assessment provision, should they be required
- Our team will include a first aider and CSCS certification



[View the Brochure](#)



Excel Power Distribution

Section 9

In this Section:

[Power Distribution Units](#)
[Efficiency Measurements](#)
[Excel Modular PDU Range](#)
[Excel Standard PDUs](#)
[Excel Intelligent PDU Family](#)
[Excel Desktop Power Distribution Units](#)

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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 PDUs 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.

1. First choose the empty housing hardware:




Part Number	No. of Modules Housed	Input Connectivity	Output Connectivity	Voltage	Current Rating (Amps)
555-050	6		Optional	250V	32A

2. 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		250V	16A
555-061	5	Fused		250V	10A
555-062	4	Fused		250V	16A

CONNECTIVITY KEY

-  3 pin - BS1363
-  "Commando Style" IEC 60309
-  C13 - IEC60320
-  C19 - IEC60320




















































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 PDUs 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).

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
D13-7HF-EXL	7	✓	✓	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
D13-10IECF-EXL	10			Vertical			250V	13A
D13-12IECF-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
555-250	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

Click here to view
the full range

CONNECTIVITY KEY



3 pin - BS1363



"Commando Style" IEC 60309



C13 - IEC60320



C19 - IEC60320



Universal - GST18



Schuko



French



IEC 60884

Excel Intelligent PDU Family



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 of one size fits all' so we provide you with a simple build configuration to get exactly what you need. however we can offer the Lite version off the shelf.

Our range of intelligent 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.

The Lite range are produced using a Neutrik connector, for the power cord, allowing the PDU to be adaptable for any environment.



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 which can be supplemented by an additional remote display that can be mounted on the front of a rack for easy reading.

	IINT1 (Overall Monitoring)	INT 2 (Overall + Individual Socket Monitoring)	INT3 (Overall + Individual Socket Monitoring + Switching)	IPLite
PDU Info				
Rack Mount Vertical (0U)	✓	✓	✓	✓
Rack Mount Horizontal (1U+)	✓	✓	✓	✓
Construction	Mild Steel	Mild Steel	Mild Steel	Mild Steel
Finish	Powder Coated	Powder Coated	Powder Coated	Powder Coated
Mains Lead	HO7	HO7	HO7	HO7
Lead Length	3 Mtr	3 Mtr	3 Mtr	3 Mtr
Maximum Number of Sockets	-	48	48	42
Socket Types	C13, C18, Uk, Schuko, Plus Other			C13 & C19
Electrical Characteristics				
Single / Three Phase Options	Both	Both	Both	Single Phase Only
Main Input	85 - 265 VAC	85 - 265 VAC	85 - 265 VAC	85 - 265 VAC
Frequency	50 - 60 Hz	50 - 60 Hz	50 - 60 Hz	50 - 60 Hz
Overall Meter Current Range	0 - 63 Amps	0 - 63 Amps	0 - 63 Amps	0 - 63 Amps
Socket Current Range	-	0 - 16 Amps	0 - 16 Amps	-
Overall Meter Accuracy	+/- 1% Typical	+/- 1% Typical	+/- 1% Typical	+/- 1% Typical
Overall Meter Accuracy				
RMS Volts	✓	✓	✓	✓
RMS Amps	✓	✓	✓	✓
Kilowatts	✓	✓	✓	✓
Frequency	✓	✓	✓	✓
Power Factor	✓	✓	✓	✓
Internal PDU Temperature	✓	✓	✓	✓
Peak Voltage	✓	✓	✓	✓
Peak Current	✓	✓	✓	✓
kVA	✓	✓	✓	✓
kWh (Cumulative)	✓	✓	✓	✓
Kg/CO2 (Cumulative)	✓	✓	✓	✓
BTU/h (Cumulative)	✓	✓	✓	✓
KJ/h (Cumulative)	✓	✓	✓	✓
Cost (Cumulative)	✓	✓	✓	✓

	IINT1 (Overall Monitoring)	INT 2 (Overall + Individual Socket Monitoring)	INT3 (Overall + Individual Socket Monitoring + Switching)	IPLite
Overall Meter Accuracy				
Class II	✓	✓	✓	✓
Billing Quality	✓	✓	✓	✓
Sampling Rate 4000 times a second	✓	✓	✓	✓
Individual Socket Measurement				
Amps	-	✓	✓	-
Watts -	-	✓	✓	-
VA	-	✓	✓	-
kWh (Cumulative)	-	✓	✓	-
Socket Control				
Single / Three Phase Options	-	-	✓	-
Main Input	-	-	✓	-
Connectivity				
SNMP v1, 2, 3.	✓	✓	✓	✓
HTML, HTTP, HTTPs	✓	✓	✓	✓
XML	✓	✓	✓	✓
Email Alerts	✓	✓	✓	✓
Daisy Chaining				
RS485 Modbus - 1 Master Upto 31 Slaves	✓	✓	✓	✓
Local RGB Display				
Fitted within PDU	✓	✓	✓	✓
Remote Display Option	✓	✓	✓	✓
	Capability Only, Sensors Available separately			
Environmental Sensor				
Temperature Sensor Port (Up to 8 Sensors)	✓	✓	✓	✓
Humidity / Temperature Sensor	✓	✓	✓	✓
Volt Free Contacts (3 Sets)	✓	✓	✓	-
Cabinet Security Ports				
Door Contacts	✓	✓	✓	-
Electronic Door Handle	✓	✓	✓	-
Card Reader / Pin Pads	✓	✓	✓	-

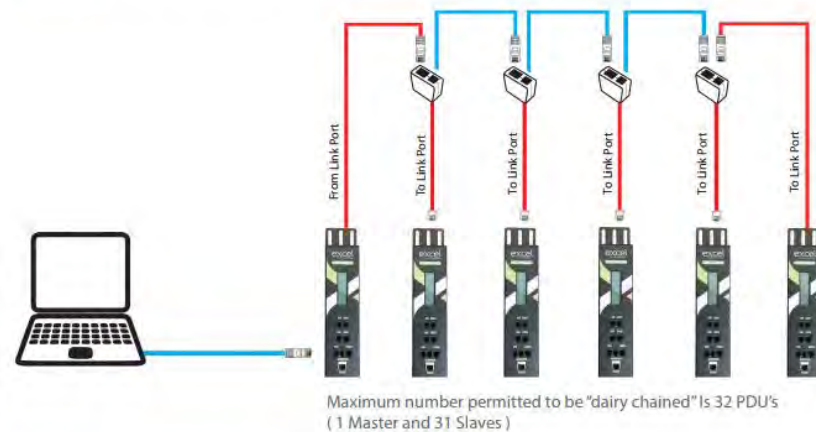
Communications Protocols

iPower PDUs can communicate using multiple methods, via web browser utilising the embedded web pages, these give you full access to all PDU functionality, enable the setup and configuring of the PDU, enable the user to view live data, set thresholds, and view alerts on Single and Multiple PDUs, SNMP, using our MiB file a customer can upload onto their own or third party software, this can be used to gather information, view live data, control PDUs and collate information and histograms.

Linking iPDUs

PDU's can be linked together with RJ22 to RJ45 communication cables by simple daisy-chain interconnections through 3-way splitters utilising 2 wire RS485 interface. This allows the construction of a network of PDU's, where the 1st PDU becomes the master and subsequent PDU's are set to "slave" mode, up to a maximum of 1600.

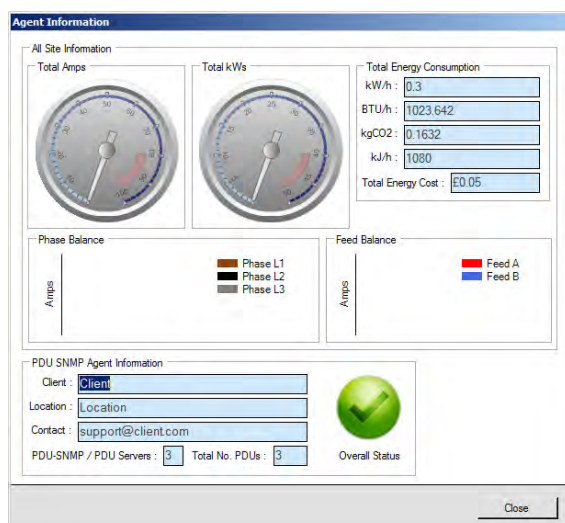
— RJ22 One End / RJ45 Other End
— RJ45 One End / RJ22 Other End



— Std Cat 5e Patch cable from Ethernet port to PC or other device

Central Management

Our own Application software SNMP PDU Agent is a free to use application software aimed at a small to medium installations where a full DCiM platform is not required, it can be installed on a local PC, this can talk to up to 50 IP Addresses, 1600 PDUs (Daisy Chained), and provide Full control and Monitoring, Creation of Thresholds and Alerts, Data and Event Logging, Graphical Information and a complete user interface.



The PDUs also have the ability to communicate using XML and Telnet, Telnet again offers full control over the PDUs functionality and is ideally suited to the home automation market.



Sensors

To complement the PDU's and create an environmental solution, there is a host of sensor options available for the system*. Some of these items:-

- Temperature Sensor – Up to 8 Temperature sensors can be connected to the PDU, via a dedicated Port.
- Humidity / Temperature Sensor – A single combined Temperature and Humidity sensor can be connected to the PDU via a dedicated port.
- Smoke, Fire, Water, Heat, + Any type of Sensor with a normally closed relay output can be connected to the any one of the 3 sets of Voltage free contacts on the PDU (Not IPLite)
- Remote Display – A slave / remote display can be connected to the PDU for mounting elsewhere within the cabinet, Door, Plinth etc. for ease of viewing cabinet status.
- Door Locks – Electronic Door Handles with a 12 VDC operating mechanism can be connected to the PDU, other voltages can be connected but require additional hardware. (Not IPLite)
- Door Contacts – Door contacts can be connected to the PDU to provide alerts when a cabinet door is opened. (Not IPLite)
- Keypads / Readers – The PDU also has a dedicated port for Wiegand 26 capable readers / pin pads. (Not IPLite)

**Some of these items are 3rd party technology, and this section is designed to show the capabilities available.*

Billing Quality

The Intelligent PDUs provide a high level of accuracy to help plan capacity and also provide accurate costs for billing purposes, the Class II billing quality meter circuitry utilises a calibrated resistor, this is more accurate than current transformers used by some manufacturers and due to the current being drawn directly through the resistor means that we can accurately measure the full AC waveform from Peak to Peak providing extremely accurate measurement of RMS Volts, RMS Amps, Power Factor, the accurate measurement of Power factor means we can correctly report values for Kilowatts and Kilowatt Hours, making billing and capacity planning straightforward, this along with other values of Peak Volts, Peak Amps, kVA, BTUs, Energy Cost and Kilograms of CO₂. The unit can also be calibrated onsite to further improve accuracy, subject to extra costs and availability.

Warranty

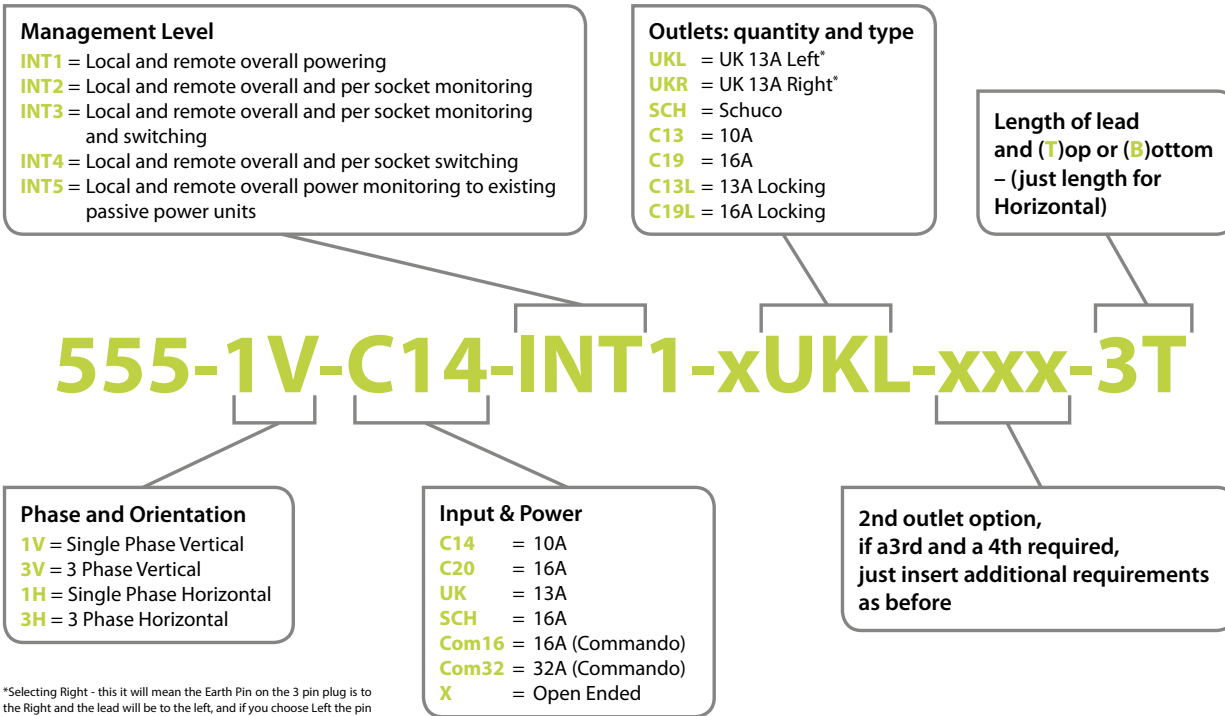
Excel offers a 5 year return to base guarantee on all there main line products, whereby the product will either be repaired or replaced at the manufacturers discretion. On being notified of a problem of an apparently defective product Excel reserves the right to send an engineer to site (if economically viable to evaluate the problem.) prior to the return.

Products containing surge suppression items are limited to a 2 year return to base warranty.

Products which have been abused, damaged or not used for their designated purpose are excluded from any warranty.

Building your Excel Intelligent PDU

Follow these basic steps to build your Excel Intelligent PDU.



S9



Schuko



3 Pin - BS1363



BS1363
& C13 - IEC60320



C13 - IEC60320



C19 - IEC60320

IntelligentPDU

excel
without compromise.

PDU's Available

Local & remote overall power monitoring
Local & remote overall and per socket monitoring
Local & remote overall and per socket monitoring,
and power switching

Socket Types

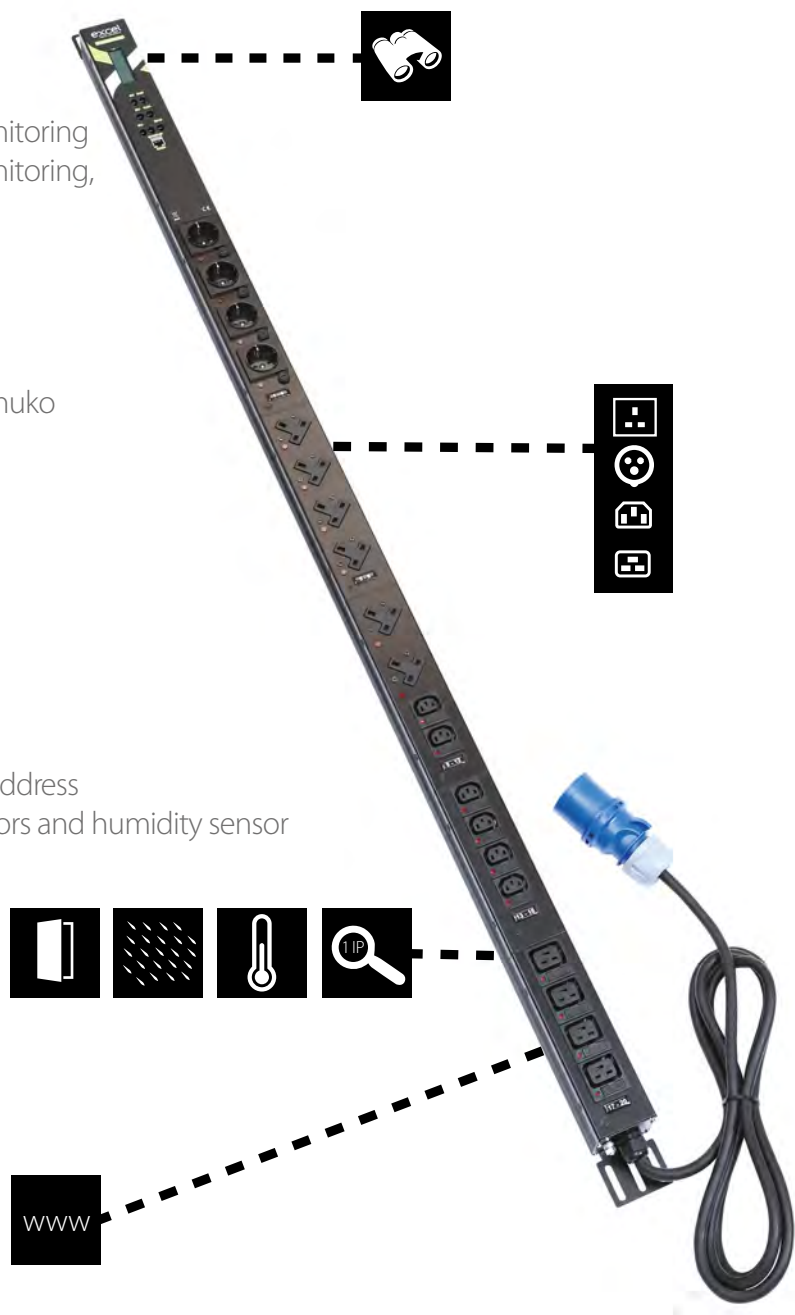
Any socket combination: C13, C19 and Schuko
Locking
Single or three phase
16 – 63 Amp
Up to 48 sockets on one PDU

Features

UK design and manufacturer
Short leads 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



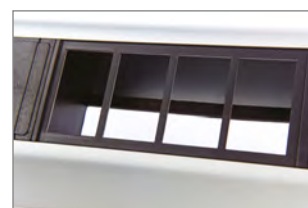
Excel [Desktop Power Distribution Units](#) offer a convenient addition to the work place. Available with either UK or Schuko power sockets and options for 6c apertures to accept data outlets and USB power in a stylish anodised aluminium finish, the PDUs are easily fitted to the desktop with the supplied 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
555-283		4		2	296 mm	78 mm	91 mm
555-284		4		4	348.5 mm	78 mm	91 mm
555-286		4	2	4	398 mm	78 mm	91 mm



BIG ON PERFORMANCE

When compromised performance is not an option our rack solutions deliver style, flexibility and specification options each and every time. With integral cable management, doors to encourage maximum ventilation, up to 1300kg load bearing, free next day UK delivery and 25 year warranty, you can be sure you are getting the best in performance when you choose an Environ rack from Excel.

Visit Environ:
excel-networking.com/environ-racks

excel
without compromise.

Excel Residential/SoHo Cabling Solutions

Section 10

In this Section:

[Connected Homes](#)

[Standards Based Systems](#)

[The Excel Residential Solution](#)

[The Excel Residential/SoHo Product Range](#)

[Fibre in the Home](#)

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Connected Homes

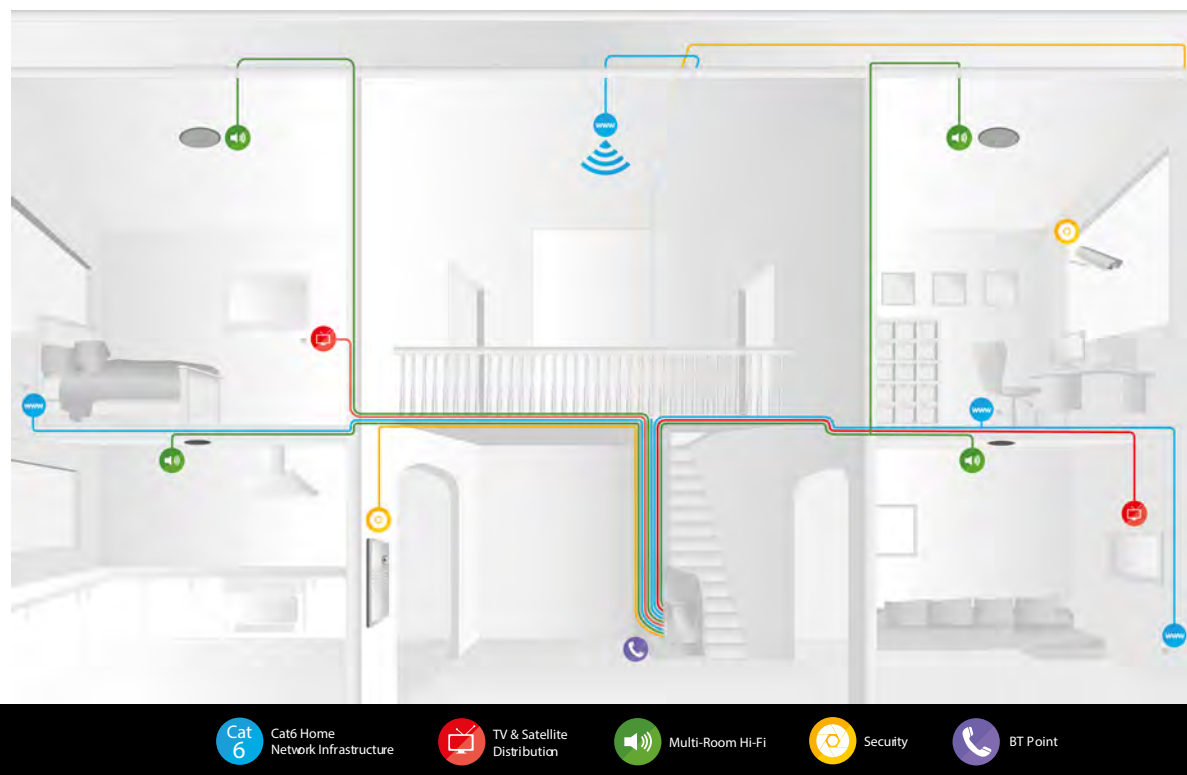
Connected homes are becoming an increasingly significant part of the construction industry as the number of wired and wireless devices and systems within residences increases. This trend is being replicated by developers of housing, apartments and high end residences, who are providing more connected services within their new homes as a differentiator, and for existing home owners who need to add more connectivity to their homes.

Products for this market are also finding their way into the increasingly important hospitality market. Many High End hotel chains need to also consider not only the quality of service they provide but also the level of experience they provide the business traveller.

Businessmen rarely choose a hotel on the decor of the room these days, it is a combination of the quality of internet connection and how they can work in a similar manner to their home office when they are in their room.

With the connected world and Internet of Things we expect to control devices from an app on a Smartphone, whether it's in the work environment or at home.

Nearly all new homes and apartments have an internet connection and the Excel Residential Cabling solution has been developed to provide a suite of products that have been designed for that purpose.



The above diagram shows a typical home installation and the type of services that are needed providing connectivity for such things as wireless, TV, sound, security, access control etc. This model is very similar, but at a different scale, whether it is a studio apartment or a high end residence.

The Excel residential range includes new 25AWG Category 6 reduced diameter cable, flat and mini Category 6 patch leads, CATV splitter, a telephone panel, a range of AV Inserts, FFX surface mount boxes and faceplates, SoHo cabinet, the Verticab along with other products from the existing Excel range that are complementary to a residential installation.

Standards Based Systems

The Cenelec standard BS EN 50173-4: 2007 +A2:2012 (Information technology -Generic cabling systems- Part 4: Homes, was developed to reflect the demands of generic cabling within homes and provides for each group of applications Information and Communications Technologies (ICT), Broadcast and Communications Technologies(BCT) and Commands, Controls and Communications in Buildings (CCCB), in essence every aspect of the Smart Home.

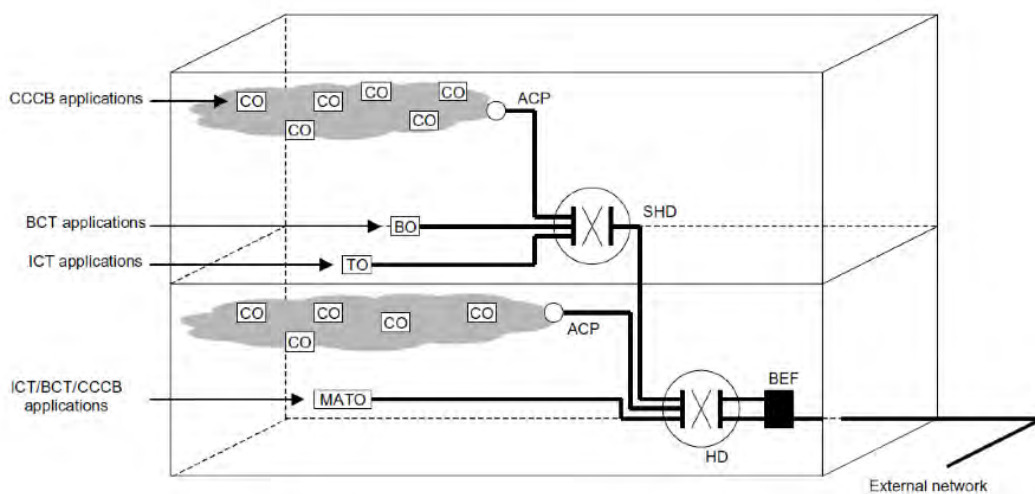
By using a generic cabling system based upon BS EN 50173-1 (generic requirements) it:

- i) allows deployment of a wide range of applications without changes to the fixed cabling infrastructure;
- ii) provides a platform to support moves, adds and changes of connectivity.

BS EN 50173-4, has been prepared to reflect the demands of generic cabling within homes and provides for:

- Users with an application-independent generic cabling system;
- Users with a flexible cabling scheme such that changes are both easy and economical;
- Building professionals (for example, architects) with guidance for the design and dimensioning of home cabling according to the end-user needs or requirements (expressed or assumed);
- Industry and applications standardisation bodies with a cabling system that supports current products and provides a basis for future product development in application standardization;
- Users, designers, and manufacturers of application-specific cabling systems with advice on interfacing to this generic cabling;
- Suppliers of cabling components and installers of cabling with relevant requirements;
- Service providers such as the ISPs (BT, Virgin Media etc) with a distribution system for their services.

As with all variations on BS EN 50173 we have to get used to a number of new terms and acronyms and it is no different with Part 4, however once you are used to them it becomes very straight forward to start it would be easiest to look at the following diagram courtesy of BS EN 50173-4.



Then we can list the terms that can be used within the standard.

ACP	Area Connection Point
BEF	Building Entrance Facility
BO	Broadcast Outlet
CATV	Community Antenna Television
CCTV	Closed Circuit TV
CO	Control Outlet
ENI	External Network Interface
HBES	Home and Building Electronic System
HD	Home Distributor
MATO	Multi-application Telecommunications outlet



PS	Power source
SHD	Secondary Home Distributor
TE	Terminal equipment
TO	Telecommunications Outlet
TV	Television

There are a few items above that are in addition to those referenced in BS EN 50173-1 and would benefit from additional explanation, the ones that will be most commonly encountered are;

Area connection point (ACP) - a point at which CCCB coverage area cabling is connected to area feeder cabling

Area feeder cable - CCCB cable connecting the home distributor (or secondary home distributor, if present) to the area connection point

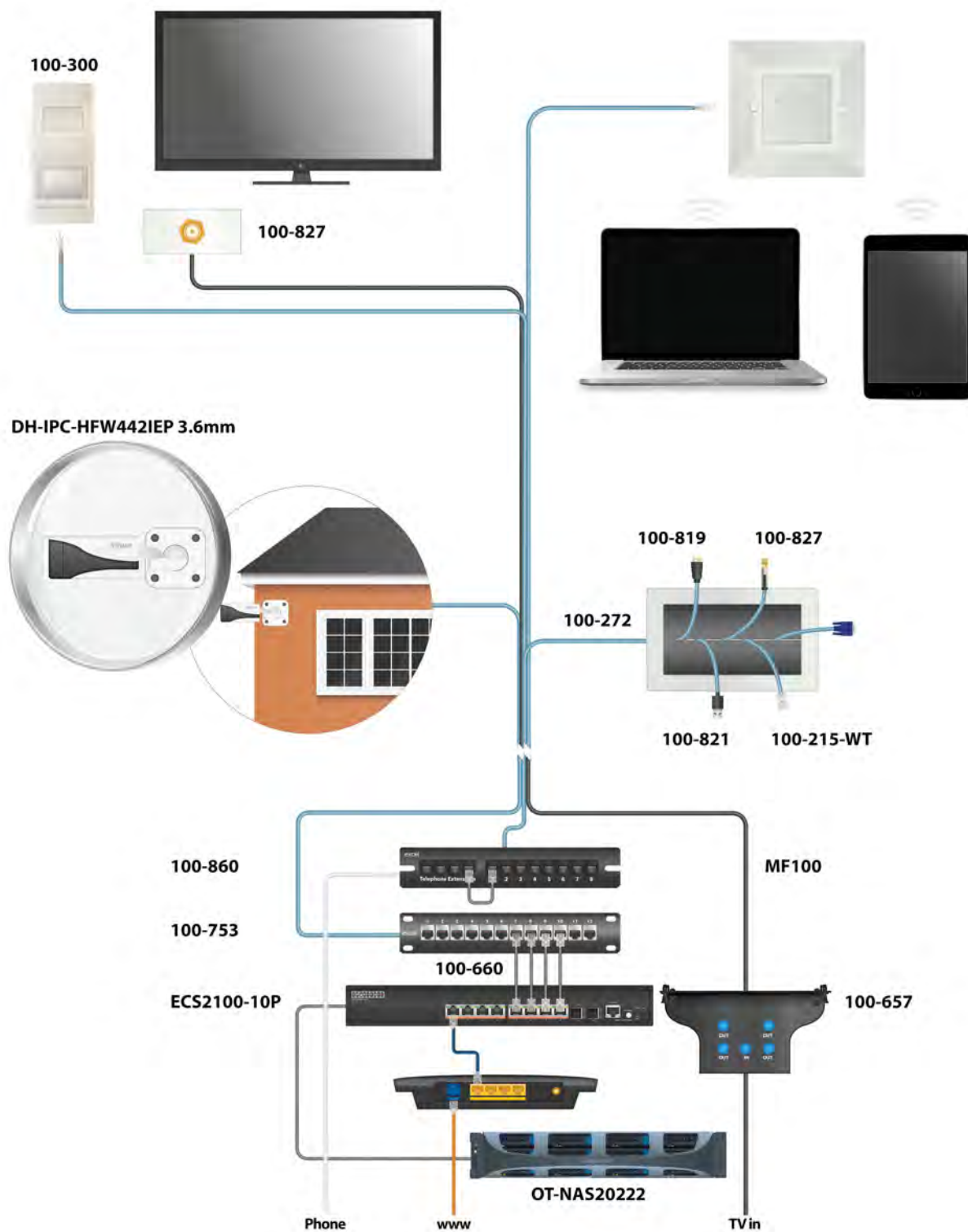
Broadcast outlet (BO) - fixed connecting device where the BCT home cable terminates

Home distributor (HD) - The distributor within a home where cables terminate

Multi-application Telecommunications outlet (MATO) - Grouping of telecommunications outlets and broadcast outlets, which may include one or several interfaces

By the nature of the standard this approach can be scaled for single dwellings, multi-tenant apartment blocks, high residences or even hotel and resort complexes.

The Excel Residential Solution



S10

The Excel Residential/SoHo Product Range

Excel Category 6 U/UTP Cable

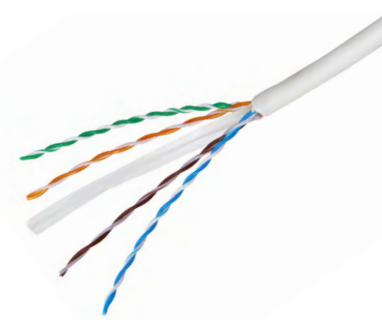
Excel Category 6 U/UTP cable is designed for optimal support of High-Speed data protocols delivering 1 Gbps performance and therefore provides the perfect infrastructure for a home or SoHo to run multiple devices across a network.

The new Excel Category 6 Cable – P/N 100-069 is specifically for use in a residential environment and has a limited permanent link of 60 metres. With a reduced overall diameter of just 4.6mm the cable consists of 8 colour coded 25AWG polyethylene insulated conductors.

Available in both Violet and White.



- Excel Category 6 U/UTP Cable LSOH - 305m Box - Violet
[100-071](#)



- Excel Category 6 U/UTP Cable LSOH - 305m Box – White
[100-074](#)

S10

With the implementation of the Construction Product Regulation (CPR) in July 2017, all permanent structured cabling must pass stringent reaction to fire performance testing. All Excel products have undergone this testing and comply to this new European standard.

With the publication of BS 6701:2016 +A1:2017 the minimum classification requirement is now Cca,s1b,d2,a2 for new installations and additions to existing, Excel is fully prepared for the new legislation.

Excel Category 6 U/UTP Flat Patch Leads - Black

Excel Category 6 U/UTP patch leads are manufactured and tested to ISO & EN requirements for patch cord assemblies. Using these Excel patch cords will ensure the installed cabling system is compliant with the TIA/EIA, ISO & EN channel specification requirements and will provide optimum performance levels for Residential cabling.

The flat construction combined with slimline molded boots and short length make them ideal for the confined spaces within residential cabling system cabinets due to their enhanced bend radius. Each Patch lead is individually bagged and has a PVC outer sheath as standard and are ideal for use in Residential Market.

- Excel Category 6 U/UTP Residential Flat Patch Leads – Black 200mm - [100-660](#)
- Excel Category 6 U/UTP Residential Flat Patch Leads – Black 250mm - [100-661](#)
- Excel Category 6 U/UTP Residential Flat Patch Leads – Black 500mm - [100-662](#)



Excel Telephone Panel

The Excel Telephone Extension panel takes 1 telephone input to 4 x output RJ45 ports, as well as 8 x Category 6 ports, making it ideal for the Residential installation market, to distribute 'wired' telephone extensions over structurally installed data cables throughout a property.

- Excel Telephone Extension/Category 6 Panel - [100-860](#)



Excel Category 6 (U/UTP) Mini Patch Leads - LSOH

Excel Category 6 U/UTP mini patch leads are manufactured and tested to ISO & EN requirements for patch cord assemblies. Using these Excel patch cords will ensure the installed cabling system is compliant with the TIA/EIA, ISO & EN channel specification requirements and will provide optimum performance levels of your Excel Category 6 cabling.

A choice of lengths and colours are available, colour coded slimline moulded boots are standard and each cable is supplied individually bagged. Each cable has a low smoke zero halogen outer sheath as standard and the small 3.8mm outside diameter makes them ideal for the data centre and high density environments.

- Excel Category 6 U/UTP Mini Patch Lead LSOH, Booted, Grey 0.5m - [100-504](#)
- Excel Category 6 U/UTP Mini Patch Lead LSOH, Booted, White 0.5m - [100-513](#)
- Excel Category 6 U/UTP Mini Patch Lead LSOH, Booted, Blue 0.5m - [100-518](#)
- Excel Category 6 U/UTP Mini Patch Lead LSOH, Booted, Yellow 0.5m - [100-527](#)



Excel Keystone Patch Panel

The Keystone patch panel allows for the housing of Keystone RJ45 toolless jacks. These panels are key to the distribution of data and AV systems throughout a residence.

- Excel MicroLan Keystone Patch Panel Frame - [100-753](#)



Excel Keystone Jacks

Taken from the existing Excel product range these high-performance and easy to terminate toolless jacks are ideal for use with the Excel Office range faceplates as well as other high-end faceplates that add a stylish look to any residential installation.

- Excel Category 6 Unscreened Toolless Keystone Jack Butterfly Style – White - [100-211](#)
- Excel Category 6 Unscreened Toolless Keystone Jack Butterfly Style – Black - [100-212](#)
- Excel Category 6 Unscreened Low Profile Toolless Keystone Jack – Black - [100-215-BK](#)
- Excel Category 6 Unscreened Low Profile Toolless Keystone Jack – White - [100-215-WT](#)



See www.excel-networking.com to see the full range of Category 6 & 6_A keystone jacks.

Excel Mounting Hardware

The Excel Office Range brings style and enhanced aesthetics to any Excel installation and are perfect for a residential installation.

- Excel Office Single Gang Faceplate with 2 half blanks – White - [100-270](#)
- Excel Office Double Gang Faceplate with 2 half blanks – White - [100-271](#)
- Excel Office Angled Keystone Shutter - 25mm x 50mm - White - [100-280](#)



[Click here to view the full range](#)

Excel CATV Splitter & Switch Mounting Plate

The Excel 4way video distribution splitter is manufactured from highest quality materials and is design to distribute incoming Satellite signal throughout the home or residence.

It has 1 F Type input and 4 outputs and supports frequencies between 5MHz and 2GHz.

Also available is a mounting plate complete with a Velcro strap to hold the small network switches within the Home Cabling Cabinet.

- Excel 4 Way CATV Splitter - [100-657](#)
- Excel Network Switch Mounting Plate - [100-656](#)



Excel AV Inserts

The Excel Audio Visual outlets provide a comprehensive range of options for both the Residential installation as well as the commercial office environment. The range includes both fly lead versions mounted into euromod size plates for use with the Excel Office range as well as keystone outlet versions for use within panels or other faceplate options with the use of the Excel Office angled shutter.

The fly lead versions have 150mm lengths of the requisite cable and are designed to provide flexible mounting options within restricted depth back boxes.

- 1 port 'F Type' Sat Coax Keystone Adaptor white - [100-805](#)
- HDMI v1.4 Keystone Adaptor white - [100-806](#)
- 1 Port USB 3.0 Keystone Adaptor white A Type - [100-807](#)
- 1 Port USB 2.0 Keystone Adaptor white A Type - [100-809](#)
- 3.5mm Audio input Keystone Adaptor white - [100-811](#)
- 25x50 HDMI v1.4 snap in adaptor with 150mm fly lead - [100-819](#)
- 25x50 USB 2.0 snap in adaptor with 150mm fly lead - [100-826](#)
- 25x50 USB 3.0 snap in adaptor with 150mm fly lead - [100-821](#)
- 25x50 SVGA snap in adaptor with 150mm fly lead - [100-828](#)
- 25x50 F Type Sat Coax snap in adaptor - [100-827](#)
- 25x50 3.5mm Audio snap in adaptor - [100-818](#)
- Brush strip black for Single Gang plate (1 pair) - [100-272](#)
- Brush strip black for Double Gang plate (1 pair) - [100-277](#)



Fibre in the Home

With the routing of cables it can be surprising how fast you exceed the 90mtr link length associated with structured cabling. Fibre optic cables are small in diameter, offer exceptional performance characteristics and can be run over a much greater distance than copper cables.

Excel FTTX Surface Mount Box and Faceplate

The Excel FTTX Surface mount box and faceplate has been designed due to the increasing amount of Passive Optical LAN and FTTX applications such as, Fibre to the Home or Fibre to the Desk, requiring the high speed connections provided by Optical Fibre. The boxes are 86.2mm high x 86.2mm wide and 22mm deep.

They provide the flexibility by having a number of singlemode options, coming either unloaded, with 2 SCAPC simplex adapters, 1 LCAPC duplex adapter or 2 LCAPC duplex adapters.

Inside the surface mount box there are a number of fingers to manage a coil of fibre, to the adapter.

- Enbeam FTTH Outlet Up To 4 Fibre Unloaded - [200-446](#)
- Enbeam FTTH Outlet Loaded 2xSC/APC OS1/OS2 Simplex Adaptors - [200-447](#)
- Enbeam FTTH Outlet Up To 8 Fibre Unloaded - [200-448](#)
- Enbeam FTTH Outlet Loaded 4xSC/APC OS1/OS2 Simplex Adaptors- [200-449](#)



Excel Cabinets & Enclosures

Residential SoHo Cabinet

The Excel Residential SoHo cabinet has been designed to accommodate the 'Hub' of a modern home networking solution; it combines both the main patching field as well as active equipment used within a Residential/SoHo network.

Space and mounting points are available for an ISP router, (compatible with all major providers) Network Switch, CATV splitter along with main patching fields to distribute all these services and more throughout the residence.

The Excel Residential SoHo cabinet is 600mm high x 450mm wide x 150mm deep and is manufactured from 1mm mild steel. It comes with a lockable door for easy access and added security.

- Excel Residential SoHo Cabinet – Black - [100-655-BK](#)
- Excel Residential SoHo Cabinet – Grey/White - [100-655-GW](#)



Recently added to the SoHo cabinet is a range of DIN Rail mounting options for both copper and fibre outlets.

Excel Verticab

The Excel Verticab offers a flexible solution for mounting equipment or patch panels, both copper and fibre in a variety of positions. This cabinet may be mounted on the wall, on the ceiling or in the floor void. The cabinet provides 3U deep mounting and 2U of shallow mounting to accommodate various patch panels and equipment. As standard the Excel Verticab includes cable securing and entry positions in an aesthetically pleasing enclosure. The hinged front cover is both lockable and supported by a gas strut.

The Excel Verticab is ideal for use as a consolidation point, small active equipment housing or as a Residential cabinet.

The Excel Verticab is 500mm high x 475mm wide x 140mm deep and provides a large hinged lockable door for easy access.

- Excel Verticab - [350-752](#)



Environ Wall Racks

The Environ WR range of Wall Racks have been designed with strength, ease of use and aesthetics in mind. The range is extensive with a choice of depths and heights, as highlighted below and are available in a choice of Grey or Black. The Environ WR Racks can be delivered assembled or flat packed and are ideal for a larger Residential installations.

A full range of Excel accessories are available to complete cable or equipment installation from shelving through to ventilation and power distribution Units.



WR390 Series – 390mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	390	WB6.390SG	WBFP6.390SG	WB6.390SG-BK	WBFP6.390SGB
9U	600	501	390	WB9.390SG	WBFP9.390SG	WB9.390SG-BK	WBFP9.390SGB
12U	600	635	390	WB12.390SG	WBFP12.390SG	WB12.390SG-BK	WBFP12.390SGB
15U	600	769	390	WB15.390SG	WBFP15.390SG	WB15.390SG-BK	WBFP15.390SGB
18U	600	901	390	WB18.390SG	WBFP18.390SG	WB18.390SG-BK	WBFP18.390SGB
21U	600	1037	390	WB21.390SG	WBFP21.390SG	WB21.390SG-BK	WBFP21.390SGB

WR500 Series – 500mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	500	WB6.5SG	WBFP6.5SG	WB6.5SGB	WBFP6.5SGB
9U	600	501	500	WB9.5SG	WBFP9.5SG	WB9.5SGB	WBFP9.5SGB
12U	600	635	500	WB12.5SG	WBFP12.5SG	WB12.5SGB	WBFP12.5SGB
15U	600	769	500	WB15.5SG	WBFP15.5SG	WB15.5SGB	WBFP15.5SGB
18U	600	901	500	WB18.5SG	WBFP18.5SG	WB18.5SGB	WBFP18.5SGB
21U	600	1037	500	WB21.5SG	WBFP21.5SG	WB21.5SGB	WBFP21.5SGB

WR600 Series – 600mm Deep

U Size	Width (mm)	Overall Height (mm)	Depth (mm)	Part Number Grey	Part Number Grey Flat Pack	Part Number Black	Part Number Black Flat Pack
6U	600	368	600	WB6.6SG	WBFP6.6SG	WB6.6SGB	WBFP6.6SGB
9U	600	501	600	WB9.6SG	WBFP9.6SG	WB9.6SGB	WBFP9.6SGB
12U	600	635	600	WB12.6SG	WBFP12.6SG	WB12.6SGB	WBFP12.6SGB
15U	600	769	600	WB15.6SG	WBFP15.6SG	WB15.6SGB	WBFP15.6SGB
18U	600	901	600	WB18.6SG	WBFP18.6SG	WB18.6SGB	WBFP18.6SGB
21U	600	1037	600	WB21.6SG	WBFP21.6SG	WB21.6SGB	WBFP21.6SGB

Network Switch/Router

Every installation requires a network switch suitable for residential purposes and we would recommend a couple of options from leading brands Edgecore Networks and Level One.

- ECS2100-10P from Edgecore Networks
8 x Gigabit Ethernet ports and 2 x SFP (Fibre ports) allow for the distribution of services throughout a residence.
- FEP0800 from Levelone
8-Port Fast Ethernet PoE Switch, 85W 10/100Mbps, full/half-duplex, auto-negotiation, auto- MDI/MDIX
Simple Plug and Play installation.
- ISP Router
The final piece of the puzzle is a suitable ISP router that will be available from your broadband provider, eg BT or Virgin Media.





Excel Voice Cabling Systems

Section 11

In this Section:

Excel Voice Cabling System

Excel Cables

Excel CW Cables Cables

Excel Cable Construction

Excel Category 3 Cable

Excel Connecting Hardware

Excel Frames

Line Jack Units – LJU

Design and Installation Considerations

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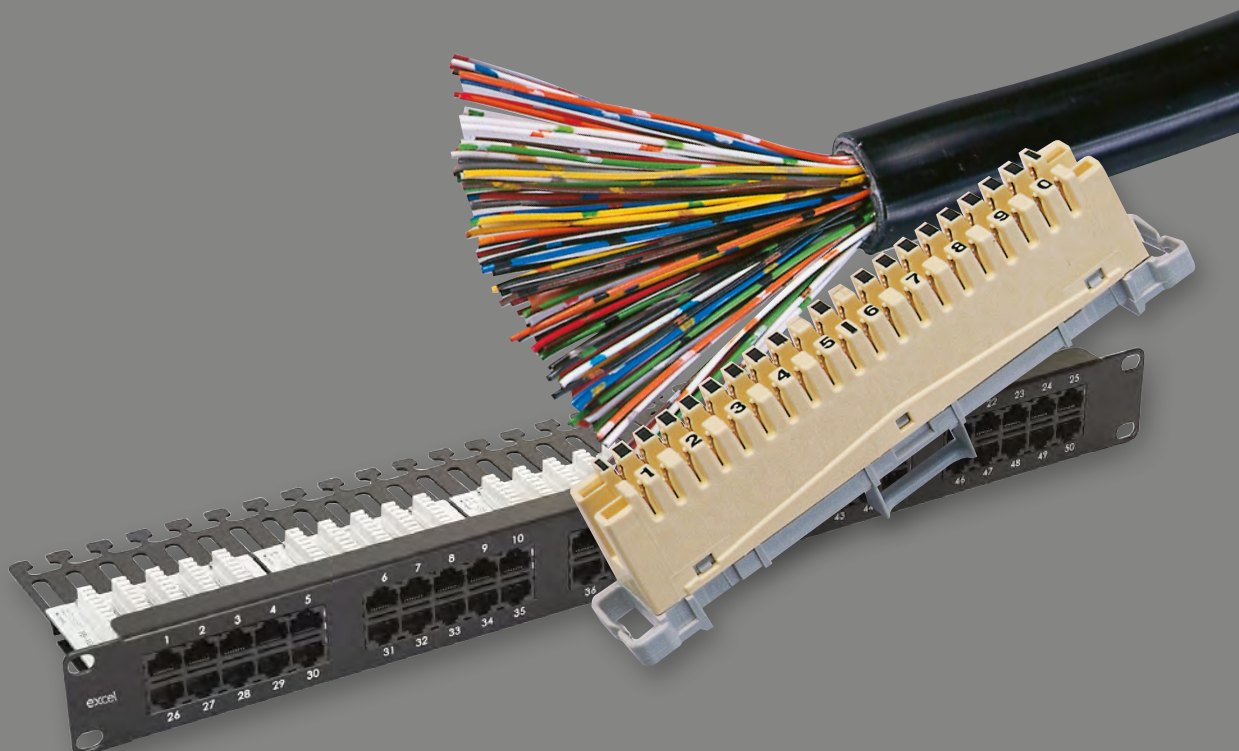
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Excel Voice Cabling System

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.

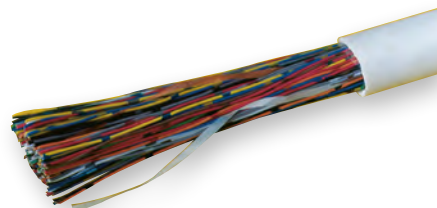
In current times, Multipair Voice cabling systems are used primarily as Emergency Back-up systems such as Emergency Lift Phones and BT RedCare etc (or for Analogue Fax Services). Therefore the Excel Range of Multipair internal telephone cables and components are manufactured in accordance with the relevant 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

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.

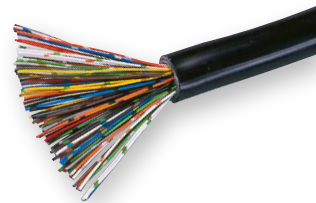
CW1308B are available in pair counts of 10, 20, 25, 50, 100, 200.

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
 - o These cables are manufactured in accordance with BT type CW1308.
- [CW1308B](#) – Internal/External Grade Low Smoke Zero Halogen Cable
 - o 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
 - o 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.
 - o 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.
 - o Please refer to page 189 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)

Note: Please ensure that you select cables with the correct CPR compliance in accordance with local regulations; in the UK this will be defined with the latest revision of BS 6701:2016+A1:2017.

Connecting Hardware

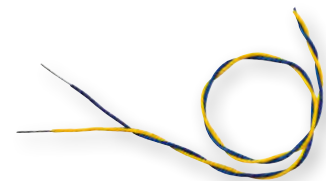
- [Excel 25, 50 or 60 Port RJ45 Patch Panels](#)

- o 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

- o CW1423 Jumper Wire is a Single Pair cable and is insulated with an Irradiated Outer Sheath for use on Distribution Frames.



- [Excel Connection Boxes](#)

- o 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.



Excel Frames

- Distribution Frames

- o [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.

- o [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.

- o Flat (<https://www.excel-networking.com/product/550-278/excel-108a-distribution-frame-dual-bank-1380-pairs>)
- o Recessed (<https://www.excel-networking.com/product/3USRR/3u-sub-rack-recessed>)

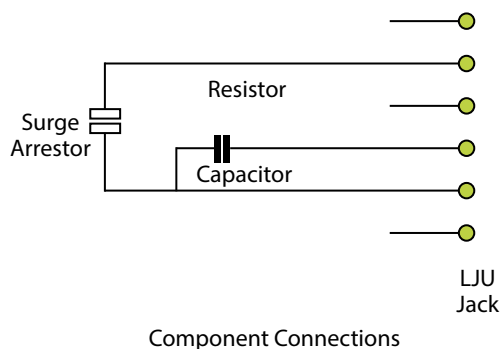


Line Jack Units – LJU

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 LJUs 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).

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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 of 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.



Excel Installation Guidelines

Section 12

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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?
- In regards to the CPR, (Construction Products Regulation) have you ordered the correct Euroclass of cable as specified by the client. If in doubt please reference Section 2 for more details.
- 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 (M₁, I₁, C₁, E₁). Most indoor office and data centre environments fall within the Class 1 environment (M₁, I₁, C₁, E₁).

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_A. 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

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 M₁, I₁, C₁, E₁.
- 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

Segregation Classification	Cable Performance	Cable Management System			
		None (or Non-metallic)	Open metallic containment	Perforated metallic containment	Solid metallic containment
d	Class F _A	10 mm	8 mm	5 mm	0 mm
c	Class D or E or E _A F/UTP	50 mm	38 mm	25 mm	0 mm
b	Class D or E or E _A U/UTP	100 mm	75 mm	50 mm	0 mm
a	Coaxial	300 mm	225 mm	150 mm	0 mm

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)	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 $\leq 32A$, Power conductors contained in overall sheath or twisted, taped, bundled together

Data Cable - Segregation Classification is "b", "c" or "d" in an E₁ 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

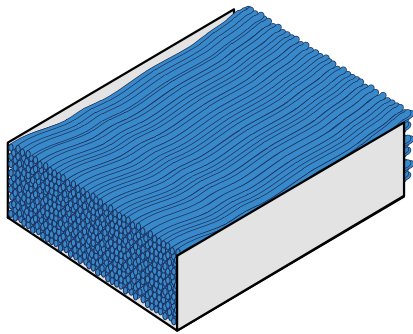
Cable trays, basket, ladder racking and other containment should be filled on day one:

- 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?

$$\text{Area of one cable} = \frac{(\text{cable diameter})^2 \times \pi}{4}$$

$$\text{Area of one cable} = \frac{(5.5)^2 \times 3.14}{4} = 23.75\text{mm}^2$$

$$\text{Area of 1000 cable} = \frac{(5.5)^2 \times 3.14}{4} \times 1000 = 23746\text{mm}^2$$

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](#).

(all dimensions in mm)

Excel Cable

Containment Sizing - Conduit

Notes: This spreadsheet is for guidance only.
This may be used for Conduit
It assumes straight runs with no bends and smooth walls.

Use our Excel
Containment Sizing
Calculator

Conduit Dimension



Inside Diameter	25 mm
Spare Capacity	10 %
Area of Containment	491 mm ²
Usable area	179 mm ²

Only edit blue cells

This spreadsheet is for information only. Based on BICSI TDDMM

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	100-196 Cat 6 A P/FTP "S" Foil	100-191 Cat 6 A U/FTP "S" Foil	100-914 Cat 6A S/FTP	100-071-500 Cat 6 U/UTP (B2ca)	100-071 Cat 6 U/UTP	100-076 Cat 6 F/UTP	100-080 Catts RD U/UTP	100-609 Residential Category 6 U/UTP	100-066 Cat 5e U/UTP	100-217 Cat 5e F/UTP
Diameter of Cable	8.5	7.8	8.3	6.9	6.7	7.5	6.5	6.2	7.6	5.4	4.6	5.2	6.4
Area of Cable	56.7	47.8	54.1	37.4	35.3	44.2	33.2	30.2	45.4	22.9	16.6	21.2	32.2
Number of Cables	2	3	2	4	4	3	4	5	3	7	10	7	5

Rev 5: November 2017

NOTE: Accurate at time of publication, higher Euroclass levels of unscreened cables are typically slightly larger in OD so please check Specification Sheets.

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.

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.

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 unscreened 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.

Unscreened

$$L_{>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0.004)$$

$$L_{>40^{\circ}\text{C}} = L / (1 + (T-20) \times 0.004 + (T-40) \times 0.006)$$

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 unscreened cable and when it does the de-rating formula is much simpler as it is based upon 0.2%.

Screened

$$L_{>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0.002)$$

L = Length T = Temperature

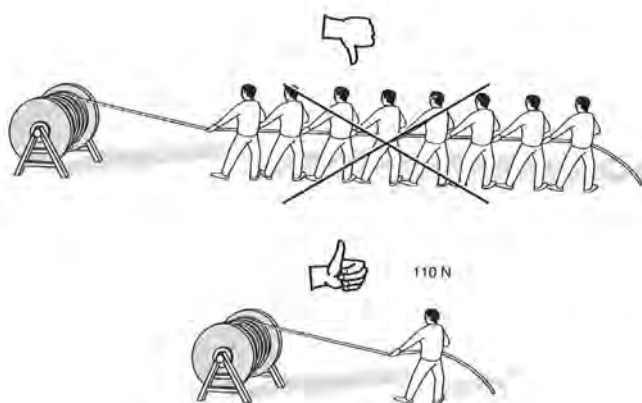
These heating effects can be mitigated by:

- 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

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.



- 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
- 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.



- 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.



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
100-065	Excel Category 5e Unscreened Twisted Pair (U/UTP) Cable - PVC	5.2 mm	42 mm	21 mm
100-066	Excel Category 5e Unscreened Twisted Pair (U/UTP) Cable - LSOH	5.2 mm	42 mm	21 mm
100-216	Excel Category 5e Screened Twisted Pair (F/UTP) Cable - LSOH	6.4 mm	51 mm	26 mm
100-609	Excel Residential Category 6 Unscreened Twisted Pair (U/UTP) Cable - LSOH	4.6 mm	37 mm	19 mm
100-070	Excel Category 6 Unscreened Twisted Pair (U/UTP) Cable - PVC	6.2 mm	50 mm	25 mm
100-071	Excel Category 6 Unscreened Twisted Pair (U/UTP) Cable - LSOH	6.2 mm	50 mm	25 mm
190-071	Excel Category 6 Unscreened Twisted Pair (U/UTP) Cable - LSOH (B2ca)	6.5 mm	52 mm	26 mm
100-076	Excel Category 6 Screened Twisted Pair (F/UTP) Cable - LSOH	7.6 mm	61 mm	30 mm
100-080	Excel Category 6 (24AWG) Unscreened Twisted Pair (U/UTP) - LSOH	5.4 mm	44 mm	22 mm
100-189	Excel Category 6A Unscreened Twisted Pair (U/UTP) Cable – LSOH	8.3 mm	67 mm	34 mm
100-191	Excel Category 6A Screened Twisted Pair (U/FTP) 'S-Foil' Cable – LSOH	6.7 mm	54 mm	27 mm
100-914	Excel Category 6A Screened Twisted Pair (S/FTP) Cable – LSOH	7.5 mm	60 mm	30 mm
100-196	Excel Category 6A Screened Twisted Pair (F/FTP) 'S-Foil' Cable – LSOH	6.9 mm	56 mm	28 mm
100-910	Excel Category 7A Screened Twisted Pair (S/FTP) Cable – LSOH	7.8 mm	63 mm	32 mm
100-912	Excel Category 7A Screened Twisted Pair (S/FTP) Cable – LSOH (1200Mhz)	8.5 mm	68 mm	34 mm

NOTE: Accurate at time of publication, higher Euroclass levels of unscreened cables are typically slightly larger in OD so please check Specification Sheets.

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.

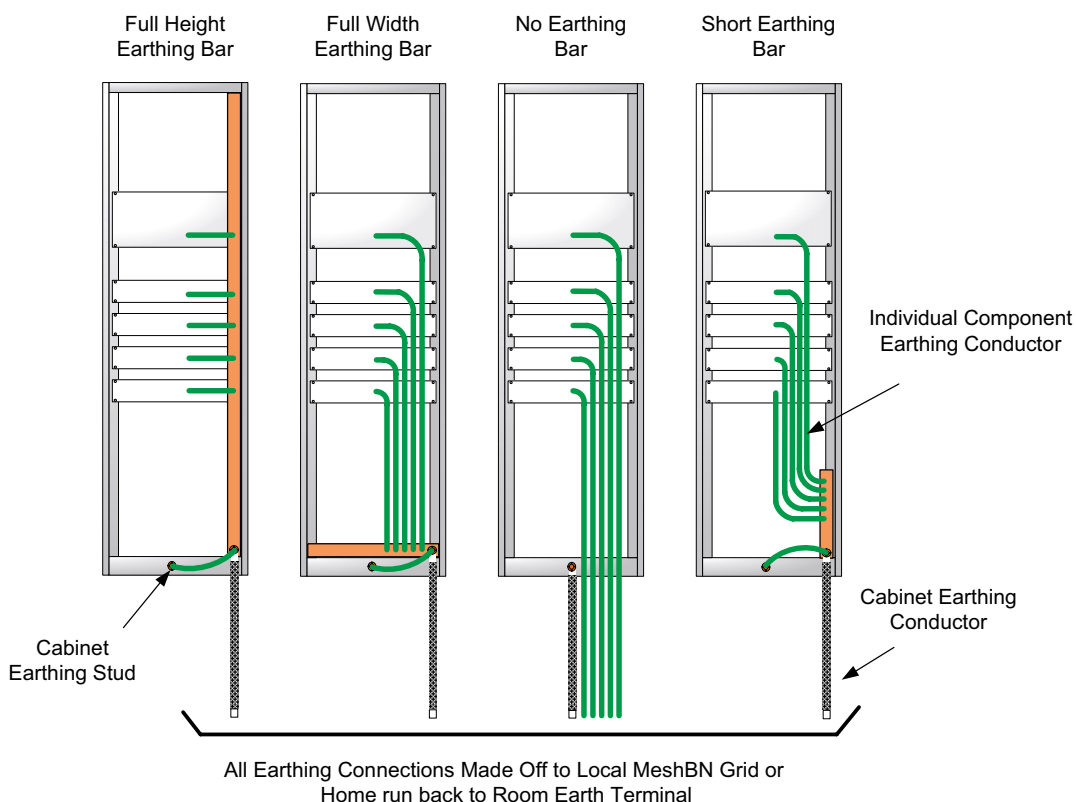
When installing a piece of equipment which requires a signal earth, always install the equipment, then attach the earth connection, then connect up the power.

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.

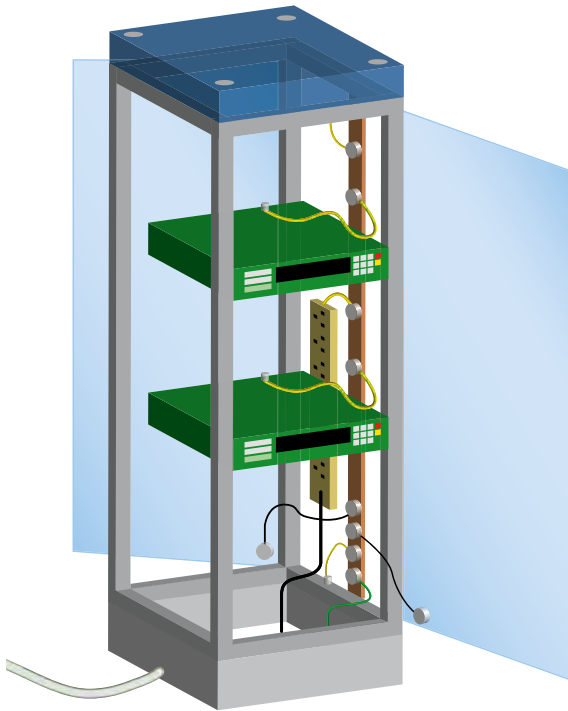
Each earthing conductor must be grounded onto a clean, purposeful earthing point. Use an approved cleaning method and bonding gel to protect the joint from oxidation.

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:

BS6701:2016 + A1:2017 Telecommunications equipment and telecommunications cabling specification for installation, operation and maintenance.

5-2.2.4 Earthing of racks, frames and cabinets.

Not less than:

- 4mm² for a rack ≤ 21U
- 16mm² for a rack > 21U

(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 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 the cable tray is mounted to the rack. Along the tray 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

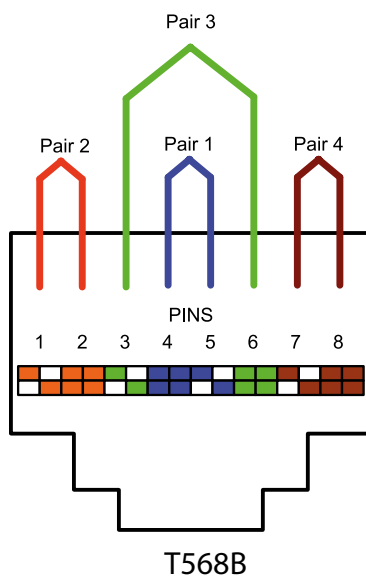
For a duplex, twin outlet presentation, choose a back box that complies with the minimum bend radius of the cable.

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	100-712 Single & 100-716 Double Gang Bevelled			
		Shutter	100-014	100-020	100-175	Nil
Jack		Direction of Incoming Cable	Euromod 25 x 50mm Flat Keystone Shutter - White	Category 6 _A Angled Shutter for Keystone Jack 50x25mm, White	Euromod 25 x 50mm Angled Keystone Shutter - White	
	100-181 Cat 6 _A Low Profile	Top	52 mm	25 mm	30 mm	
		Bottom	52 mm			
		Side	52 mm			
	100-182 Cat 6 _A Unscreened	Top	62 mm	30 mm	35 mm	
		Bottom	62 mm			
		Side	62 mm			
	100-300 Cat 6 Unscreened Module	Top				22 mm
		Bottom				22 mm
		Side				22 mm
	100-366 Cat 6 Unscreened Low Profile	Top				5 mm
		Bottom				15 mm
		Side				5 mm
	100-011 Cat 6 Keystone IDC	Top	30 mm	19 mm	19 mm	
		Bottom	30 mm			
		Side	30 mm			
	100-211 Cat 6 Toolless Jack	Top	33 mm	25 mm	29 mm	
		Bottom	33 mm			
		Side	33 mm			
	100-760 Cat 5e Unscreened Low Profile	Top				5 mm
		Bottom				14 mm
		Side				5 mm
	100-010 Cat 5e Keystone IDC	Top	29 mm	19 mm	23 mm	
		Bottom	29 mm			
		Side	29 mm			
	100-203 Cat 5e Toolless Jack	Top	32 mm	25 mm	29 mm	
		Bottom	32 mm			
		Side	32 mm			
	100-906 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	100-714 Single & 100-718 Double Gang Flat			
		Shutter	100-014	100-020	100-175	Nil
Jack		Direction of Incoming Cable	Euromod 25 x 50mm Flat Keystone Shutter - White	Category 6 _A Angled Shutter for Keystone Jack 50x25mm, White	Euromod 25 x 50mm Angled Keystone Shutter - White	
	100-181 Cat 6 _A Low Profile	Top	58 mm	31 mm	36 mm	
		Bottom	58 mm			
		Side	58 mm			
	100-182 Cat 6 _A Unscreened	Top	68 mm	36 mm	41 mm	
		Bottom	68 mm			
		Side	68 mm			
	100-300 Cat 6 Unscreened Module	Top				28 mm
		Bottom				28 mm
		Side				28 mm
	100-366 Cat 6 Unscreened Low Profile	Top				11 mm
		Bottom				21 mm
		Side				11 mm
	100-011 Cat 6 Keystone IDC	Top	36 mm	25 mm	25 mm	
		Bottom	36 mm			
		Side	36 mm			
	100-211 Cat 6 Toolless Jack	Top	39 mm	31 mm	35 mm	
		Bottom	39 mm			
		Side	39 mm			
	100-210 Cat 6 Screened Toolless Jack	Top	69 mm	36 mm	41 mm	
		Bottom	69 mm			
		Side	69 mm			
	100-760 Cat 5e Unscreened Low Profile	Top				11 mm
		Bottom				20 mm
		Side				11 mm
	100-010 Cat 5e Keystone IDC	Top	35 mm	35 mm	29 mm	
		Bottom	35 mm			
		Side	35 mm			
	100-203 Cat 5e Toolless Jack	Top	38 mm	31 mm	35 mm	
		Bottom	38 mm			
		Side	38 mm			
	100-906 Cat 5e Screened Toolless Jack	Top	69 mm	36 mm	41 mm	
		Bottom	69 mm			
		Side	69 mm			

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Suggested Minimum Back Box Depth




6c Faceplates

		Face Plate	100-670 Single & 100-671 Double Gang 6c Faceplate		
		Shutter	100-018	100-022	Nil
Jack		Direction of Incoming Cable	6c Flat Keystone Shutter	6c Angled Keystone Shutter	
	100-181 Cat 6 _A Low Profile	Top	50 mm	30 mm	
		Bottom	50 mm		
		Side	50 mm		
	100-182 Cat 6 _A Unscreened	Top	60 mm	30 mm	
		Bottom	60 mm		
		Side	60 mm		
	100-301 Cat 6 Unscreened 6c	Top			21 mm
		Bottom			21 mm
		Side			21 mm
	100-011 Cat 6 Keystone IDC	Top	27 mm	22 mm	
		Bottom	27 mm		
		Side	27 mm		
	100-211 Cat 6 Toolless Jack	Top	60 mm	30 mm	
		Bottom	60 mm		
		Side	60 mm		
	100-210 Cat 6 Screened Toolless Jack	Top	60 mm	30 mm	
		Bottom	60 mm		
		Side	60 mm		
	100-758 Cat 5e Unscreened Low Profile	Top			20 mm
		Bottom			20 mm
		Side			20 mm
	100-010 Cat 5e Keystone IDC	Top	26 mm	22 mm	
		Bottom	26 mm		
		Side	26 mm		
	100-203 Cat 5e Toolless Jack	Top	29 mm	22 mm	
		Bottom	29 mm		
		Side	29 mm		
	100-906 Cat 5e Screened Toolless Jack	Top	60 mm	30 mm	
		Bottom	60 mm		
		Side	60 mm		

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Suggested Minimum Back Box Depth

Office

		Face Plate	100-270 Single & 100-271 Double Gang Office	Floor Box Plate
		Shutter	100-280	Nil
	Jack	Direction of Incoming Cable	Office Angled Keystone Shutter	
	100-181 Cat 6 _A Low Profile	Top	22 mm	
		Bottom		
		Side		
	100-182 Cat 6 _A Unscreened	Top	35 mm	
		Bottom		
		Side		
	100-276 Office Cat 6 Low Profile	Top		10 mm
		Bottom		20 mm
		Side		10 mm
	100-011 Cat 6 Keystone IDC	Top	23 mm	
		Bottom		
		Side		
	100-211 Cat 6 Toolless Jack	Top	32 mm	
		Bottom		
		Side		
	100-210 Cat 6 Screened Toolless Jack	Top	45 mm	
		Bottom		
		Side		
	100-297 Cat 6 Low Profile 6c	Top		18 mm
		Bottom		20 mm
		Side		
	100-275 Office Cat 5e Low Profile	Top		10 mm
		Bottom		19 mm
		Side		10 mm
	100-010 Cat 5e Keystone IDC	Top	23 mm	
		Bottom		
		Side		
	100-203 Cat 5e Toolless Jack	Top	32 mm	
		Bottom		
		Side		
	100-906 Cat 5e Screened Toolless Jack	Top	45 mm	
		Bottom		
		Side		
	100-757 Cat 5e Low Profile 6c	Top		18 mm
		Bottom		20 mm
		Side		

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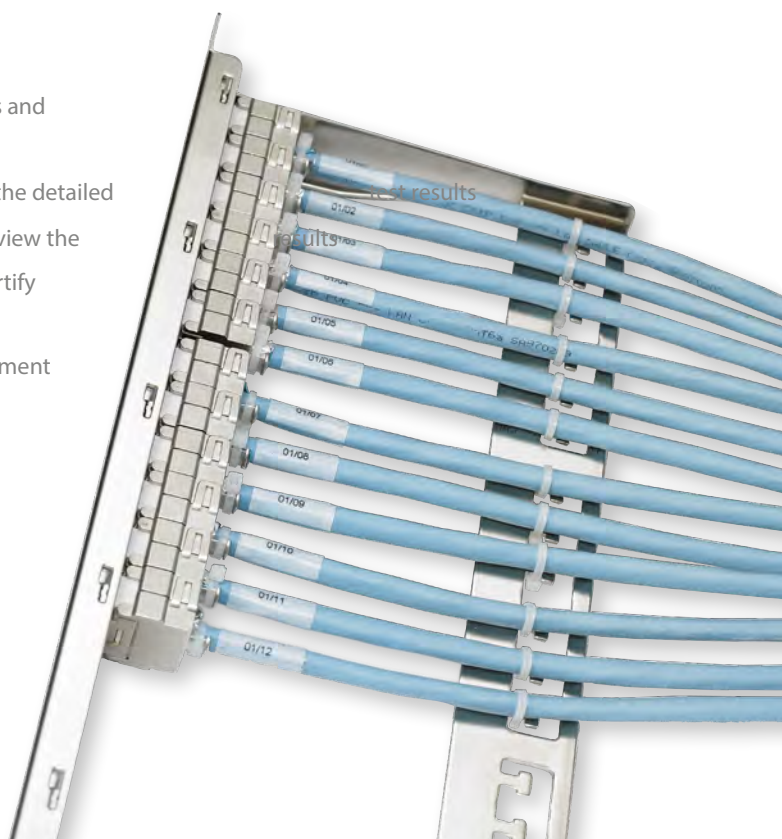
Operation & Maintenance

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 18 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
 - Copy of the Fluke Linkware used to view the
- 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



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_A (Cat6_A) 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.



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.

- 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.
- All Channel Test Heads, Personality Modules or Personality Module tips must be frequently inspected for damage or undue wear.
- 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, PLA4 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 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 DSX setup tab
- Enter the performance level specification for the Channel or Permanent Link to be tested CENELEC EN50173 Class E_A, Class E, etc.

Recommendations

- Perform a basic wire map test 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.

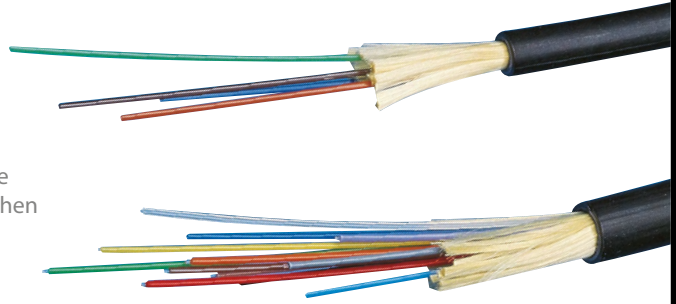
Each report will be stored by Excel.

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 16 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

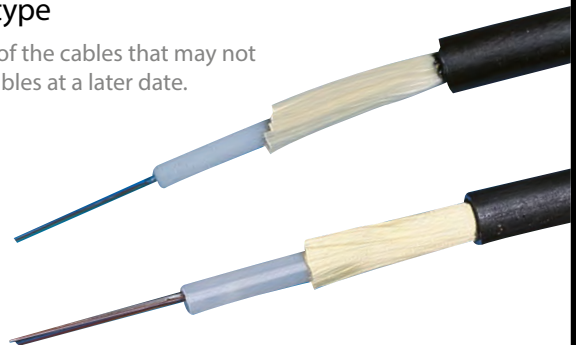
Make sure you check the installation instructions of the module for the appropriate cable lengths to ensure proper operation. You may experience additional attenuation loss when using bulkhead connectors to join cables even when the total length is less than the maximum allowed. Care should be used in 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

Use proper pulling techniques when installing the cables. Putting twists in the cable greatly increases the chances of breaking the fibres.



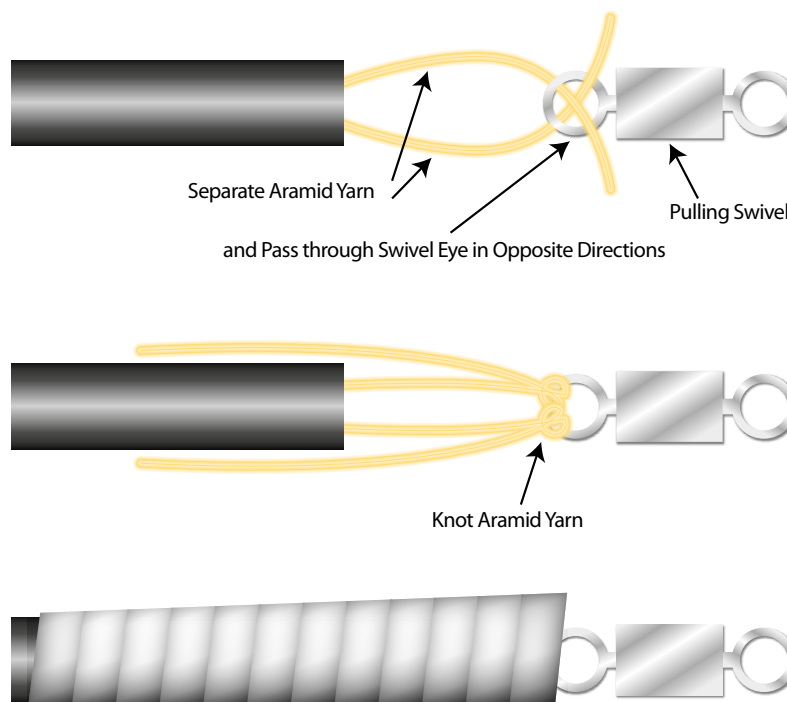
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Fibre Optic Cable Pulling Techniques

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.



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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		

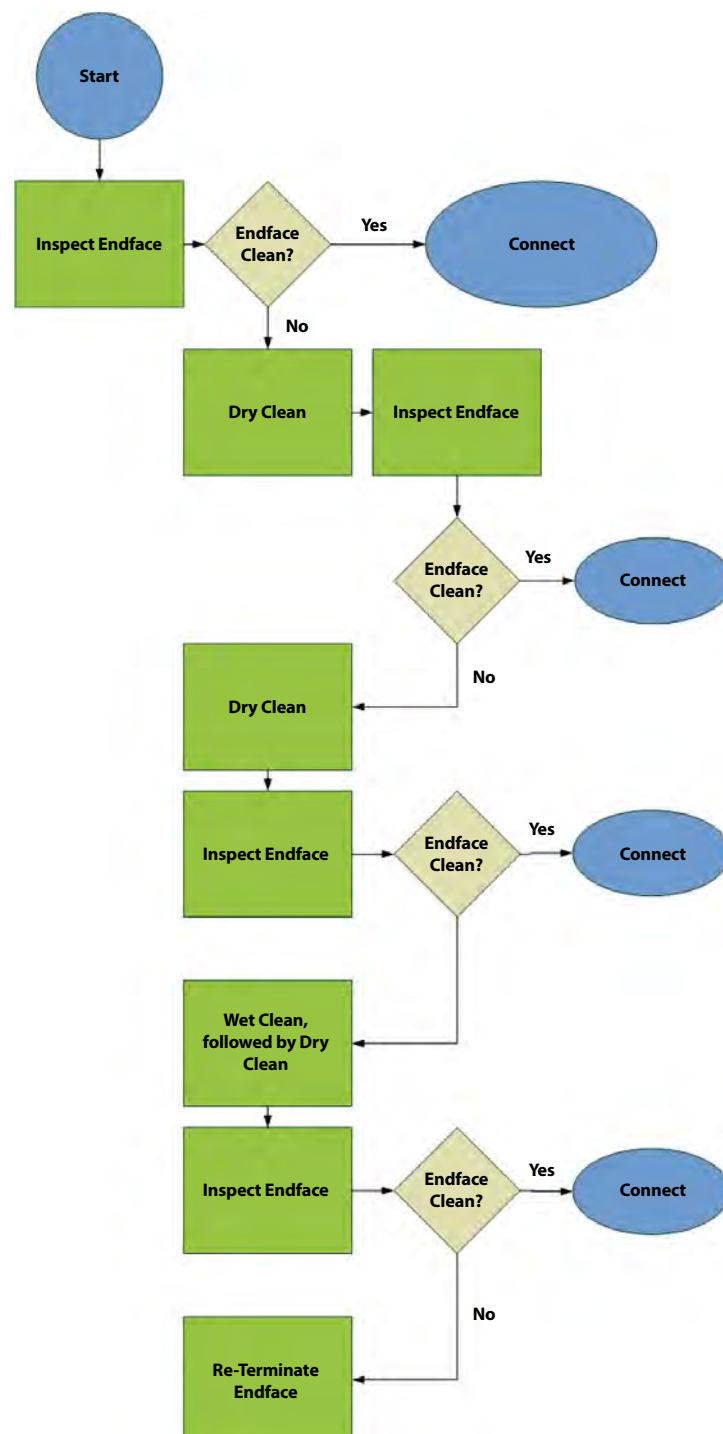
Cleaning Techniques for Fibre Optic Cables

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.

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 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.

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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 pigtails.

For full details on the correct procedures for Fusion Splicing please visit the following link.

<http://www.fujikura.co.uk/products/videos/>

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, OM4 & OM5 multimode 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

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, pigtails 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 slightly 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

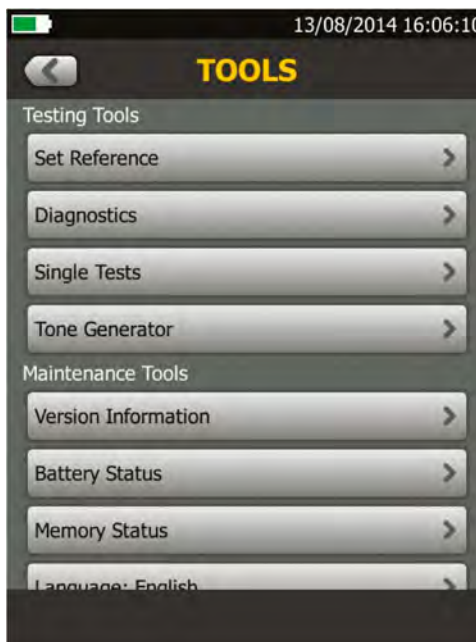
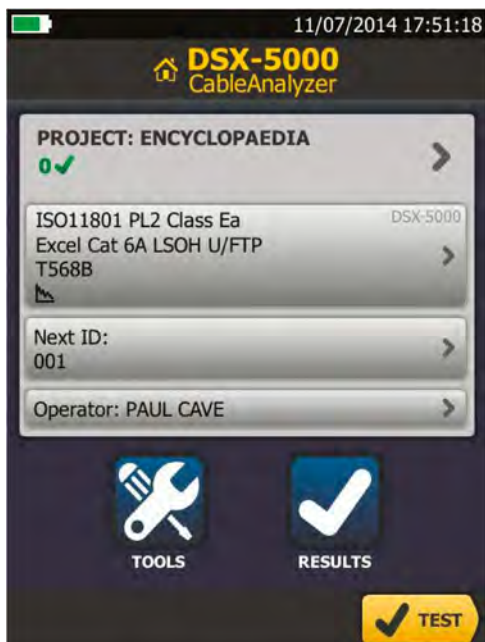
This will be broken down into a number of sub-topics, Permanent Link, Channel, Harness Links/Consolidation Cables and Patch Leads. A full description of what each one of these constitutes can be found in the diagrams in other sections.

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 www.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.



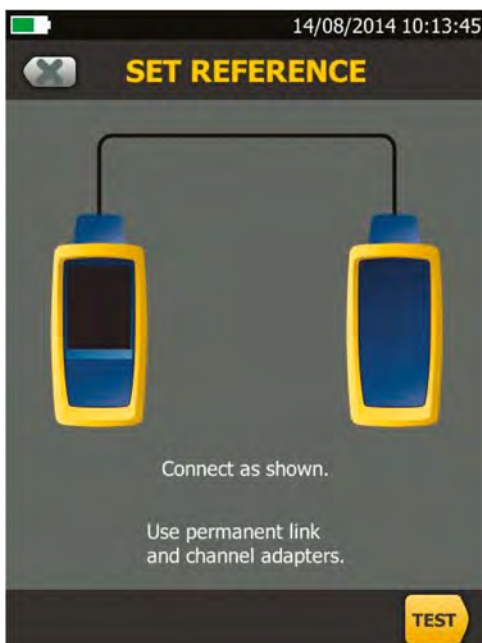
Go into Tools once there select Version Information, within here you will be able to check both the Main Unit and the module that is fitted, whether that be Copper or Fibre.



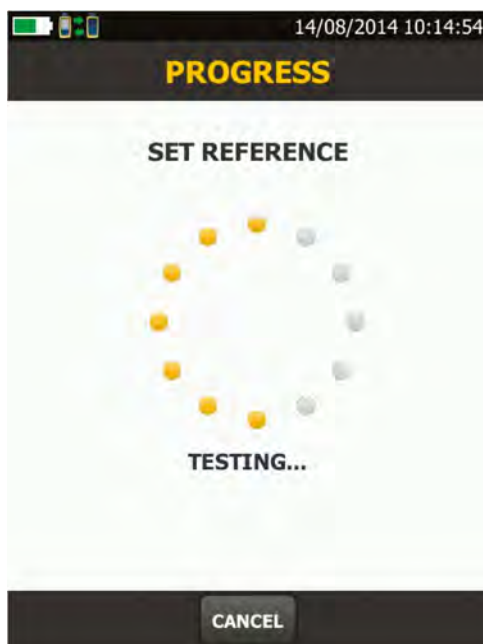
Within Tools you can also set up units of measure, language, date & time etc.

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.

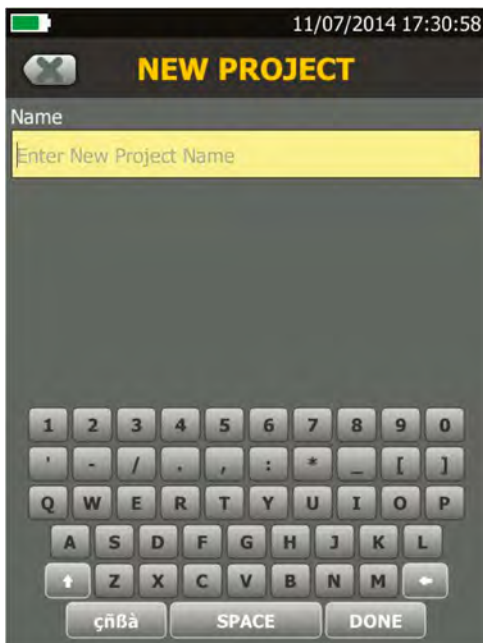


The next task is to set up the PROJECT INFORMATION. Once more this has been simplified and is even quicker to complete. From the Home Screen select PROJECT, within this screen you will be able to see each of the topics that require input.



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



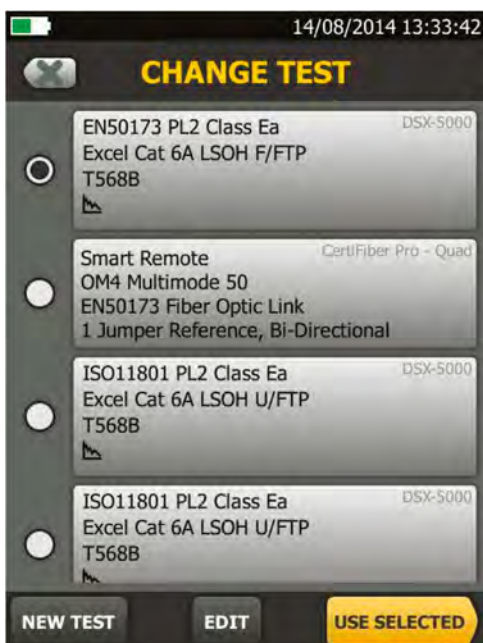
Repeat the process for OPERATOR, which allows for the selection from a list of previous users or the creation of a new one.

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.

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.



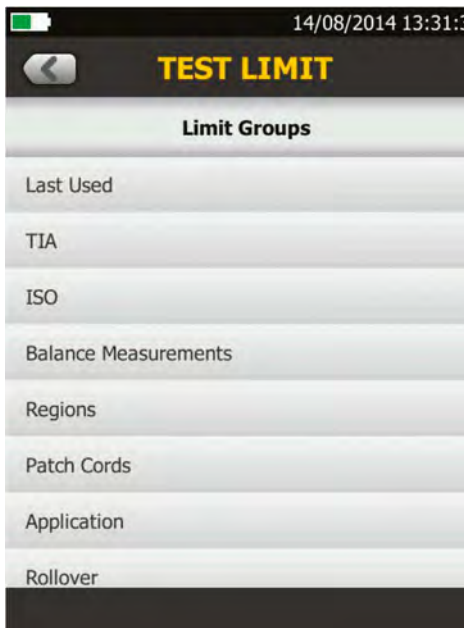
Again this initially brings up the previous test criteria for you to edit and amend

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.

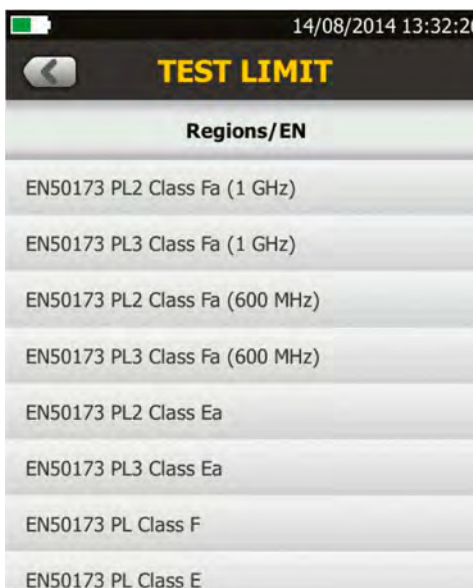


Select the type required, which inserts the relevant NVP etc and automatically takes you back to the previous screen. Follow the same process for selecting the required test limit.

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).



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.



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*

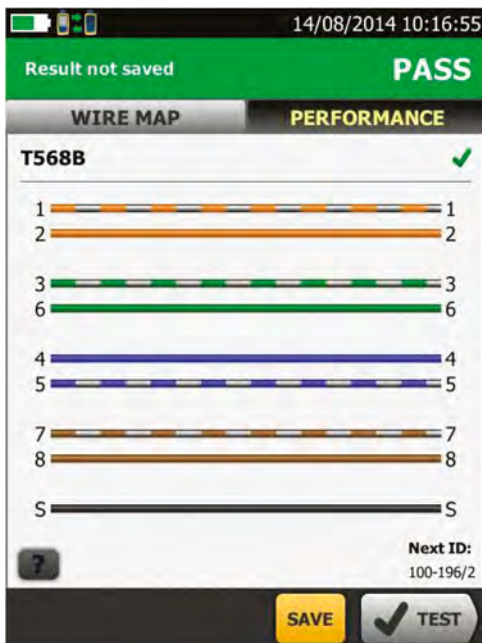
You are now almost ready to start testing but first of all you must select SAVE to store the information you have just created.

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.

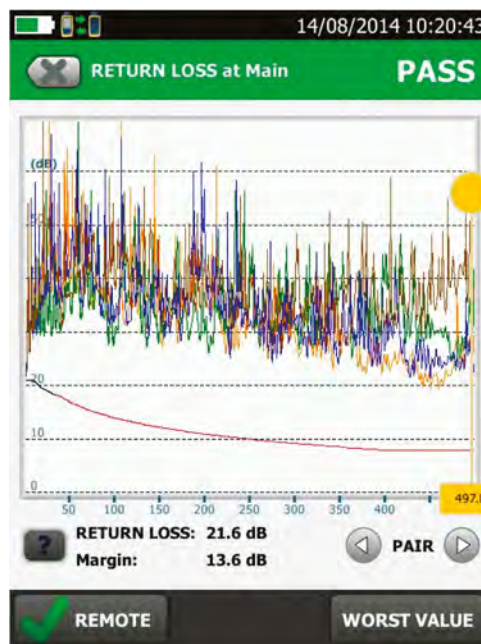
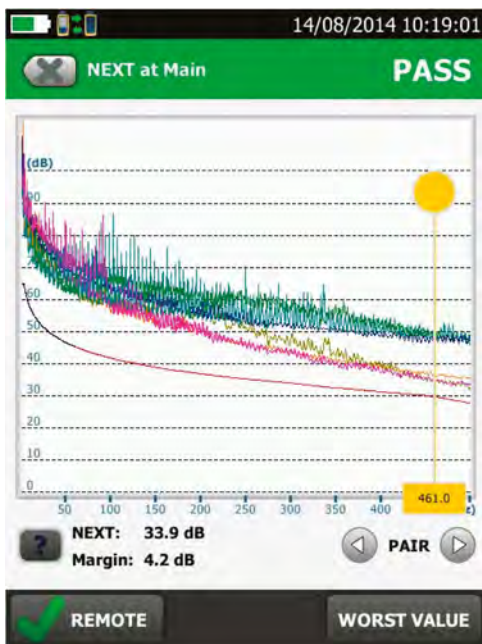
Once you select DONE, it will take you back to the test you have set up

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

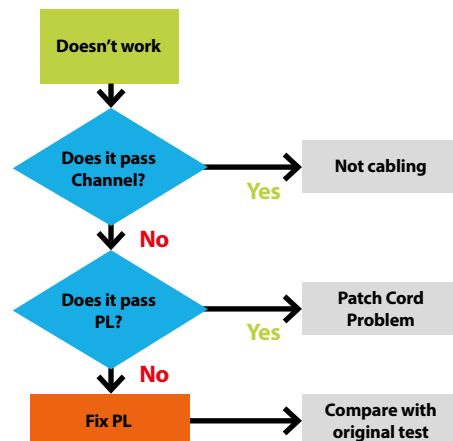
Channel Testing is not to be used for Warranty Applications, these guidelines are designed for troubleshooting purposes only. Testing the channel is very simple and straightforward.

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.

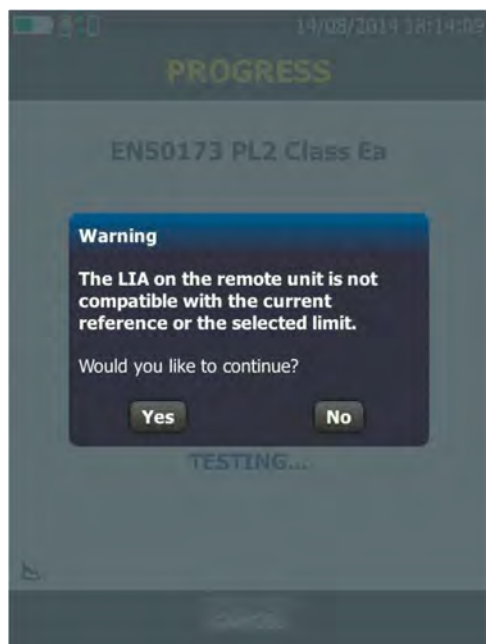
Cabling standards such as EN50173 defined two definitions for link testing, Channel and Permanent Link. In the case of the above link, it does not fit either model.



** 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 affect 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_A. 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



Select the required length and then SAVE, and select from the list and you can start testing.



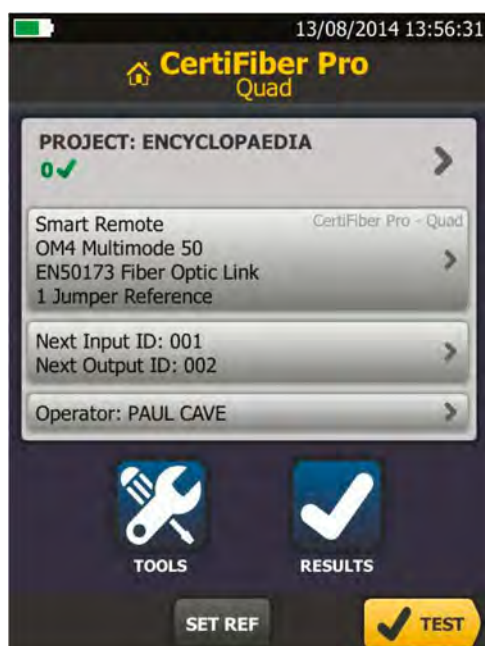
Fibre Testing – (Tier 1)

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 Certifiber 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 Certifiber 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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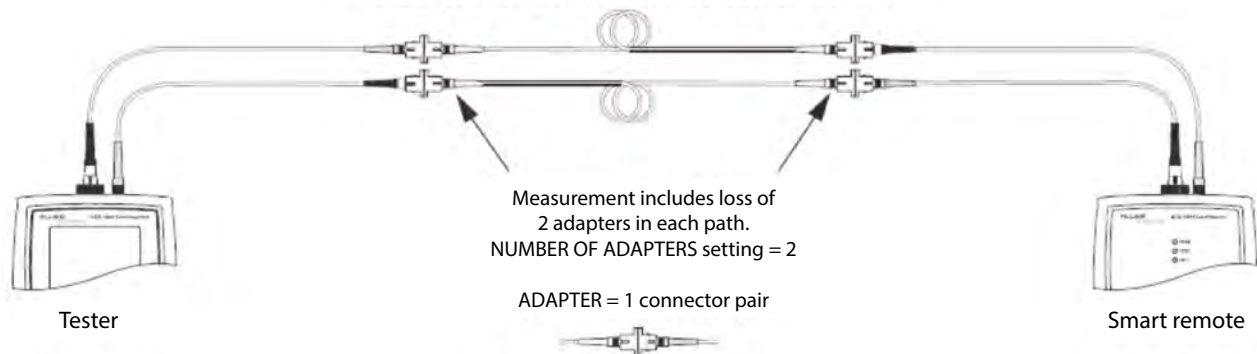
Select TEST LIMIT and you will have a number of options, once more we want to select the EN50173 Standards, if it isn't in the LAST USED list use the same process as previously described.



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.

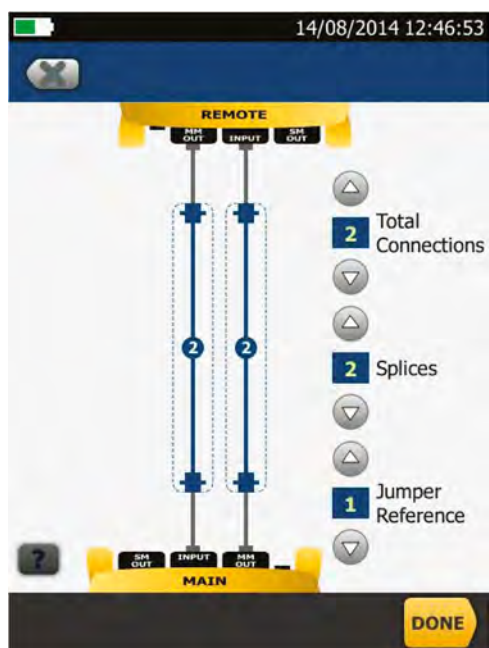
Example of Smart Remote mode test connections



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.

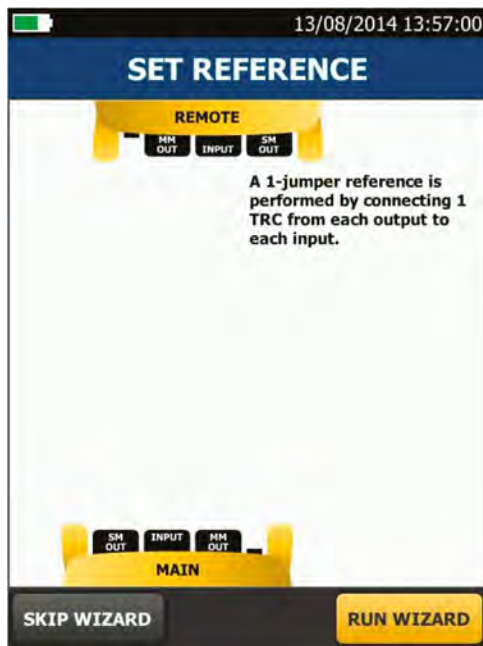
The next is the Connector Type the last one covers the number of Connections/Splices, select this and it will bring up the next screen.



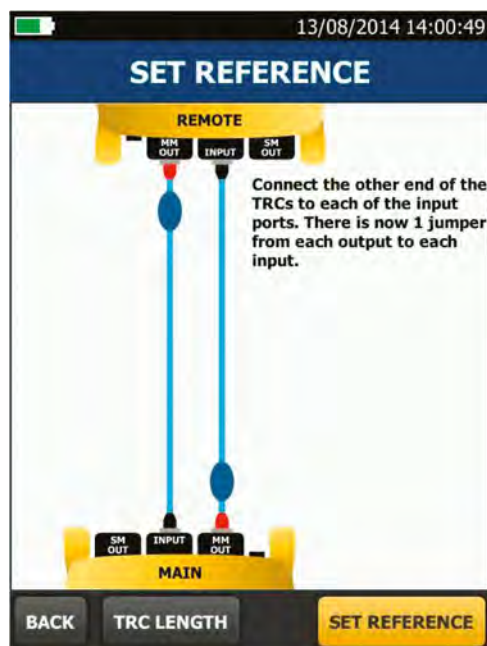
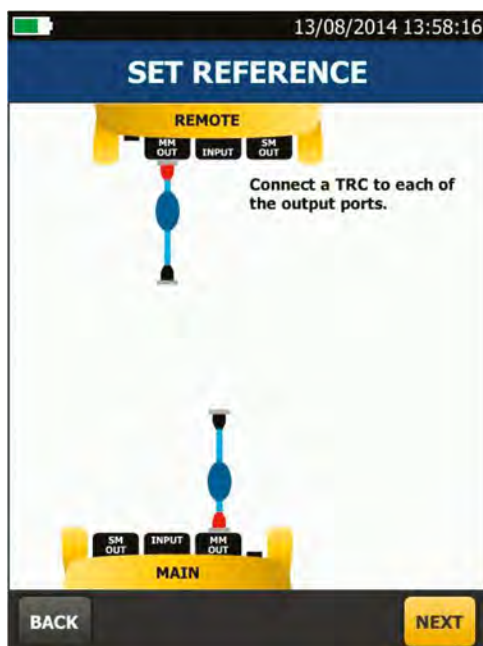
Once you have selected the right number for each item select DONE and you will be taken back to the TEST SETUP screen.

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.

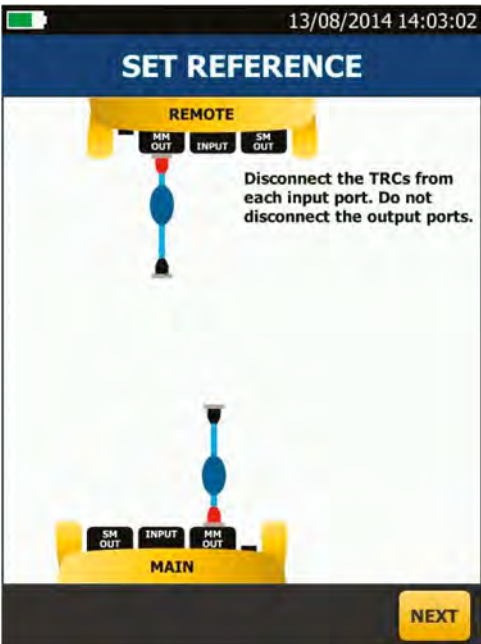
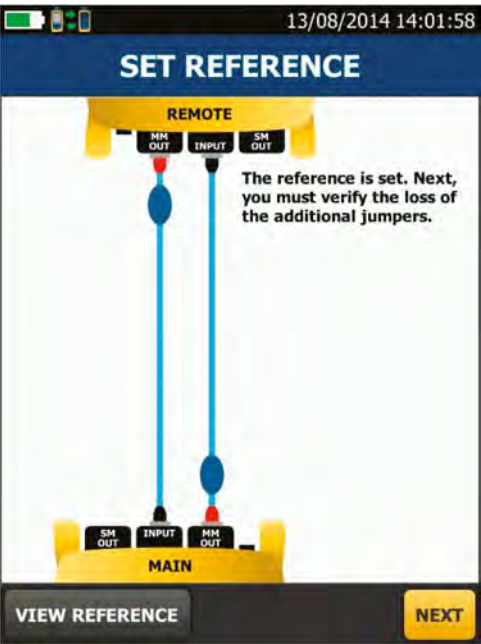
This brings up the SET REFERENCE Screen, which provides two options.



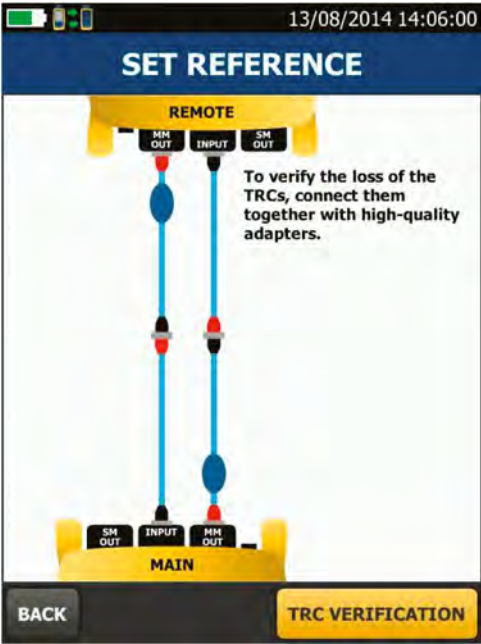
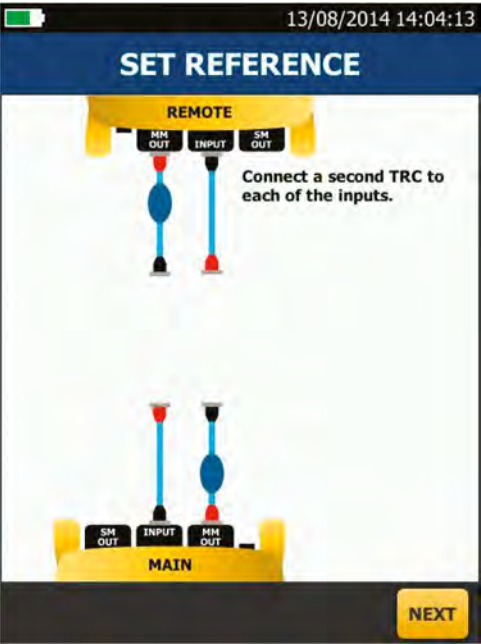
To ensure that you complete this important phase correctly select RUN WIZARD, this will take you through all the steps required.



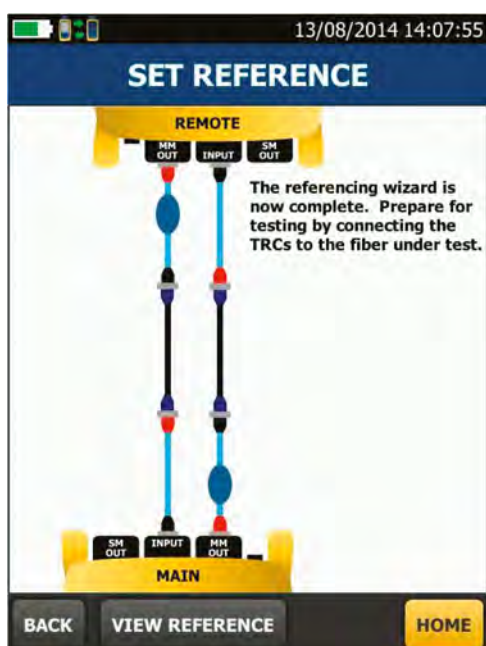
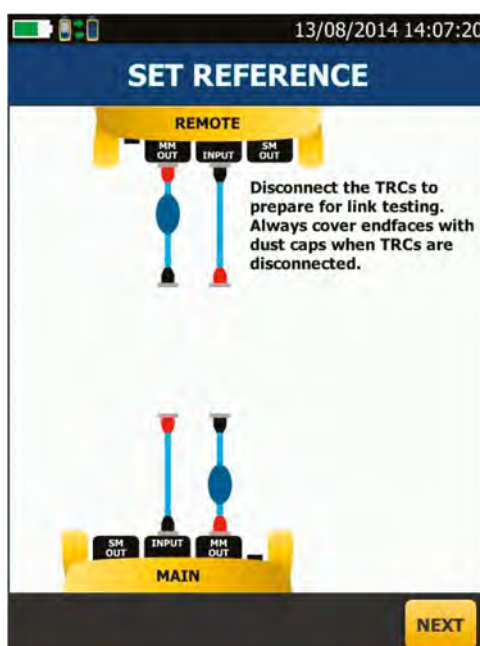
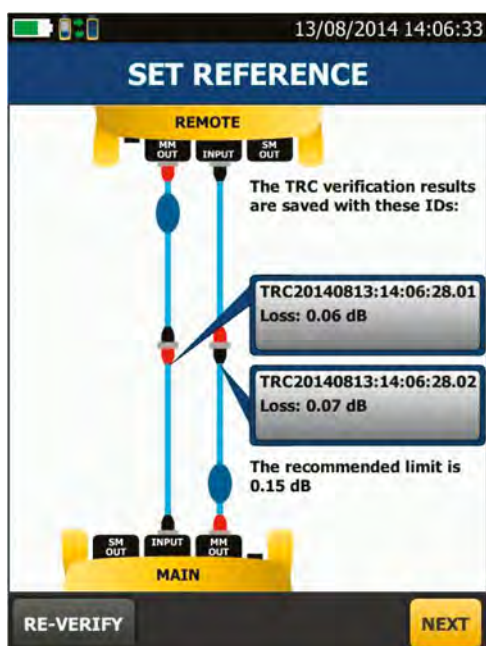
Once the units are connected Select SET REFERENCE



After each step select NEXT



Select TRC VERIFICATION, this brings up the values of the leads that have been Referenced Out.



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 STET, insertion loss, NEXT, RL, PSACR-F 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 insertion loss, NEXT, RL, PSACR-F 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.

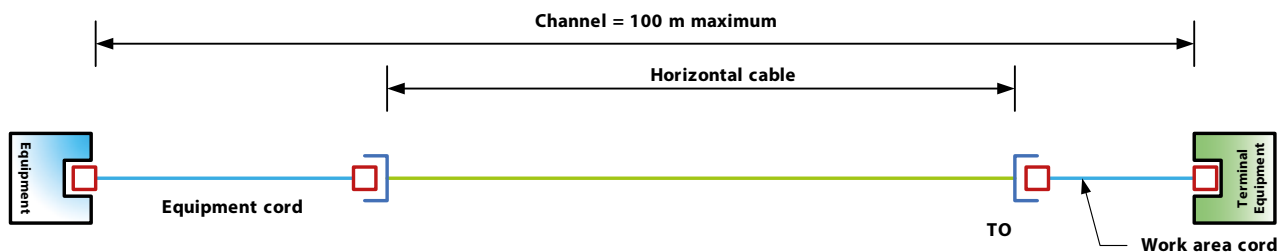
The term “Reference Cord” is defined here as a new Excel patch cord that will only be used for up to 100 tests. After 100 tests the Reference Cord must be destroyed and replaced with another new Excel Reference Cord.

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



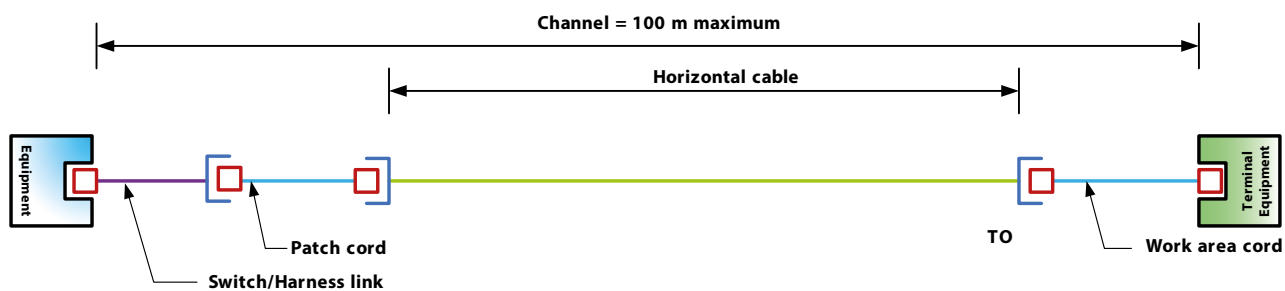
Mandatory tests:



Optional tests:



b) Crossconnect – TO model



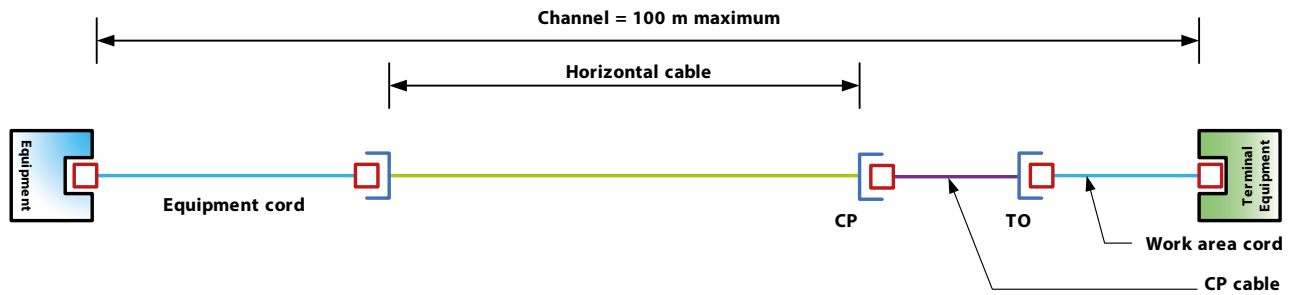
Mandatory tests:



Optional tests:



c) Interconnect – CP - TO model



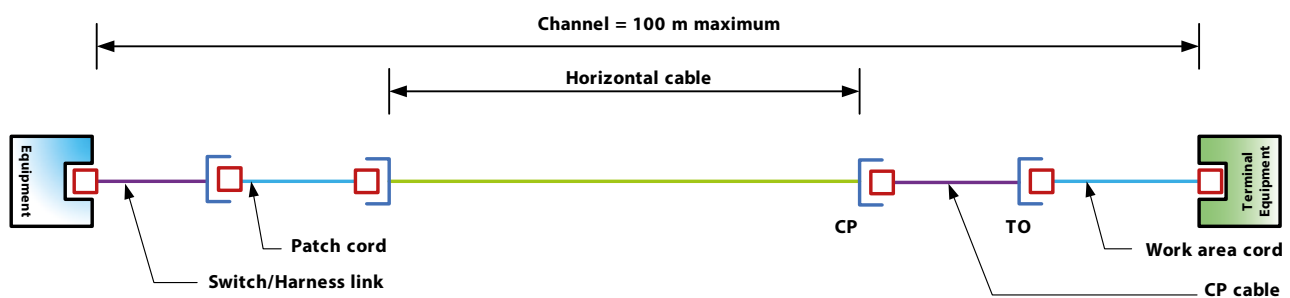
Mandatory tests:

Element	Test
CP Link	Permanent Link
CP Cable	Permanent Link (PL head to Ch head)

Optional tests:

CP Link - TO	Permanent Link
Channel	Channel

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

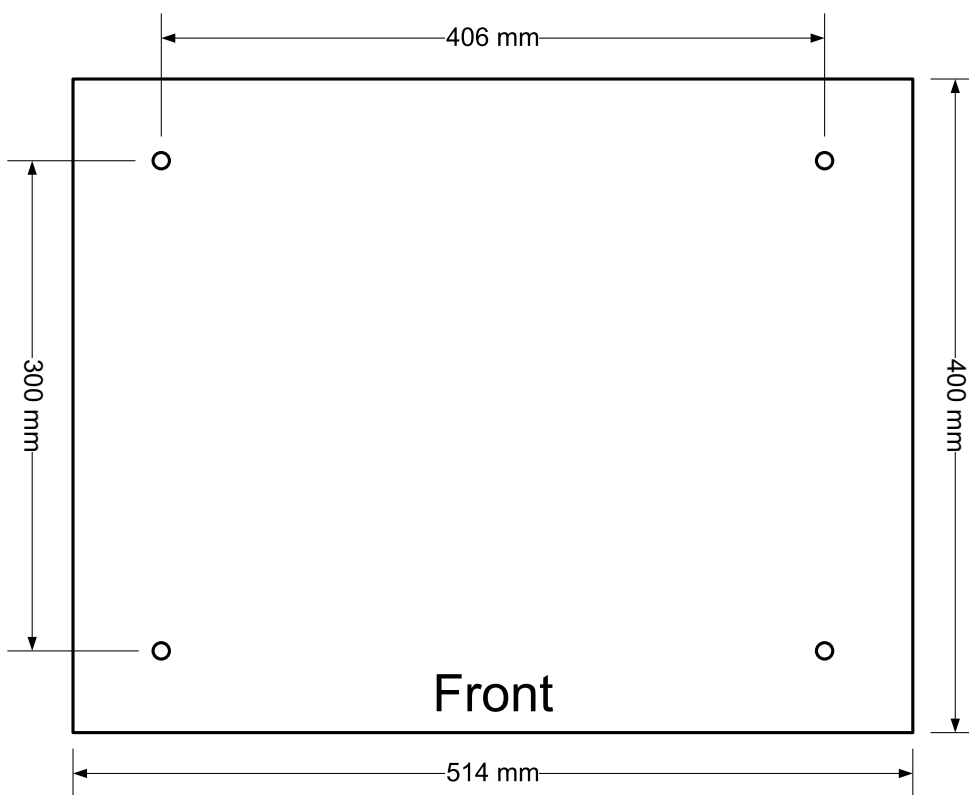


Assembly Instructions - OR

- 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 ± 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.



S12

Baying Vertical Cable Management

The [Vertical Cable Management](#) can be attached to each side of the OR 2 Post Racks. 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

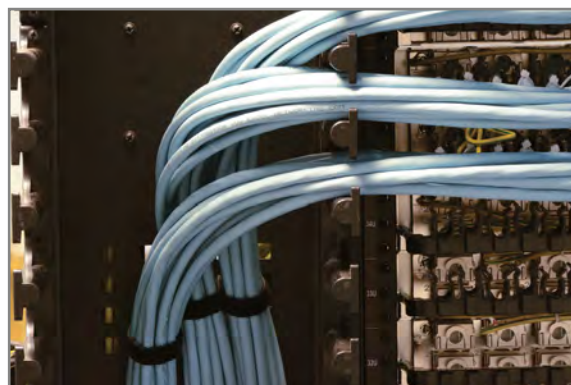
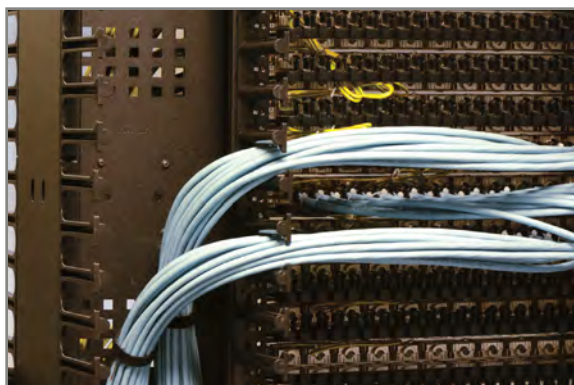
Fitting 19" Patch Panels / Equipment

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".

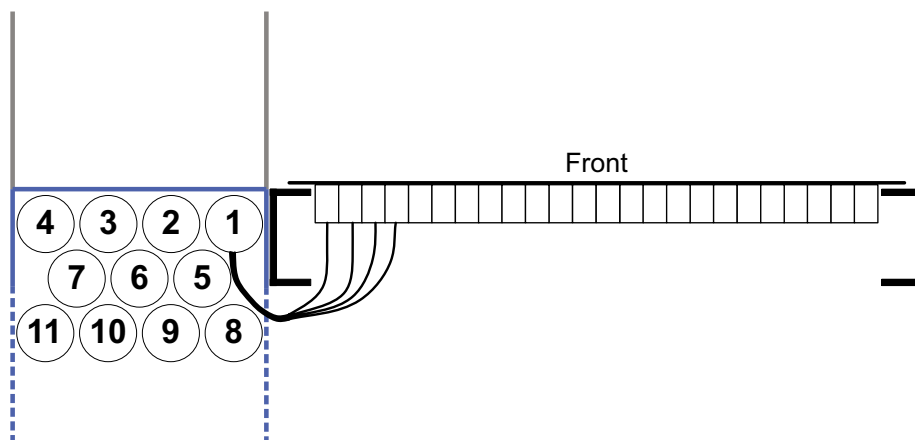
Managing cable from the rear of the patch panels

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.

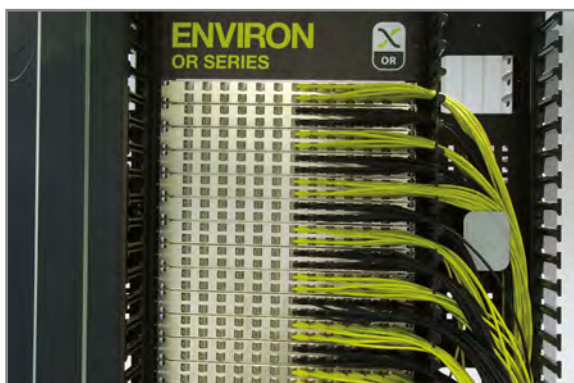


- The bundles are fixed in place within the Vertical Cable Manager. The Hook & Loop cable tie type is best to ensure no damage to the cable.
- It is suggested that if the incoming cables rise from below the upper most panel is installed first and if the cables descend from above then the lower most panel is installed first.
- The bundles then may be attached in the following order in the left and right Vertical Cable Managers



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.



How Configure a 4 Post Rack

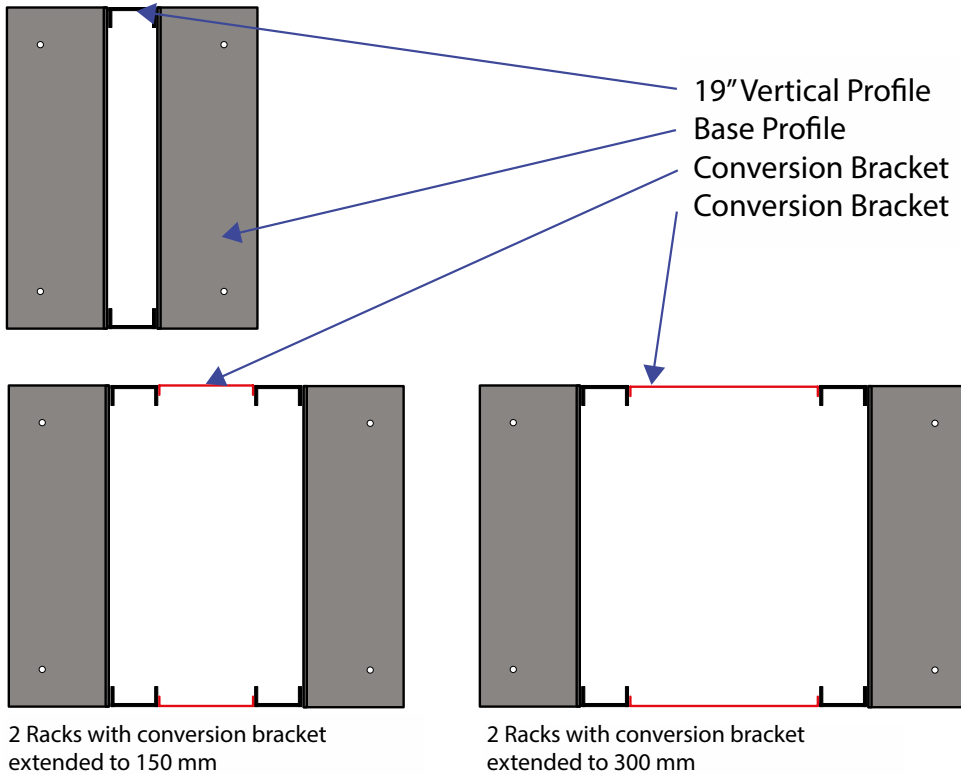
Two racks can be fitted to together to create a 4 post rack using the Excel conversion brackets. conversion brackets may be used. List of items required.

- 2 qty Environ® 2 Post Rack
- 1 qty Excel conversion bracket (2 Pack) - size to match 2 Post Rack height



- Assemble the two OR 2 Post Racks without the inner Base Angles
- Join the Excel conversion bracket to the inner rack mount profiles of the 2 Post Racks using the supplied M6 Screws

Single 2 Post Rack



Excel Pre-Sales Support

Section 13

In this Section:

[Winning Business with Excel](#)

[Excel Corporate Presentation](#)

[Excel Tender Response Document Overview](#)

[Structured Cabling Tender Response Document](#)

[Category 6_A Structured Specification Document \(SCS\)](#)

[Category 6_A Data Centre Specification Document \(DC\)](#)

[Category 6 Structured Specification Document \(SCS\)](#)

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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
- Cabinet services including Cabinet Configuration and on-site assembly.
- Labelling Services

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_A or 6 system or for answering a Tender with the Excel product range.

Copies of the Excel Tender Response document and Category 6_A document are included in this chapter. You can download the these documents in Microsoft Word format, together with the Category 6_A Data Centre Specification and Category 6 Specification document.

Click on the links below to download the documents in Microsoft Word:

- [Excel Category 6_A Generic SCS Document](#)
- [Excel Category 6_A Data Centre Specification Document](#)
- [Excel Category 6 Generic SCS Document](#)

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.

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.

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.

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

Global reach

70 Number of countries sold into and growing

AUSTRIA, ALGERIA, AMB, BAHRAIN, BELGIUM, BRAZIL, BULGARIA, CANADA, CHINA, COLOMBIA, CYPRUS, CZECH REPUBLIC, DENMARK, EGYPT, ESTONIA, FINLAND, FRANCE, GERMANY, GREECE, HONG KONG, INDIA, ITALY, JAPAN, KOREA, KUWAIT, LATVIA, LITHUANIA, MALAYSIA, MALTA, MEXICO, NETHERLANDS, NEW ZEALAND, NORWAY, OMAN, POLAND, PORTUGAL, ROMANIA, REPUBLIC OF GIBRALTAR, SAUDI ARABIA, SINGAPORE, SLOVAK REPUBLIC, SLOVENIA, SOUTH AFRICA, SPAIN, SWEDEN, SWITZERLAND, SYRIA, THAILAND, TURKEY, UNITED ARAB EMIRATES, VIETNAM, YEMEN, ZIMBABWE

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

Award winning solution

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

Customers & case studies

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

Component vs channel testing

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

Excel warranty cover

Positioning | 3rd Party Verification | Partner Programme | 25yr Warranty | Technical Support | Quality Service | Business Development | Marketing Support | Products

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 Category 6_A 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

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) – tandard 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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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
- OM4 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.

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

CPR	-	Construction Products Regulation
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 where 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.



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

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, CPR compliant solution in accordance with BS6701:2016+A1:2017 is required for this installation. The part number for this element will be 190-071

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 OM4 50/125 mm (4700 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 IEEE 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.

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. Velcro cable ties will be used on vertical cable runs at regular intervals with a metal tie in addition every third one.

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)

Examples –

ER/APF04/U32 – ER/A2/U42

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 (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 6701:2016+A1:2017, ISO/IEC 11801:20010 Ed 2.2, 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 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 11801:2010 Ed 2.2 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

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_A 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_A - 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

THE CLIENT	- XXXXXXXXXX
SCS	- Structured Cabling System
CD	- Campus Distributor
BD	- Building Distributor
FD	- Floor Distributor
CP	- Consolidation Point
TO	- Telecommunications Outlet
GOP	- Grid Outlet Point
SD	- Service Distributor
SCP	- Service Concentration Point
SO	- Service Outlet
OLTS	- Optical Loss Test Set
OTDR	- Optical Time Domain Reflectometer
CPR	- Construction Products Regulation

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2.4	Equipment Room Locations
3	Scope of Works
4	Component Manufacturers Details
4.1	Structured Cabling System Manufacturer
4.2	SCS Equipment & Server Racks
5	Interpretation & Comms Room Locations
5.1	Room Size Requirements
6	General Specification & Requirements of the SCS Contractor
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8.3.4	Harness/Switch Links
8.3.5	Horizontal Category 6 _A F/FTP Patch Leads
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8.4.1	Category 6 _A IDC Screened Junction Box/Coupler
9	BD & FD Configurations - Horizontal Cabling Requirements
9.1	Server Rack
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10	Horizontal Infrastructure Additional Restrictions & Requirements
10.1	Horizontal Category 6 _A - Containment
10.2	Equipment Room – Analogue Voice Cabling
10.3	Horizontal Category 6 _A Infrastructure Testing
11	Specification & Requirements - Backbone Fibre Optic Infrastructure
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11.3	Fibre Optic Patch Panels
11.4	Connectors & Fibre Patch Leads
11.5	Splices
11.6	Pigtails
12	Blown Fibre Solutions
12.1	Blown Fibre Tube Cable
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12.3	Connectivity & Connectors

13	Backbone Optical Fibre Testing
13.1	Tier 1 Requirement
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14.1	Mandatory Requirement of All Enclosure Styles
15	Additional SCS Contractors Requirements
16	Drawings Schedule of Applicable Drawings
17	SCS Infrastructure - Pricing Schedule
18	Appendices

2 Summary of Works

2.1 Site address

Project site address:

2.2 Site contact:

2.3 SCS requirement

The solution will be designed in accordance to the relevant sections of the BS EN 50173 series and the installation requirements in accordance with BS EN 50174 series as outlined in appendix A

Based upon the SCS specification as detailed within this document, the requirements for this installation will include, but not limited to:

- Minimum Category 6_A U/FTP cabling throughout.
- Multi core OM4 or OS2 fibre optic cables between distribution locations
- Equipment and Server cabinets
- Security cameras and associated recording systems

The solution will follow the design principles as outlined in BS EN 50173-2 for Voice and Data services and BS EN 50173-6 –Distributed Building Services for connectivity for all other IP enabled devices.

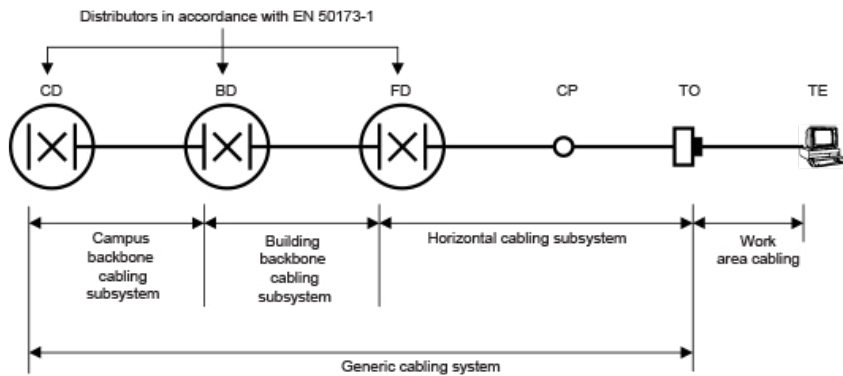


Figure: courtesy BS EN 50173-2:2007 +A1:2010

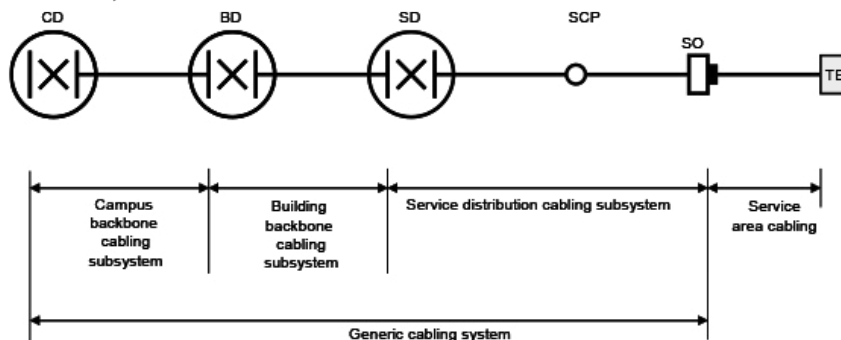


Figure: courtesy BS EN 50173-6:2013

2.4 Equipment Room locations

Final locations of all BD/FD shall be coordinated with the Client, although as an initial guide:

- BD (Building Distributor/Main Equipment Room)
 FD (Floor Distributor/Secondary Equipment Room)

2.5 The BD shall contain:

- X No. Equipment Rack
 X No. Server Rack
 X No. Open Rack (Two Post Frames)

2.6 The SER shall contain:

- X No. Equipment Rack
 X No. Open Rack

3 Scope of Works

The Client requires design and installation of 2 x Category 6_A screened outlets per user position and 2 high level Service Outlets per Wifi AP Location, each one of the latter will have a 12m radius in all office locations.

This will Include equipment, materials, labour and services to provide the SCS Infrastructure to support this involves, but not limited to:

- Horizontal Infrastructure (Category 6_A U/FTP or F/FTP).
- Backbone Infrastructure (Optical Fibre OS2 and/or OM4).
- Equipment cabinets, frames, racks and enclosures.

- Intelligent PDUs (Power Distribution Units)
- 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 of 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, BS6701 & 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, provided by appointed Electrical Subcontractor
- Builder's work in relation to the SCS Contract, includes 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 inclusive of all cabling components, racks and enclosures, from the 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/Frames shall be Excel Environ and covered under the Manufacturer's single 25 year warranty.

5 Interpretation & Communications Room Locations

The physical building design incorporates multiple-use units and administrative offices in a closed environment. The Structured Cabling System provides the physical connectivity from the Entrance Facility (EF) to a centralised Building Distributor (BD), through to Floor Distributors (BD) to the final work area Telecommunication Outlet or Service Outlet, including consolidation points if required.

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.

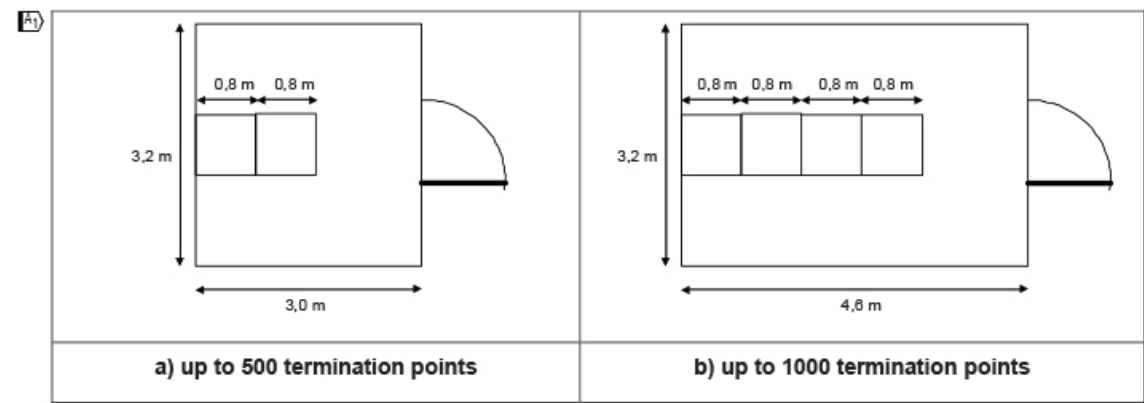
Location: To be confirmed.

BD (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.

FD (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.

5.1 Room Size Requirements

All distributors shall be sized in accordance with EN 50174-2. This requires a minimum distance of 1.2m of clearance on all faces of cabinets, racks & frames where access is required. The design shall ensure that a minimum of 900mm (ISO14763-2 Section 7) shall be maintained as a passageway where no access to cabinets is required. Permission for any deviation must be sought from THE CLIENT Building Project Manager with approval in writing confirmed.



Minimum Dimensions for rooms containing active equipment as well as cabling components

- The room shall be a minimum of 2.6m high normally without any false ceiling from the finished floor surface
- Minimum height of the raised floor is 200mm, 300mm recommended
- No piping systems, other than those providing services to the room, shall run through the rooms
- Lighting shall provide a minimum of 500lux measured 1m above the finished floor in the front and rear of the cabinets, racks & frames

6 General Specification & Requirements of the SCS Contractor

The SCS Contractor shall apply the methodologies for installation in accordance with the latest revisions of BS EN 50174, BS6701 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 duly note each failure.

The SCS Contractor shall rectify all faults and any damaged cabling shall be replaced with new cables in complete runs.

6.3 Cable Plant Witness Tests

THE CLIENT and 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 failures within the agreed 10% will result additional testing within the given area or floor at The Clients discretion without additional charge.

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 EN50174 and 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.
- Provide evidence that the above compliance testing of RJ45 outlets includes IEC 60512-99-002 (draft 48B/2531/CD-Mating and Un-mating under Electrical Load up to 2A per contact (4PPoE)
- Manufacturers' literature for products installed.
- 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 racks, 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 Client's 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_A

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 BD/FD to which each outlet must be connected to maintain cable length restrictions in the use of Category 6A 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 EN 50173-1:A2:2011, ISO 11801:Ed2.2, ISO 60603-7-5, ISO 61156-5, 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_A compliant system must also be backwards compatible with Category 6 ISO 11801:Ed2.2, ISO 61156-5, EN 50173-1:A2:2011.

8.2 Cable

The cabling must be four-pair 100Ohm Category 6_A 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 60332-1-2 flammability standard as a minimum.

Furthermore, all installation cables deemed to be permanent, including those that are pre-terminated such as Harness/Switch Links etc. must meet the minimum Euroclass requirements of the Construction Products Regulation (CPR) as outlined in the latest edition of BS 6701:2016 + A1:2016.

Acceptable construction of cable is as follows:

Category 6_A U/FTP "S-Foil" LSOH Ice Blue 500m Reel

Or

Category 6_A F/FTP "S-Foil" LSOH Ice Blue 500m Reel

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

8.3.2 Outlet Connectors:

- Cable terminations must be Toolless Insulation Displacement Connectors (IDC).
- Connector style to be RJ45
- Toolless Termination
- Lifetime Product Warranty
- Must have current independent third party approval status at component level to a minimum of ISO/IEC 11801. + IEC 60512-99-001

When used in conjunction with Dado Trunking 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
- 2 x Excel Office White Angled Shutter
- 2 x Excel Category 6_A Low Profile Screened Keystone Jack

Alternatively, where there is a raised floor the use of a 2 or outlet GOP box may be preferred on these occasions they will be from the Excel GOP Box Plus range, with 6C angled shuttered modules attached to 5m of 25mm flexible conduit, the alternative end will be securely fixed to the floor slab using an L bracket.

These will be left coiled under the floor for protection until the furniture is in position, they will then be drawn through a grommet in the floor tile and attached to the underside of the desk furniture.

8.3.3 Field Terminated RJ45 Plug

BS EN 50173-6 - Distributed Building Services, under 'Type B Generic Cabling' allows for the direct connection of a device without the use of a Service Outlet therefore a suitable RJ45 plug to terminate on to the horizontal solid core cable for the connection to devices such as CCTV cameras, access control and digital signage etc. is required.

On these occasions the plug to be used will be the Excel Field Terminated Category 6_A RJ45 Plug.

8.3.4 Harness/Switch Links

If Harness/Switch links are used they will be created from Excel Solid Core Patch Leads of 20m & 30m will be used (5m, 10, 15m leads are also available), these will be cut in half and terminated with the 100-185 toolless angled outlets, which will then be installed in the unloaded panel frames.

The use of a switch template will be used to neatly dress the harness/switch links within the cabinets prior to the selected switches being installed.

8.3.5 Horizontal Category 6A F/FTP Patch Leads

The SCS Contractor shall allow for the supply only of the following Excel Category 6_A compliant Patch leads.

Each patch lead shall be complete with strain relief boot and RJ45 connector. All patch leads must have current independent third party approval status at component level and include specification references.

The Client 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.

The SCS Contractor will allow for patch leads to be available for the Patching Fields, these are supplied in standard lengths.

The Client standards shall be confirmed prior to tender response and may include up to ten different colours.

8.4 Category 6A U/FTP External Rated Cable

When connecting external equipment such as IP Cameras or Wireless Access Points the SCS contractor must use a cable that can be installed into external ducts and pathways. The cable to be used will be Excel Category 6_A External U/FTP.

8.4.1 Category 6A IDC Screened Junction Box/Coupler

In accordance with BS EN 50174-2:2009+A2:2014 the limitation for bringing external cables within a building before there is a transition point to terminate on to internally rated cables is 2m, in a lot of occasions this will not be possible to do this directly on to a patching field, in these instances the Excel Category 6_A Screened IDC junction box will be used.

9 BD and FD Configurations - Horizontal Cabling Requirements

Building Distributor and Floor Distributors will contain a quantity of Equipment and Server Racks as defined as follows:

9.1 Server Rack

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 or Black RAL 9004
- 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

9.2 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 or Black 9004
- 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

9.3 Open Rack

As an option for High Density patching fields a Two Post Patching frames may be utilised in this instance they 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

9.4 Intelligent Power Distribution Units

It is the requirement of the Client that Excel Intelligent PDU's be installed within each Equipment Rack or Server Rack.

Select the appropriate Excel Intelligent iPDU from the following list, according to the size and load bearing requirements of each cabinet, and pay particular attention to the required equipment termination plugs.

Managed iPDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed iPDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed iPDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed iPDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed iPDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed iPDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed iPDU 24 way BS1363 with 32A IEC6039 plug - vertical

10 Horizontal Infrastructure Additional Restrictions & Requirement

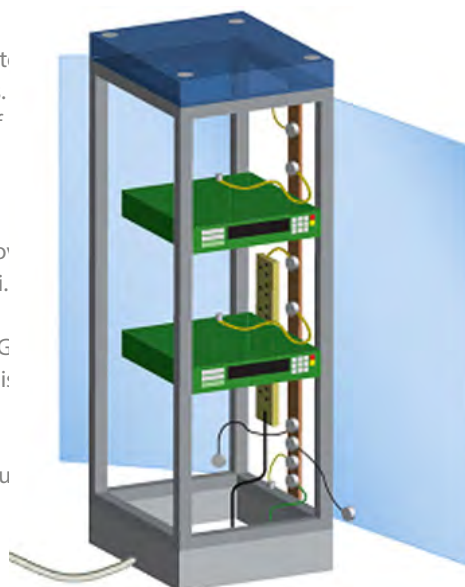
The restrictions & requirements listed below are in addition to those stated in standards set with the scope of works. Horizontal structured cabling shall emanate from the BD/FD terminated upon 19" rack mountable 24-Port, RJ45 patch panels. There will be 1U horizontal cable management panel installed for a maximum of every 3U of patch panels.

All cables shall be bundled in no more than 24s. Ties shall be positioned every 600mm in the Horizontal and every 300mm plus a metal tied shall also be used on every 3rd one in the Vertical. Additional ties shall be used to maintain bend radii.

Rack mounted equipment passive or active in nature shall be bonded to a sub-TG (Telecommunications Grounding Bar) positioned in each equipment rack which in turn shall be bonded to the TR/ER room, TMGB/TGB.

Work area BD/FD shall consist of an RJ45 socket presented as either a single or dual formation. BD/FD faceplates must be in keeping with the environment they are being installed in. In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be bonded in accordance with the manufacturer's instructions, EN50174-2, EN50310 and BS6701 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.



10.1 Horizontal Category 6_A – 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.

10.2 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.

10.3 Horizontal Category 6_A Infrastructure Testing

The SCS Contractor shall test 100% of the Category 6_A horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in EN50173, ISO/IEC 11801 Class EA PL2. 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'.

11 Specification & Requirements - Backbone Fibre Optic Infrastructure

The selected Fibre Optic Cabling System shall have performance objectives 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 polarity shall be installed using the reverse fibre polarity scheme as detailed within BS EN 50174-2

Options of both a Conventional and a 'Blown Fibre' fibre optic solution are available, the SCS Contractor will provide a recommendation on which is the most applicable for each installation. There are some elements that are common to both and they are listed in this section.

All backbone cable will be Bend Insensitive, whether meeting G.675.A standard for Single-Mode or generic requirements for Multi-mode furthermore the fibres will follow the colour code scheme as outline within EIA/TIA 598, also followed by BT (British Telecom) and other ISP providers throughout Europe.

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

11.1 OS2, Optical Cable Requirements:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	1.00	0.40
1550	0.50	0.25

11.2 OM4, Optical Cable Requirements:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.50	3.0
1300	1.5	1.0

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.
- The adapters will be recessed to allow for enhance labelling
- With sufficient finger space around connectors to allow patch cables to be connected and disconnected and to allow individual connectors to be mounted and dismantled without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding, drawer mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Suitable for either conventional or blown fibre installs
- Must be complete with 2 x Plastic Splice holders, 2 x cable entry glands, Cable tie bridges in base of drawer.

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.

Both patch leads and adapters will be colour coded to the relevant category OM4 – Heather Violet, OS2 – Yellow with Blue connectors.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

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 i.e. bend insensitive. Pigtails will also be colour coded to match that of the backbone cable as outlined previously. Pigtails shall be kept slack when the cable is terminated.

12 Blown Fibre Solution (Optional)

The blown fibre solution will comprise of the following major components:

12.1 Blown Fibre Tube Cable

- HDPE low friction tubes
- Internal and external options
- From 2 to 19 tube versions

- 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)

12.2 Blown Fibre Units (EPFU)

- The 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
- Colour coding indicates the type of fibre (singlemode yellow, 50/125 turquoise/blue)
- OS2 singlemode and OM4 multimode constructions will be used.

12.3 Connectivity & Connectors

The SCS contractor will select the most suitable connectivity from the following selection:

- 19" Patch Panels
- Choice of internal and external Customer Splice Boxes
- Compact Termination Boxes
- Tube Distribution Closures
- Blown Fibre Gas Seal Units
- Tube Connectors
- Tube End Connectors
- Water Blocking Connectors
- Gas Seal Connectors
- Tube Sealing Caps
- Reducer Connectors
- Bulkhead Connectors

13 Backbone Optical Fibre Testing

13.1 Tier 1 Requirements

All links must be tested using an OLTS in the first instance for warranty purposes

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 Multimode links shall be tested using the "Encircled Flux" methodology with the relevant TRCs (Test Reference Cords).

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

13.2 Tier 2 OTDR Testing

The Client may also require additional OTDR testing on all backbone and inter-building links.

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.

13.2.1 Length Measurement

- The length of each fibre shall be recorded.

13.2.1 Length Measurement

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.

14 Specification and Requirements – Cabinets & Racks

Each cabinet must be laid out using the instruction provided by the Client, the following image is an example of a spreadsheet the SCS contractor is expected to submit prior to final sign-off and installation.

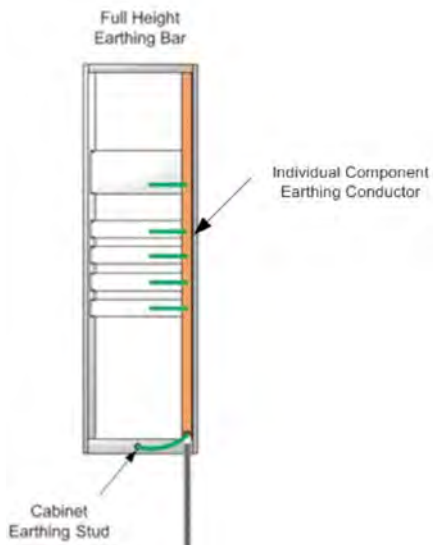
CAB 1		
42U	1U Fibre Patch Panel	42U
41U	1U (4 hoop) Cable Manager	41U
40U	48 Port POE Ethernet Switch	40U
39U	48 Port POE Ethernet Switch	39U
38U	1U (4 hoop) Cable Manager	38U
37U	Chrome Panel with 100-185 linked to Cab 1	37U
36U	Chrome Panel with 100-185	36U
35U	Chrome Panel with 100-185 linked to Cab 1	35U
34U	Chrome Panel with 100-185	34U
33U	48 Port POE Ethernet Switch	33U
32U	48 Port POE Ethernet Switch	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	UPS/PDU	11U
10U		10U
9U		9U
8U		8U
7U		7U
6U		6U

14.1 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 16mm².

All parts of the cabinet including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the cabinet earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm².

A full height vertical earth bar shall be used for all floor mounted cabinets / 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 cabinet, 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.

15 Additional SCS Contractor 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 have a fully qualified Network Infrastructure Designer, on staff that will be ultimately responsible for this section of the project. The CV of proposed individual shall accompany the tender response including details of similar projects undertaken.

The Project Engineer/Manager 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 Project Engineer/Manager must be attached to The Vendor's response for evaluation by the Client. Should the Project Engineer assigned to this project change during the installation, the new Project Engineer/Manager assigned must also submit a CV for review by the Client.

If, in the opinion of the Client, the Project Engineer/Manager does not possess adequate qualifications to support the project, they reserve the right to require the SCS Contractor to assign a Project Engineer/Manager who, in the Client opinion, possesses the necessary skills and experience required of this project.

The SCS Contractor would ideally have Excel Certified Installers 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 should provide evidence of Tool Box training is booked to be carried out by Excel Networking personnel before each important stage they are:

- Cable Installation
- Outlet Termination
- Testing

These will coincide with site audit visits to inspect the work on a regular basis, it will also be the opportunity for the SCS Contractor to gain input and guidance from the manufacturer.

The SCS Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

16 Drawings Schedule of Applicable Drawings

17 SCS Infrastructure -Pricing Schedule

The SCS Contractor shall create and fully populate a separate 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 a full bill of material and schedule of rates to support the price schedule upon request from the Client.

The SCS Contractor must consider and allow for all aspects, scope, requirements and specifications sighted in (SCS Infrastructure) duly before completing the pricing schedule.

The SCS Contractors are reminded that any alternative manufacture pricing must be provided as an addendum to their tender response.

18 Appendices

18.1 Appendix A

European (Cenelec) Standards referenced in the Client Specification

Standard	Description
BS EN 50173-1:2011	Information technology. Generic cabling systems. General requirements
BS EN 50173-2:2007+A1:2010	Information technology. Generic cabling systems. Office premises
BS EN 50173-3:2007+A1:2010	Information technology. Generic cabling systems. Part 3: Industrial premises
BS EN 50173-4:2007+A2:2013	Information technology. Generic cabling systems. Homes
BS EN 50173-5:2007+A2:2012	Information technology. Generic cabling systems. Data centres
BS EN 50173-6:2013	Information technology. Generic cabling systems. Distributed building services
BS EN 50174-1:2009 +A2:2014	Information technology. Cabling installation. Installation specification and quality assurance
BS EN 50174-2:2009 +A2:2014	Information technology. Cabling installation. Installation planning and practices inside buildings
BS EN 50174-3:2013	Information technology. Cabling installation. Installation planning and practices outside buildings
BS EN 50310:2016	Application of equipotential bonding and earthing in buildings with information technology equipment
BS EN 50346:2002+A2 2009	Information technology. Cabling installation. Testing of installed cabling

Other Standards referenced in the Client Specification

EIA/TIA 598	Optical fibre cable colour coding standard
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British Standards & Regulations referenced in the Client Specification

Standard	Description
BS 7671:2008 +A3:2015	Requirements for Electrical Installations. IET Wiring Regulations
BS 6701:2016 + A1:2017	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
BS 8492:2016	Telecommunications equipment and telecommunications cabling – Code of practice for fire performance and protection









Other Standards referenced in the Client Specification

18.2 Appendix B

The approved products for the installation, the following is an indicative list of the main components additional items may be suggested but no substitutes will be allowed without the written permission of the Client's Building Project Manager.

Part Number	Description	Image
170-191	Excel Category 6 _A U/FTP 'S Foil' Cable	
170-196	Excel Category 6 _A F/FTP 'S Foil' Cable	
100-024	Excel Unloaded Angled Jack Patch Frame	
100-185	Excel Category 6 _A Screened Angled Keystone Jack	
100-270	Excel Office Single gang faceplate	
100-280	Excel Office White Angled Shutter	
100-181	Excel Category 6 _A Low Profile Screened Keystone Jack	

350-639	Excel 2 Way GOP Box Plus - 25mm	
100-140	Excel Field Terminated Category 6 _A RJ45 Plug	
100-123	Excel 20m U/FTP solid core patch lead	
100-132	Excel 20m F/FTP solid core patch lead	
100-148	Category 6A Patch Lead F/FTP Screened LS0H1m Grey	
100-980	Excel Category 6A, U/FTP External cable	
100-111	Excel Category 6A Screened IDC junction box	
544-42810	Excel Environ Server Rack SR	

543-42810	Excel Environ Equipment Rack ER	
541-742	Excel Environ Open Rack	
205-324	Enbeam OS2 9/125µm tight buffered optical fibre cables	
204-112	Enbeam OM4 50/125µm tight buffered optical fibre cables	
200-466 & 200 -476	Enbeam Optical Fibre Patch Panel – Sliding Drawer – LC Style Multimode/ Singlemode	
204-330	Enbeam OM4, LC-LC Fibre Optic Patch Lead - 1m	
204-678	Enbeam OS2, LC-LC Fibre Optic Patch Lead - 1m	
200-602	Enbeam OS2 LC Pigtail 50/125 2.0m 12-Colour Pack	

200-604	Enbeam OM4 LC Pigtail 50/125 2.0m 12-Colour Pack	
5500533	LS0H Internal Blown Fibre Tube - 4 Way - 5mm	
T6500027	Blown Fibre Tube Direct Install MF	
EPFU_MA12B_2000	12 Core OS2 Singlemode 9/125 Blown Fibre EPFU 2000m	
Various	Requisite Joints, Closures, Tube connectors and bulkhead adapters to match the above	

Data Centre Specification Document including Category 6_A Copper Cabling and OM2/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

THE CLIENT	- XXXXXXXXXX
SCS	- Structured Cabling System
EF	- Entrance Facility
BD	- Building Distributor
ZD	- Zone Distributor
CP	- Consolidation Point
TO	- Telecommunications Outlet
GOP	- Grid Outlet Point
OLTS	- Optical Loss Test Set
OTDR	- Optical Time Domain Reflectometer
CPR	- Constriction Products Regulation
MPF	- Main Patching Field

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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_A).
- Backbone Infrastructure (Optical Fibre OS2 and OM4).
- Inter-Cabinets Links, both Copper and Fibre.
- Equipment cabinets, 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-Cabinet Links

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 OS2/OM4 fibre between edge switch and storage cabinet locations
- 2 Post frames for Main Patching Location
- Equipment Grade Cabinets for Switch and Storage devices
- Server Grade Cabinets for all Processing Equipment
- Aisle Containment system comprising of:
 - o Motorised Sliding Doors, with Keypad/Swipe Card operation.
 - o 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 cabinet 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 switch located in cabinet locations.

Core Switch Cabinet 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 Cabinet defined as a location Data Processing Servers and Storage devices

Edge Switch Cabinet 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 Cabinets 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 series 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.

5.2 Cable Plant Test Failures

The Contractor upon detection of cable plant failures during testing shall be duly noted of 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.
- 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 Cabinets & Frames (to the correct standards).
- All cabling test results showing positive results (to the correct standards).
- All documentation.

6.4 Training

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_A

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_A 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_A 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_A 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.

Furthermore all installation cables deemed to be permanent, including those that are pre-terminated such as Harness/Switch Links etc. Must meet the minimum Euroclass requirements of the Construction Products Regulation (CPR) as outlined latest edition of BS 6701:2016 +A1:2017.

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.

7.3 Horizontal Category 6_A F/FTP Patch Leads

The SCS Contractor shall allow for the supply only of the following Category 6_A 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

8 Cabinet & Rack Requirements

a. Server Rack

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 or Black RAL 9004
- 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

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 or Black RAL 9004
- 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

c. Open Rack

The Two Post Patching frames shall be Excel Environ OR series and conform as a minimum with the following:

- DIN414 compliant
- 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

8.1 Aisle Containment System

The Aisle Containment system will be from Nubis Solutions and designed as a complete package to support the Cabinets 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 cabinet footprint
 - o Designed to be used with overhead fire suppression.
 - o Designed to drop into aisle when release by solenoid linked to fire suppression system.
- 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.

8.2 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 iPDU 8 way C13 + 4 way C19 with 16A IEC6039 plug – horizontal
- Managed iPDU 12 way C13 + 4 way C19 with 16A IEC6039 plug – vertical
- Managed iPDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical
- Managed iPDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical
- Managed iPDU 16 way BS1363 with 16A IEC6039 plug - vertical
- Managed iPDU 20 way BS1363 with 32A IEC6039 plug - vertical
- Managed iPDU 24 way BS1363 with 32A IEC6039 plug - vertical
- Intelligent PDU Hub
- Intelligent PDU Temperature/Humidity Sensor

Further detail is given for typical layouts of wiring and equipment closets at a later date.

9 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, EN50310:2016 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.

9.1 Copper Infrastructure Testing

The SCS Contractor shall test 100% of the Category 6A horizontal cabling over the permanent link to confirm cable plant performance characteristics as stated in ISO 11801 Class EA & EN50173 Class EA. Sample testing for ANEXT will not be required. The Contractor must use a level IV Cable Tester it should have a current calibration certificate issued by the manufacturer of the tester.

9.2 Category 6_A – 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.

10 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

10.1 OS2, Optical Cable Requirements:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	1.00	0.40
1550	0.50	0.25

10.2 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

10.3 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 dismantled 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.

10.4 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.

10.5 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.

10.6 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.

10.7 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

11 Fibre Optic Infrastructure Requirements

S13

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.

11.1 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.

11.2 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.

11.3 Length Measurement

- The length of each fibre shall be recorded

11.4 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 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 10mm².

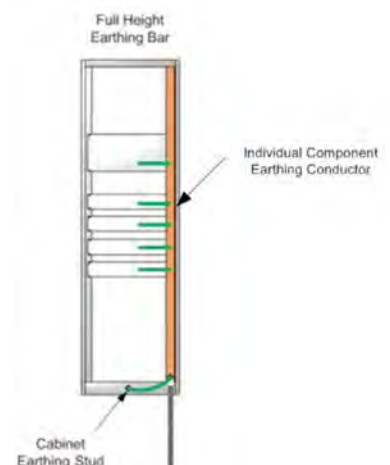
All parts of the cabinet including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the cabinet earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm².

A full height vertical earth bar shall be used for all floor mounted cabinets / 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 cabinet, 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.



12.1 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.

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 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.

The Contractor shall have Excel accredited engineers 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 from 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 _A 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	£
	Summary Total	£
10	Optional MTP Fibre Elements	£

16 Appendices

16.1 Appendix A

European (Cenelec) Standards referenced in the Client Specification

Standard	Description
BS EN 50173-1:2011	Information technology. Generic cabling systems. General requirements
BS EN 50173-2:2007+A1:2010	Information technology. Generic cabling systems. Office premises
BS EN 50173-3:2007+A1:2010	Information technology. Generic cabling systems. Part 3: Industrial premises
BS EN 50173-4:2007+A2:2013	Information technology. Generic cabling systems. Homes
BS EN 50173-5:2007+A2:2012	Information technology. Generic cabling systems. Data centres
BS EN 50173-6:2013	Information technology. Generic cabling systems. Distributed building services
BS EN 50600-1: 2012	Information Technology. Data centre facilities and infrastructures, General Requirements
BS EN 50600-2-4:2015	Information Technology. Data centre facilities and infrastructures, Telecommunications Cabling
BS EN 50600-2-6:2015	Information Technology. Data centre facilities and infrastructures, Management and operational information
BS EN 50174-1:2009 +A2:2014	Information technology. Cabling installation. Installation specification and quality assurance
BS EN 50174-2:2009 +A2:2014	Information technology. Cabling installation. Installation planning and practices inside buildings
BS EN 50174-3:2013	Information technology. Cabling installation. Installation planning and practices outside buildings
BS EN 50310:2016	Application of equipotential bonding and earthing in buildings with information technology equipment
BS EN 50346:2002+A2 2009	Information technology. Cabling installation. Testing of installed cabling

Other Standards referenced in the Client Specification







EIA/TIA 598	Optical fibre cable colour coding standard
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British Standards & Regulations referenced in the Client Specification

Standard	Description
BS 7671:2008 +A3:2015	Requirements for Electrical Installations. IET Wiring Regulations
BS 6701:2016 + A1:2017	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
BS 8492:2016	Telecommunications equipment and telecommunications cabling – Code of practice for fire performance and protection





16.2 Appendix B

Approved Excel Networking products for the installation, the following is an indicative list of the main components additional items may be suggested but no substitutes will be allowed without the written permission of the Client's Building Project Manager.

Part Number	Description	
170-191	Excel Category 6 _A U/FTP 'S Foil' Cable	
170-196	Excel Category 6 _A F/FTP 'S Foil' Cable	
100-024	Excel Unloaded Angled Jack Patch Frame	
100-185	Excel Category 6 _A Screened Angled Keystone Jack	
100-123	Excel 20m U/FTP solid core patch lead	
100-132	Excel 20m F/FTP solid core patch lead	

100-148	Category 6 _A Patch Lead F/FTP Screened LS0H1m Grey	
544-42810	Excel Environ Server Rack SR	
543-42810	Excel Environ Equipment Rack ER	
541-742	Excel Environ Open Rack	
205-324	Enbeam OS2 9/125µm tight buffered optical fibre cables	
204-112	Enbeam OM4 50/125µm tight buffered optical fibre cables	
200-466 & 200 -476	Enbeam Optical Fibre Patch Panel – Sliding Drawer – LC Style Multimode/Singlemode	



208-100	Enbeam 1U 144F HD Cassette F/Optic Patch Panel	
208-105	Enbeam HD 12F LC Quad OS2 Cassette	
204-330	Enbeam OM4, LC-LC Fibre Optic Patch Lead - 1m	
204-678	Enbeam OS2, LC-LC Fibre Optic Patch Lead - 1m	
200-602	Enbeam OS2 LC Pigtail 50/125 2.0m 12-Colour Pack	
200-604	Enbeam OM4 LC Pigtail 50/125 2.0m 12-Colour Pack	

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
CD	- Campus Distributor
BD	- Building Distributor
FD	- Floor Distributor
CP	- Consolidation Point
TO	- Telecommunications Outlet
GOP	- Grid Outlet Point
SD	- Service Distributor
SCP	- Service Concentration Point
SO	- Service Outlet
OLTS	- Optical Loss Test Set
OTDR	- Optical Time Domain Reflectometer
CPR	- Construction Product Regulation

Download this document from the 'Encyclopaedia' section of the 'Partner Area' located at 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

The solution will be designed in accordance to the relevant sections of the BS EN 50173 series and the installation requirements in accordance with BS EN 50174 series as outlined in appendix A

Based upon the SCS specification as detailed within this document, the requirements for this installation will include, but not limited to.

- Minimum Category 6 U/UTP cabling throughout.
- Multi core OM4 or OS2 fibre optic cables between distribution locations
- Equipment and Server cabinets
- Security cameras and associated recording systems

The solution will follow the design principles as outlined in BS EN 50173-2 for Voice and Data services and BS EN 50173-6 – Distributed Building Services for connectivity for all other IP enabled devices.

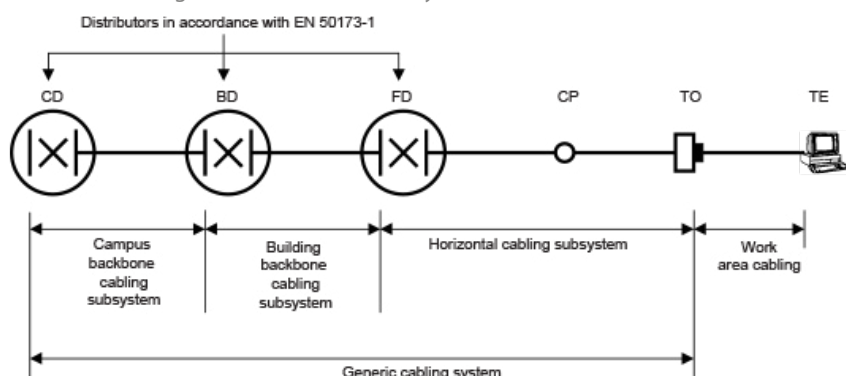


Figure: courtesy BS EN 50173-2:2007 +A1:2010

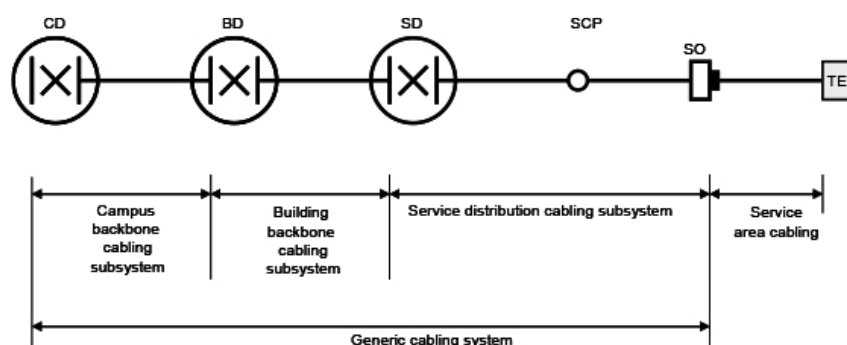


Figure: courtesy BS EN 50173-6:2013

2.4 Equipment Room locations

Final locations of all BD/FD shall be coordinated with the Client, although as an initial guide:

BD	(Building Distributor/Main Equipment Room)
FD	(Floor Distributor/Secondary Equipment Room)

2.5 The BD shall contain:

X No.	Equipment Rack
X No.	Server Rack
X No.	Open Rack (Two Post Frames)

2.6 The SER shall contain:

X No.	Equipment Rack
X No.	Open Rack

3 Scope of Works

The Client requires design and installation of 2 x Category 6 unscreened outlets per user position and 2 high level Service Outlets per Wifi AP Location, each one of the latter will have a 12m radius in all office locations.

This will include equipment, materials, labour and services to provide the SCS Infrastructure to support this involves, but not limited to:

- Horizontal Infrastructure (Category 6 U/UTP).
- Backbone Infrastructure (Optical Fibre OS2 and/or OM4).
- Equipment cabinets, frames, racks and enclosures.
- Intelligent PDUs (Power Distribution Units)
- 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 of 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, BS6701 & 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, provided by appointed Electrical Subcontractor
- Builder's work in relation to the SCS Contract, includes 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 inclusive of all cabling components, racks and enclosures, 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 an approved installer for the proposed solution.

4.2 SCS Equipment & SR Racks

All Equipment, Server and Open Racks/Frames shall be covered under the Manufacturer's single warranty for 25 years.

5 Interpretation & Communications 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 Main 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.

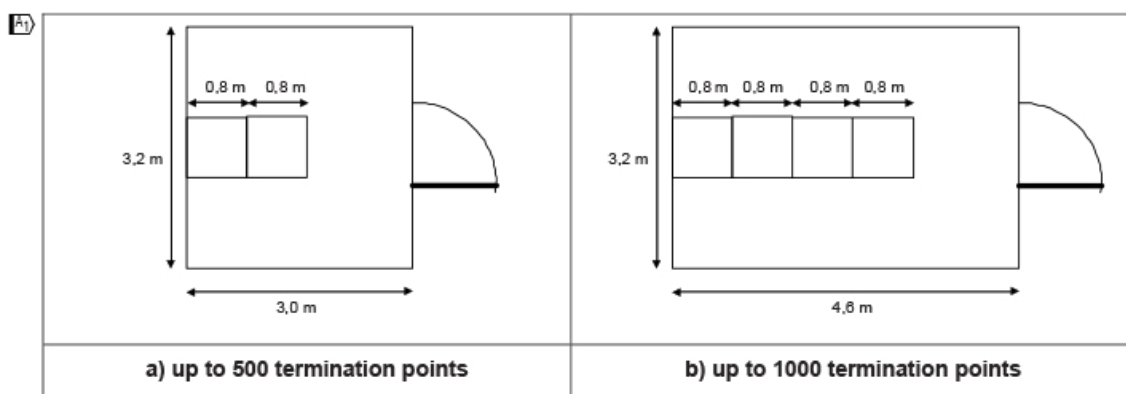
Location: To be confirmed

BD (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.

FD (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.

5.1 Room Size Requirements

All distributors shall be sized in accordance with EN 50174-2. This requires a minimum distance of 1.2m of clearance on all faces of cabinets, racks & frames where access is required. The design shall ensure that a minimum of 900mm (ISO14763-2 Section 7) shall be maintained as a passageway where no access to cabinets is required. Permission for any deviation must be sought from the Client's Building Project Manager with approval in writing confirmed.



Minimum Dimensions for rooms containing active equipment as well as cabling components

- The room shall be a minimum of 2.6m high normally without any false ceiling from the finished floor surface.
- Minimum height of the raised floor is 200mm, 300mm recommended.
- No piping systems, other than those providing services to the room, shall run through the rooms
- Lighting shall provide a minimum of 500lux measured 1m above the finished floor in the front and rear of the cabinets, racks & frames

6 General Specification & Requirements of the SCS Contractor

The SCS Contractor shall apply the methodologies for installation in accordance with the latest revisions of BS EN 50174, BS6701 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:
 - o Cable terminations shall be labelled at patch panel outlets.
 - o Cable shall be labelled at telecommunication outlets.
 - o Cables shall be labelled at the entry/exit points of rooms and buildings.
 - o 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 note 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 Client and 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 failures within the agreed 10% will result additional testing within the given area or floor at the Clients' discretion without additional charge.

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 EN50174 and 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.
- Provide evidence that the above compliance testing of RJ45 outlets includes IEC 60512-99-002 (draft 48B/2531/CD-Mating and Un-mating under Electrical Load up to 2A per contact (4PPoE)
- Manufactures' literature for products installed.
- 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 Client's 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

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 BD/FD 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:

The performance of the SCS Contractors Horizontal structured system being provided shall meet ISO 11801:Ed2.2, IEC 60603-7-5, IEC 61156-5, EN 50173-1:A2:2011, 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.

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 60332-1-2 flammability standard as a minimum.

Furthermore all installation cables deemed to be permanent, including those that are pre-terminated such as Harness/Switch Links etc. must meet the minimum Euroclass requirements of the Construction Products Regulation (CPR) as outlined latest edition of BS 6701:2016 +A1:2017.

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 305m Box
- Category 6 U/UTP LSOH White 305m Box
- Category 6 U/UTP LSOH Orange 305m Box

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
- 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 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. + IEC 60512-99-001

The form factor of the data outlet plate shall be from the Excel Office range, and shall be made up of:

- 1 x Office Single gang faceplate
- 2 x Office Category 6 Unscreened Module – Low Profile
- 2 x Office Category 6 unscreened keystone Jack
- 2 x Office Angled Shutter

Alternatively, where there is a raised floor the use of a 2 or outlet GOP box may be preferred on these occasions they will be from the Excel GOP Box Plus range, with 6C angled shuttered modules attached to 5m of 25mm flexible conduit, the alternative end will be securely fixed to the floor slab using an L bracket.

These will be left coiled under the floor for protection until the furniture is in position, they will then be drawn through a grommet in the floor tile and attached to the underside of the desk furniture.

8.3.3 Harness/Switch Links

If Harness/Switch links are used they will be created from Solid Core Patch Leads of 20m & 30m will be used (5m, 10, 15m leads are also available), these will be cut in half and terminated with the tool-less angled outlets, which will then be installed in the unloaded panel frames.

The use of a switch template will be used to neatly dress the harness/switch links within the cabinets prior to the selected switches being installed.

8.3.4 Horizontal Category 6 U/UTP Patch Leads

The SCS Contractor shall allow for the supply only of the following Excel Category 6 Component 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.

The Client's standards shall be confirmed prior to tender response and may include up to ten different colours.

9 BD and FD 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.

9.1 Server Rack

Server Cabinet shall 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 or Black RAL 9004
- 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

9.2 Equipment Rack

FD Enclosures shall 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 or Black RAL 9004
- 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

9.3 Open Rack

The Two Post Patching frames shall 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

9.4 Intelligent Power Distribution Units

It is the requirement of The Client that Intelligent PDU's be installed within each Equipment Rack or Server Rack.

Select the appropriate iPDU from the following list according to the size and load bearing requirements, and pay particular attention to the required equipment termination plugs.

Managed iPDU 8 way C13 + 4 way C19 with 16 IEC6039 plug – horizontal

Managed iPDU 12 way C13 + 4 way C19 with 16 IEC6039 plug – vertical

Managed iPDU 16 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed iPDU 20 way C13 + 4 way C19 with 32A IEC6039 plug – vertical

Managed iPDU 16 way BS1363 with 16 IEC6039 plug - vertical

Managed iPDU 20 way BS1363 with 32A IEC6039 plug - vertical

Managed iPDU 24 way BS1363 with 32A IEC6039 plug - vertical

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 BD/FD 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.

All cables shall be bundled in no more than 24s .

Ties shall be positioned every 600mm in the Horizontal and every 300mm plus a metal tied shall also be used over every 3rd one in the Vertical. Additional ties shall be used to maintain bend radii.

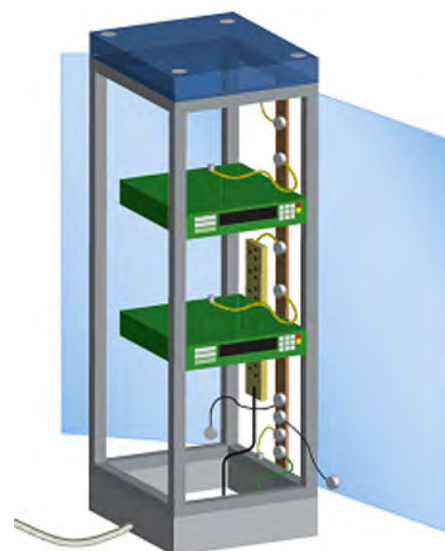
Rack mounted equipment passive or active in nature shall be bonded to a sub-TGB (Telecommunications Grounding Bar) positioned in each equipment rack which is in turn shall be bonded to the TR/ER room, TMGB/TGB.

Work area BD/FD shall consist of an RJ45 socket presented as either a single or dual formation. BD/FD faceplates must be in keeping with the environment they are being installed.

In all structured cabling termination instances the ANSI/TIA/EIA568-B colour code will be used throughout Installation.

The cabling system must be bonded in accordance with the manufacturer's instructions, EN50174-2, EN50310 and BS6701 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.



10.1 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.

10.2 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.

10.3 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 E PL2. 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'.

11 Specification & Requirements - Backbone Fibre Optic Infrastructure

The selected Fibre Optic Cabling System shall have performance objectives 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 polarity shall be installed using the reverse fibre polarity scheme as detailed within BS EN 50174-2

Options of both a Conventional and a 'Blown Fibre' fibre optic solution are available, the SCS Contractor will provide a recommendation on which is the most applicable for each installation. There are some elements that are common to both and they are listed in this section.

All backbone cable will be Bend Insensitive, whether meeting G.675.A standard for Single-Mode or generic requirements for Multi-mode furthermore the fibres will follow the colour code scheme as outline within EIA/TIA 598, also followed by BT (British Telecom) and other ISP providers throughout Europe.

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

11.1 OS2, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
1310	1.00	0.40
1550	0.50	0.25

11.2 OM4, Optical Cable Performance levels:

Wave Length (nm)	Max. Fibre Attenuation (dB/Km)	Typical Cabled Attenuation (dB/KM)
850	3.50	3.0
1300	1.5	1.0

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 dismantled without disturbing other adjacent connectors.
- In the case of panels housing terminations with maintenance access to rear, using sliding drawer mechanism that does not strain the terminated cables or terminations.
- Multiple Pre-Stamped Cable Entry points
- Suitable for either conventional or blown fibre installs
- Must be complete with 2 x Plastic Splice holders, 2 x cable entry glands, Cable tie bridges in base of drawer

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.

Both patch leads and adapters will be colour coded to the relevant category OM4 – Heather Violet, OS2 – Yellow with Blue connectors.

The average loss for all connector pairs shall be less than 0.3dB, including the loss due to splicing.

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

All links must be tested using an OLTS in the first instance for warranty purposes

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 Multimode links shall be tested using the "Encircled Flux" methodology with the relevant TRCs (Test Reference Cords).

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

12 Backbone Optical Fibre Testing

12.1 Tier 1 Requirements

All links must be tested using an OLTS in the first instance for warranty purposes

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 Multimode links shall be tested using the "Encircled Flux" methodology with the relevant TRCs (Test Reference Cords).

All results should be capable of being stored within the test equipment for future submission electronically as part of the warranty application.

12.2 Tier 2 OTDR Testing

The Client may also require additional OTDR testing on all backbone and inter-building links.

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.

12.2.1 Length Measurement

- The length of each fibre shall be recorded.

12.2.2 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.

13 Specification and Requirements – Cabinets & Racks

Each cabinet must be laid out using the instruction provided by the Client, the following image is an example of a spreadsheet the SCS contractor is expected to submit prior to final sign-off and installation.

CAB 1		
42U	1U Fibre Patch Panel	42U
41U	1U (4 hoop) Cable Manager	41U
40U	48 Port POE Ethernet Switch	40U
39U	48 Port POE Ethernet Switch	39U
38U	1U (4 hoop)Cable Manager	38U
37U	Chrome Panel with 100-185 linked to Cab 1	37U
36U	Chrome Panel with 100-185	36U
35U	Chrome Panel with 100-185 linked to Cab 1	35U
34U	Chrome Panel with 100-185	34U
33U	48 Port POE Ethernet Switch	33U
32U	48 Port POE Ethernet Switch	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
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18U		18U
17U		17U
16U		16U
15U		15U
14U		14U
13U		13U
12U		12U
11U	UPS/PDU	11U
10U		10U
9U		9U
8U		8U
7U		7U
6U		6U
5U		5U
4U		4U
3U		3U
2U		2U
1U		1U

13.1 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 16mm².

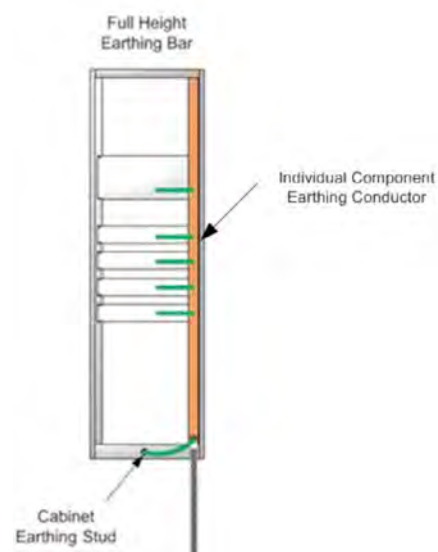
All parts of the cabinet including doors, blank panels, gland plates, and any equipment that are provided with earth studs, shall be bonded individually to the cabinet earth bar by green/yellow copper conductor flexible tri-rated cables with minimum cross section 4mm².

A full height vertical earth bar shall be used for all floor mounted cabinets / 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 cabinet, 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.

14 Additional SCS Contractor 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 have a fully qualified Network Infrastructure Designer, on staff that will be ultimately responsible for this section of the project. The CV of proposed individual shall accompany the tender response including details of similar projects undertaken.

The Project Engineer/Manager 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 Project Engineer/Manager must be attached to The Vendor's response for evaluation by the Client. Should the Project Engineer assigned to this project change during the installation, the new Project Engineer/Manager assigned must also submit a CV for review by the Client

If, in the opinion of the Client, the Project Engineer/Manager does not possess adequate qualifications to support the project, they reserve the right to require the SCS Contractor to assign a Project Engineer/Manager who, in the Clients' opinion, possesses the necessary skills and experience required of this project.

The SCS Contractor would ideally have Excel Certified Installers 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 should provide evidence of Tool Box training is booked to be carried out by Excel Networking personnel before each important stage they are:

- Cable Installation
- Outlet Termination
- Testing

These will coincide with site audit visits to inspect the work on a regular basis, it will also be the opportunity for the SCS Contractor to gain input and guidance from the manufacturer.

The SCS Contractor shall additionally be an Accredited, Approved Designer and Installer for the chosen System Supplier.

15 Drawings Schedule of Applicable Drawings

16 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 form 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 Elements	£
2	Backbone Optical Fibre Elements	£
3	Equipment Cabinet Elements	£
4	Multi-pair Voice Cabling	£
5	Project Management	£
7	Documentation & Warranty	£
8	Training	£
	Summary Total	£

17 Appendices

17.1 Appendix A

European (Cenelec) Standards referenced in the Client Specification

Standard	Description
BS EN 50173-1:2011	Information technology. Generic cabling systems. General requirements
BS EN 50173-2:2007+A1:2010	Information technology. Generic cabling systems. Office premises
BS EN 50173-3:2007+A1:2010	Information technology. Generic cabling systems. Part 3: Industrial premises
BS EN 50173-4:2007+A2:2013	Information technology. Generic cabling systems. Homes
BS EN 50173-5:2007+A2:2012	Information technology. Generic cabling systems. Data centres
BS EN 50173-6:2013	Information technology. Generic cabling systems. Distributed building services
BS EN 50600-1: 2012	Information Technology. Data centre facilities and infrastructures, General Requirements
BS EN 50600-2-4:2015	Information Technology. Data centre facilities and infrastructures, Telecommunications Cabling
BS EN 50600-2-6:2015	Information Technology. Data centre facilities and infrastructures, Management and operational information
BS EN 50174-1:2009 +A2:2014	Information technology. Cabling installation. Installation specification and quality assurance
BS EN 50174-2:2009 +A2:2014	Information technology. Cabling installation. Installation planning and practices inside buildings
BS EN 50174-3:2013	Information technology. Cabling installation. Installation planning and practices outside buildings
BS EN 50310:2016	Application of equipotential bonding and earthing in buildings with information technology equipment
BS EN 50346:2002+A2 2009	Information technology. Cabling installation. Testing of installed cabling

British Standards & Regulations referenced in the Client Specification

Standard	Description
BS 7671:2008 +A3:2015	Requirements for Electrical Installations. IET Wiring Regulations
BS 6701:2016	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
BS 8492:2016	Telecommunications equipment and telecommunications cabling – Code of practice for fire performance and protection

Other Standards referenced in the Client Specification

EIA/TIA 598	Optical fibre cable colour coding standard
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Excel White Papers and Technical Notes

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White Paper

The importance of cleanliness when handling fibre



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.

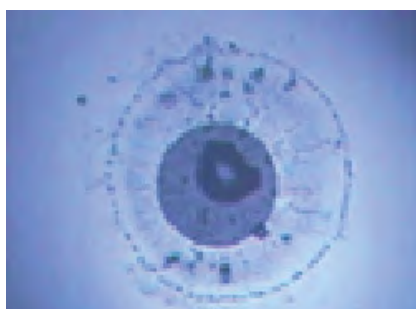
Any contamination in the fibre connection can cause failure of the component or failure of the whole system. Even microscopic dust particles can cause a variety of problems for optical connections. In a survey carried out by Fluke Networks they claim that 85% of the failing links can be attributed to '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.



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.

There are many excellent documents which cover the correct procedure for cleaning and inspecting fibre optic end-faces, however we should always defer to the standards if they are available. In February 2010 the British Standards Institute published BS EN 61300-3-35 Examinations and

Visual requirements for PC polished connectors, single mode fibre, RL \geq 45 dB

Zone name	Scratches	Defects
A: core	None	None
B: cladding	No limit \leq 3 μ m None $>$ 3 μ m	No limit $<$ 2 μ m 5 from 2 μ m to 5 μ m None $>$ 5 μ m
C: adhesive	No limit	No limit
D: contact	No limit	None \Rightarrow 10 μ m

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.

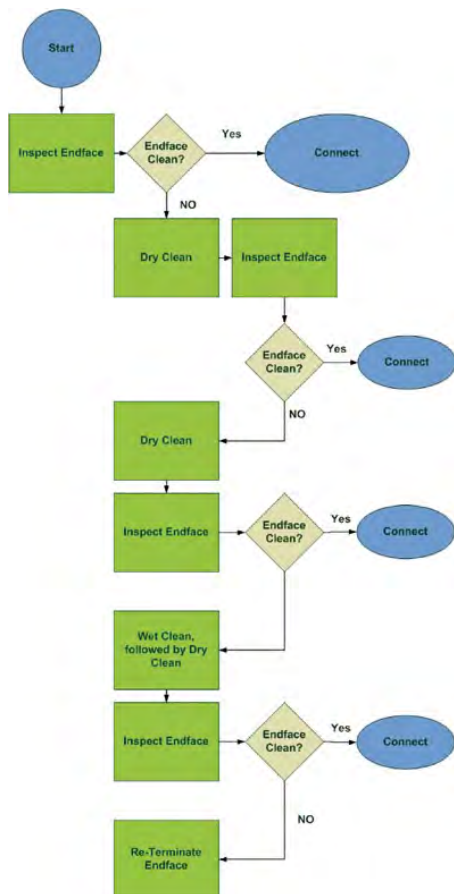
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Measurements-Fibre optic connector end-face visual and automated inspection. This document outlines the criteria for the number and details of the scratches and defects that can appear on the end-face, both in the core and cladding areas. The following is a table 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

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.

This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.

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.

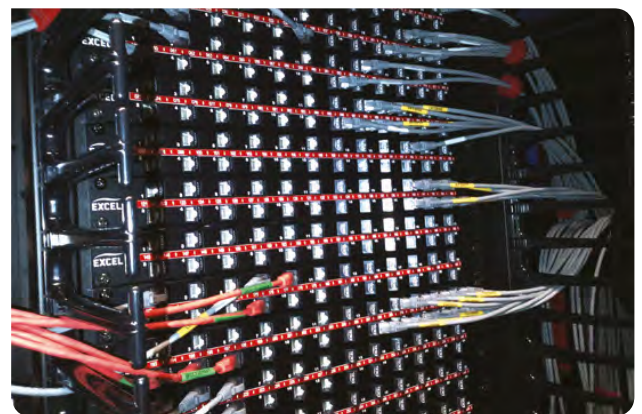
Copper Pre-terminated cassettes have been traditionally restricted to Category 6 and below due to the potential problems of Alien Cross Talk. Category 6_A is usually installed by way of individual screened jacks, that are then mounted into patch frames. These assemblies typically involve harness links 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.

continued overleaf

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.

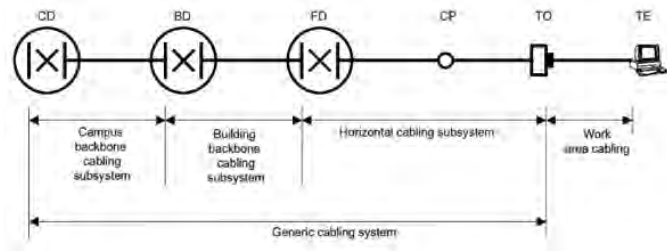
Therefore pre-termination for commercial office installations is becoming increasingly popular as the project timescales are being constantly shrunk. Some integrators have even taken the step to invest in their own facilities to keep up with the demand.

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.

continued overleaf



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 led 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.

This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.

White Paper

Category 6, 6_A and Category 7_A (ISO Class Fa) – A Comparison.



Structured cabling has evolved over a number of years since its inception in the mid to late 1980's

Overview

Structured cabling has evolved over a number of years since its inception in the mid to late 1980's.

Over the period the popular standards prevalent in the market were:

EIA/TIA Category 5e (ISO Class D)

EIA/TIA Category 6 (ISO Class E)

However, due to increasing demand for bandwidth, new standards have been developed over the last few years to provide a future-proof solution to growing needs of the LAN.

Hence the IEEE released 802.3an the 10GBase-T standard in April 2006, this was intended to use Category 6 Augmented, in simple terms this became widely known as Category 6_A or ISO Class Ea. The requirement of the systems was to offer 10Gb/s speeds at a frequency up to 500MHz. This increase in throughput was achieved using a combination of the higher performing cabling system along with new and improved encoding techniques.

Category 6

Typically an Unscreened solution (although some countries insist on a Screened version), Category 6 was introduced to anticipate the requirement for more bandwidth than 1Gbs networks. Application Switches were now able to allocate Quality of Services Policies (QoS) to enable users to run some applications faster than others. These applications were typically Video Applications (Video Conferencing over IP) and large image files (CAD drawings). Therefore this increase in frequency to 250MHz (two and a half times that compared with Category 5e which operates at 100MHz) would assist in this however what wasn't anticipated was the fact that the IEEE changed/improved the Ethernet encoding technique, which allowed 10 times the bandwidth for a 5 fold increase in frequency from 100Mhz to 500Mhz.

Category 6 is still only capable of providing 1Gbs Ethernet, so the bandwidth is the same as Category 5e however it does have a number of features that provide a tangible benefit over Category 5e.

With the proliferation of Power over Ethernet (PoE) tests have shown a significant benefit regarding the heating characteristics and the ability of a Category 6 cable to be less impacted by the increase in Attenuation (reduction in signal) due to heating up when carrying power as well as data. All forecasts suggest that the PoE market is not only going to keep on increasing in size the level of power deployed will also increase.

Category 6_A

The first Category 6_A solutions were based around both Unscreened solutions, as well Screened but in recent times the preferred solution has become a Screened system. This is mainly due to concerns over interference both from other data cables as well as external sources better known as Alien Crosstalk (ANEXT) at the new higher frequencies now used.

Category 6_A is designed to perform at a frequency of 500MHz, twice the range of Category 6 and 5 times that of Category 5e. This high frequency operation can leave the cabling susceptible to external interference from local EMI and RFI signals, unfortunately the Transceivers involved cannot cancel out this interference from external sources and it must be done in the cabling. This interference can be minimised with improved installation techniques and the design of the components for an Unscreened solution, hence the Standards state they 'may' be compliant by design. However the client is still within their rights to have that confirmed by Alien Crosstalk testing

A Screened solution on the other hand is not seen to be susceptible at all to any external interference affecting performance, therefore all Standards agree Alien Crosstalk testing is 'Not Required' and on this basis Screened solution are now becoming the system of choice for most end users.

Connectors

The Category 6_A solution offered by all manufacturers is still based around the RJ45 connector, offering full backwards compatibility from switch connections in the Data Centre through to the outlet at a workstation. Standards compliant Category 6_A RJ45 Patch Cords are produced by the manufacturers for the Category 6_A systems.

Frequency Capabilities

Category 6_A/ISO Ea is designed to operate up to 500MHz, the current standard for 10Gbs Ethernet transmission. Multiple Applications are also supported, including VOIP Telephony, IP Security (CCTV, Door Entry Systems, Alarms and Environmental Controls)

Modern construction methods of Category 6_A Screened solutions have reduced the Excel Category 6_A U/FTP cable diameter by over 14% to 6.7mm – just 0.5mm bigger than Category 6 U/FTP. This has seen the use of U/FTP solutions increase significantly for 10Gbs requirements, but also the increase the overall cable size and the use of a screen has future-proofing capabilities for future PoE (Power over Ethernet) developments.

ISO Class Fa (Category 7_A)

ISO Class Fa systems are constructed using Category 7_A components however no EIA/TIA Standard exists for systems (Channels & Links). The ISO Class F Category 7 market is dominant in central European countries due to the long history of using Screened systems for the implementation of 'Sheath Sharing' which is no longer allowed by the standards but used to be prevalent for 10/100 systems that only required 2 pairs.

Multiple Proprietary Connectors

The ISO Class FA standard is also unique in that it does not state a specific type of connector for the system. This has resulted

Frequency Capabilities

The frequency range of ISO FA systems is 1000-1200MHz, and no applications are designed to run at this frequency. The original design of ISO Class F was a 350MHz operational frequency, with future-proofing headroom to 600MHz. This was seen as a great advantage in the mid 1990's but new cabling technology has superseded this capability using traditional RJ45-based solutions.

The only data application that can currently be supported over and above 500MHz is Fibre Channel (FC) which would require the higher performing ISO FA (Cat 7) at 600MHz, but this restricted to the lower speed FC and is now negated by the wide deployment of higher speed Fibre Channel systems requiring Fibre connectivity.

One other application currently using a frequency over and above 500MHz is Analogue CCTV at 862MHz, therefore requiring the higher performing ISO FA (Cat 7_A) at 1000MHz, but this is also now rapidly shrinking due to the advent of IP CCTV systems which are capable of Megapixel quality images over standard LAN cabling. It is not anticipated that any new build projects will employ an analogue CCTV system, and so Category 6_A will be the most viable cost effective solution for all applications of High Speed LAN, VOIP Telephony, and IP Security systems, given its capabilities at higher levels of PoE being planned.

Cabling Bandwidth Overview

Standard	Type	Frequency	Length	LAN Applications	Notes
Cat 5e/ ISO Class D	U/UTP, F/UTP	100MHz	100m	100Mbs, 1Gbs	General LAN use
Cat 6/ ISO Class E	U/UTP, F/UTP	250MHz	100m	100Mbs, 1Gbs	General LAN use
ISO Class Ea Cat 6 _A	U/UTP, U/FTP, F/FTP	500MHz	100m	100Mbs, 1Gbs, 10Gbs	High Speed LAN use
ISO Class F/ Cat 7	S/FTP	600MHz	100m	10Gbs	High Speed LAN use Fibre Channel
ISO Class Fa Cat 7 _A	S/FTP	1000-1200MHz	100m	10Gbs	High Speed LAN use Fibre Channel

in two FA connectors being produced and accepted, including the TERA connector and the GG45 connector. These connectors are all proprietary to their own systems and are typically 30-40% more expensive than RJ45 based solutions, whilst these connectors are available to licence by other manufacturers other than the patent holders the terms involved are very restrictive which will limit their deployment.

Custom Patching Equipment

Special custom patch cords will also be required to convert the ISO FA connector to a traditional RJ45 connector for switch connection. These are also typically 30-40% more expensive. However this will bring the performance of the overall system back to the 'lowest common denominator' there if the RJ45 is of Category 6_A performance then the whole system will be limited to that.

"With the proliferation of Power over Ethernet (PoE) tests have shown a significant benefit regarding the heating characteristics and the ability of a Category 6 cable to be less impacted by the increase in Attenuation (reduction in signal) due to heating up when carrying power as well as data. All forecasts suggest that the PoE market is not only going to keep on increasing in size the level of power deployed will also increase."

Future High Frequency Requirements

Data Centre Applications

With the announcement of the NGBase-T working group by the IEEE it set out a series of requirements for the future, the first announcement was to try 40Gbps over Copper using an RJ45 'Style' connector (not any of the proprietary connectors that had been approved for Category 7_A) the transmission distances required would be 25-30m Channels to support 'Top of Rack/End of Row' topologies within the Data Centre.

This work whilst started in 2013 still has some way to go however the Cabling Task Group suggested that a Category 8 screened cable supporting 2000Mhz would be required,

ISO are working on a interim solution using a 1600Mhz cable and either TERA or GG45 connectivity at a further reduced distance of possibly as short as 15m.

10 Gbs Hardware Manufacturers

It is not anticipated that switching hardware manufacturers will be making proprietary switching equipment for each of these aforementioned 7_A connectors, and so the RJ45 interface remains the accepted connector for its copper 10Gbps interface. The only anticipated change will be in the fibre backbone where multi channel fibre connectors (MTP) are used for 40Gbps and 100Gbps backbone connections between switching equipment.

Cable Performance Summary

Category	5e		6		6 _A			7	7 _A
Construction	U/UTP	F/UTP	U/UTP	F/UTP	U/UTP	U/FTP	F/FTP	S/FTP	S/FTP
Bandwidth	★★★★	★★★★	★★★★	★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★
Headroom*	★	★	★★★★	★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★
PoE Performance	★	★★	★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
Alien Crosstalk	★	★★★★	★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
EMI/RFI Immunity	★	★★★★	★★	★★★★	★★	★★★★	★★★★	★★★★	★★★★

Note: Headroom is the additional margin expected at the maximum bandwidth of the previous Category

i.e. 1Gbps using Category 6 rather than Category 5e

Legend: all values are marked between 1 to 5 with 5 being the highest value

White Paper

The impact of IEEE 802.11ac on copper cabling systems.



The emergence of new wireless applications will have a major impact on the future.

Overview

This white paper will discuss the emergence of new wireless applications that will have a major impact on the future of the copper cabling systems we install in the next 5 to 10 years.

It was only a few years ago that some people questioned the future of copper cabling and believed one day it would all be wireless, the reality is, for the foreseeable future, the next generation of Wireless connectivity will actually drive an increase in the installation of high Category cabling.

802.11ac technology fundamentals

The current generation of 802.11ac Wave 1 products that have been certified by the Wi-Fi Alliance since mid 2013, deliver a three-fold increase in performance. This is driven by a doubling of channel bandwidth to 80MHz, the addition of a more efficient 256-QAM encoding technique and explicit transmit beam-forming to improve signal quality.

Wave 1 802.11ac supports multiple streams to the same client much as 802.11n did (MIMO). The major change in Wave 2 802.11ac will introduce multi-user MIMO where an access point (AP) transmits simultaneously to multiple clients or a single radio can transmit multiple simultaneous conversations to different clients.

The following table gives an indication of the theoretical rates available with Wave1 products.

The table on the next page shows how simple multiplication can generate all other rates, up to nearly 7 Gbps. Bear in mind that the conditions required for the highest rates – 160-MHz channels, eight spatial streams – are not likely to be implemented in any chipsets in the near future due to design complexity and power requirements.

Now is the time many organisations are looking to move ahead with 802.11ac Wave 1 products that deliver 3X the performance

802.11AC THEORETICAL LINK RATES

Channel Bandwidth	Transmit - Receive Antennas	Modulation and coding	Typical client scenario	Throughput
40MHz	1x1	256-QAM 5/6, short guard interval	Smartphone	200 Mbps
40MHz	3x3	256-QAM 5/6, short guard interval	Laptop	600 Mbps
80MHz	1x1	256-QAM 5/6, short guard interval	Smartphone, Tablet	433 Mbps
80MHz	2x2	256-QAM 5/6, short guard interval	Laptop, Tablet	867 Mbps
80MHz	3x3	256-QAM 5/6, short guard interval	Laptop	1.3 Gbps

The 802.11ac project title succinctly reads “Enhancements for Very High Throughput for operation in bands below 6 GHz.” These changes enable modes of operation capable of supporting:

- A maximum multi-station (STA) throughput (measured at the MAC data service access point), of at least 1 Gbps.

of the prior 802.11n generation. Some are even looking towards the 802.11ac Wave 2 products that are just starting to emerge.

If this isn't enough to convince you of the size of the potential impact, the following data might give an indication of the scale of change.

**DATA RATES FOR VARIOUS
802.11AC CONFIGURATIONS**

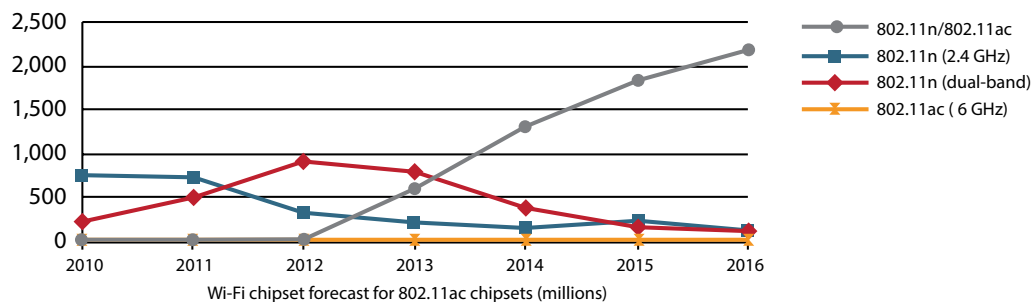
Spatial streams	Highest rates Mbps (160MHz channel, 8x SS)	
	Long GI	Short GI
x2 for 2 SS	468.0	520.0
x3 for 3 SS	939.0	1040.0
	1404.0	1560.0
x4 for 4 SS	1872.0	2080.0
	2808.0	3120.0
x5 for 5 SS	3744.0	4160.0
	4212.0	4680.0
x6 for 6 SS	4680.0	5200.0
	5616.0	6240.0
x7 for 7 SS	6240.0	6933.3

This has led to one major manufacturer of Wireless technology to make the following statement:

“Preparing your wired network for 802.11ac:

- Ensure minimum 1 Gbps uplink ports for the APs
 - Ensure 10 Gbps uplink from edge switches to core
- One 11ac AP can max out a 1 Gbps uplink on a switch”

Source: **ARUBA Networks**



Source: ABI research

The impact on cabling Infrastructure

The first point to highlight is the cabling standards recommend that any new cabling installation should be able to support two full hardware technology upgrades.

Therefore any cabling infrastructure needs to support a wireless LAN for much longer than the lifetime of any particular generation of access points. With the second wave of 802.11ac, the speed will rise to 1.7 Gbps in 80 MHz channels and may be as high as 3.5 Gbps, if 160 MHz channel support is introduced. With these speeds, a single gigabit link will probably be no longer sufficient.

Therefore any new cable installation required for the first-wave 802.11ac deployment, could possibly still exist using a Category 6 system, however many specifiers are now laying the foundation for the second wave and beyond by installing two

Category 6 cables to each AP location.

Whilst at this moment in time it still makes financial sense to utilise two 1Gbps switch ports, purely on the basis that the cost of these, including the cabling infrastructure, is still considerably less than trying to utilise a 10Gbps switch port. However this will probably change in the next 3-5 years according to all forecasts when we start to see commoditisation of the technology.

The other hurdle at this moment is the Ethernet ports on the APs themselves are still 1Gbps and will probably stay that way for the next few years, until Wave 2 is mature and the cost of the 10Gbps ports come down to a reasonable level.

Power options for 802.11ac in the most part, is unchanged from previous generations of wireless LAN access points. However, some vendors require the additional power provided by 802.3at (PoE+) which provides up to 25.5 watts at the end of a full-length Ethernet cable. 802.3at power is provided by many newer edge switches and can be added onto existing networks by using mid-span power injectors.

Alternatively, some products have the ability to draw power simultaneously from multiple Power over Ethernet (PoE) connections, which enable these products to add two 13-watt 802.3af sources together for higher power draw. In most cases, the cost of running a second cable to existing AP mounting locations is negligible if it is part of a new cable installation, however the level of disruption and cost could be prohibitive if this was part of a retrofit upgrade. Finally enthusiasm for bring-

your-own-device (BYOD) programs is based on the productivity increases that flow from putting information quite literally in the hands of users. Designing a technical architecture for a BYOD program is a book topic in itself; however it is leading to a requirement to build a network that requires a significantly higher level of service due to increases in device density. 802.11ac will not only have a major impact on the corporate network it will certainly effect the cabling infrastructure that supports it.

“Now is the time many organisations are looking to move ahead with 802.11ac Wave 1 products that deliver 3X the performance of the prior 802.11n generation. Some are even looking towards the 802.11ac Wave 2 products that are just starting to emerge”.



Conclusions

Access points based on 802.11ac Wave 2 will add more users and more bandwidth to the wireless network. Like all legacy Wi-Fi standards, 802.11ac Wave 1 allows access points to send multiple streams to only one client at a time, which means fewer flows on the network. Wave 2 will support multiuser, multiple-input, multiple-output (multi-user MIMO), which allows access points to send multiple streams to multiple clients at the same time. This technology will allow businesses to support significantly more end users and applications. Employee productivity may get a boost - but Wave 2 won't enable these changes without the supporting infrastructure being capable of supporting it.

As far as the cabling infrastructures are concerned the days of running just one Category 6 cable to an AP location is over, many organisations are now planning at least 2 x Category 6 cables to support both the Data requirements as well as the PoE, some are even planning further ahead by installing Category 6_A at high level and Category 6 to the desktop.

One other impact that we haven't covered in this paper is the knock on effect of having to use additional switch ports to support Wave 2 of 802.11ac. It doesn't matter whether it is a College or a Corporate user, if they are going to upgrade 400 APs throughout the campus or HQ building, that is an additional 9 x 48 port Switches and 32 patch panels, using a traditional cross-connect. This will subsequently involve an additional 2 cabinets at least. Does the building physically have the space and power feed to accommodate the upgrade?

So whilst on the surface this development appears to hold a welcome enhancement in performance for the future, it doesn't come without its challenges and some major considerations if it is to go without a hitch, as it isn't just a case of replacing an existing AP with a new one. Therefore the questions that need to be asked as part of the process should include but not be limited to:

- Have enough cables been run to each AP location?
- Is the existing containment capable of holding additional new cables?
- Is there sufficient switch capacity to support the upgrade?
- Are those switches capable of supporting 802.3at (PoE+)?
- Is there space for additional switching within existing cabinets?
- Is there space for additional patching fields?
- Is there sufficient space for additional cabinets?



This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.

White Paper

The impact of remote powering (PoE) on Balanced Twisted Pair Cables



"Powered Ethernet - heat effects on various categories of cables where will it stop?"

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 wants to have available. The benefits are obvious: reduced cabling to equipment in terms of power and data comms provides financial, weight and real estate savings. While some disadvantages are also obvious, such as the failure of a cable bundle which exceeds its temperature limit, other disadvantages are less obvious and include changes in the channel performance during heating and potentially over several heating cycles. This paper builds on work presented at the International Wire and Connectivity Symposium (IWCS) to further analyse the effects on channel performance of powered Ethernet.

The 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 that purpose has been gaining momentum in recent years as more and more powered devices are being deployed.

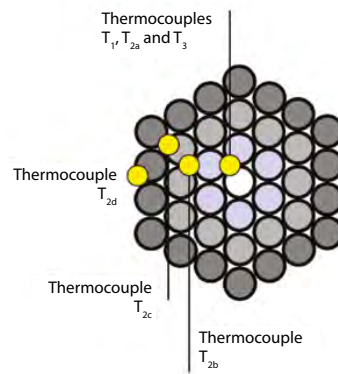
In 2010 the International Standards Organisation/International Electrotechnical Commission (ISO/IEC) published a technical report (TR 29125) that looked at ways to mitigate this heating effect, however many felt the initial testing model was not as robust as it could have been and didn't look into all the environments a twisted pair cable may be installed and therefore questioned whether it did give a reliable set of results.

Cenelec decided to produce their own 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. The proposed testing method has gone much further than previous examples, in the main by calling for the optimum bundle size that allows for at least 6 temperature probes or thermocouples to be employed, it also allows for the cable bundle to be, both in 'free air' and insulated, allowing a more realistic investigation of the impact of having cables installed within a range of sealed containment and unventilated spaces etc.

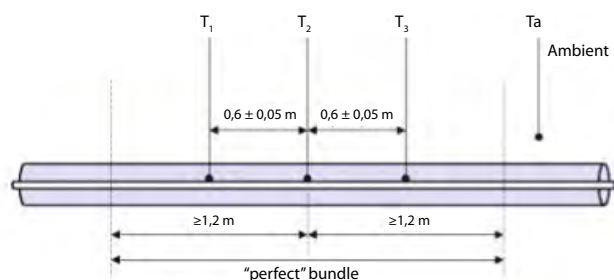
Today there are very few test rigs that have been constructed to carry out this level of testing and even less are said to be independent, one of which is at De Montfort University, Dept of Engineering, Leicester, UK. Excel Networking commissioned a series of tests under the guidance of Dr Alistair Duffy from the University. This paper will look at the results of that testing, the results will also be 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 is to construct a rig that allows for a bundle of 37 cables to be suspended initially in 'free air' with thermocouples installed within each layer as shown in the following diagram.



As well as being distributed throughout the layers, thermocouples are also positioned along the length of the cable sample this is to measure the difference in temperature closer to the actual source of the power.



In total 3 levels of testing were completed, PoE+ at 34.2 watts, UPoE at 60 watts and 100 watts which is a level being discussed by the IEEE for the development of the new 802.3bt, which has a stated minimum of 49watts and could be in excess of 100 watts when finally ratified, this also relates to some of the higher claims coming from proprietary systems such as HDBase-T which is a hybrid application intended for the AV market.

To get a true reflection of the impact these levels of power have on channel performance a range of cables we tested. The above 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.

The following sample cables were initially tested Category 5e U/UTP, Category 6 U/UTP, Category 6 F/UTP, Category 6_A F/FTP, and Category 7_A S/FTP.

In addition we took the opportunity to assess the impact of using cables with construction which differ from the industry standard, for example such as a Category 6 cable that is 24 AWG rather than the more common 23 AWG. We also included a length of 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.

Finally these tests were carried out both in 'Free Air' and contained within a glass fibre based insulating material commonly found within modern construction, the latter being a recognised method of simulating the effects of the cable bundle being contained within an insulating medium, whilst this may seem extreme it is important to note that some cables run either in high level tray or under a raised floor could run into many hundreds. We wanted to try to understand what may happen to a bundle of 37 cables in the centre of this mass, the test also provides evidence for the model to calculate the cables being in an unventilated containment for a prolonged period, for example 24 cables within dado or 3 compartment trunking is estimated at 80% of the value of the 37 cables. All the testing done to date has shown the cables do reach a 'steady state' after a given period when the heat increase levels out and this insulating material helps reach that point quicker. The 'steady state' can vary from 40 minutes up to over 30 hours depending upon the cable construction.

Testing Results

Before going into the details 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 'real life' installations.

Therefore the following results will show some extremes of temperature increase over the ambience of the test room environment.

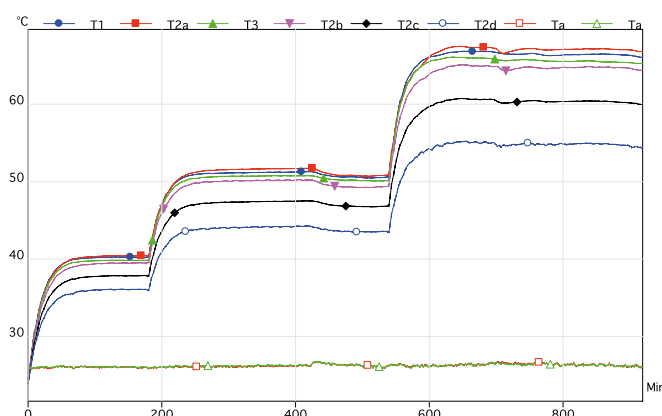
Category 5e U/UTP

This cable was of a standards compliant construction, 4 pairs contained within a LSOH sheath, conductor size being 0.51mm (24AWG) as seen in the table below the temperature increases at 802.3at and UPoE levels during the 'Free Air' tests are at an acceptable level, however when we get to 100watts results show it going beyond the operating temperature range of up to +60°C stated within the cable construction standard EN50288-3-1. The Ambient Temperature (Ta) during this test was 23.36°C + 41.02 = 64.38°C

Test Date	20/3/2014
Test ID	001A
Wires used	8
Conventional test set-up	Yes
Cable type	LSOH Cat5e UTP
Cable diameter	5.2mm
Installation conditions	Free Air
Humidity at test end	40%
Average Conductor Resistance	0.098Ω/m
DC Loop Resistance	19.7 Ω/100m

Temperature Rise above Ambient					
Power	T1	T2a	T3	T2b	T2c
Watts	°C	°C	°C	°C	°C
34.2	14.21	14.39	13.79	13.4	11.8
60	25.09	25.52	24.57	24.02	21.33
100	40.38	41.02	39.62	38.63	34.29

During this test it took approx 180 minutes to reach 'Steady State' at 34.2Watts, 530 minutes at 60Watts and over 800 minutes for 100Watts before the temperature stabilised as shown in the following graph.



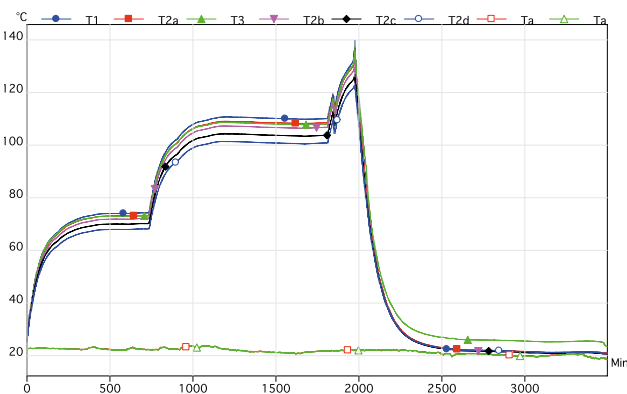
The most concerning results were recorded at the second stage of testing when the bundle of cables are encased in insulation and then the same levels of power were introduced.

Test Date	21/3/2014
Test ID	001B
Wires used	8
Conventional test set-up	Yes
Cable type	LSOH Cat5e UTP
Cable diameter	5.2mm
Installation conditions	28mm X 25mm Foam Insulation
Humidity at test end	40%
Average Conductor Resistance	0.098Ω/m
DC Loop Resistance	19.7 Ω/100m

Temperature Rise above Ambient

Power	T1	T2a	T3	T2b	T2c
Watts	°C	°C	°C	°C	°C
34.2	52.04	51.06	50.89	49.84	47.94
60	88.26	86.6	86.19	84.8	81.84
100	117.61	114.1	115.51	108.02	104.14

As we can see the actual temperature is outside the defined operating temperature range at all levels, $T_a = 22.72^\circ\text{C}$ for this test. So with 100 watts we actually hit a peak of 140.33°C . It also has a major impact on the time to reach 'Steady State' with 740 minutes at 34.2Watts. 1220 minutes at 60Watts. However it took a little over a further 100 minutes from the time that the 100 watts was introduced before the cable failed completely as is shown in the following table.



The catastrophic failure of the cable took us by surprise initially until we did some further research and some additional factors come into play. Firstly the resistance of the overall bundle changes during the heating cycle and that level of change is directly proportional to the temperature of the bundle. This has always been a known factor and is why we have always taken temperature into account when calculating the attenuation over a 100m channel.

The calculation for this is different for screened and unscreened cables using the formulas provided with EN50173-2. We were expecting to see as much as a 10% difference in resistance which is what we got.

However the extreme temperature increase had a major impact on the construction of the cable, the insulating material starts to lose its properties. The first thing that happens is that it starts to go soft and sticky which is again not overly surprising when you consider that the insulating polyethylene compound is extruded on to the conductors at a temperature of $160-180^\circ\text{C}$ therefore the copper conductors can migrate to the surface and eventually short out.

In speaking with compound manufacturers we were advised heating and rapid cooling can start to make the compound re-crystallise and lose some of its dielectric properties. Even if the conductors do not short, the cable will have lost the values that have been designed into the cable, for example Insertion Loss (IL), Return Loss (RL) and Next which are vital elements enabling system performance in line with standards.

Category 6 U/UTP

Test Date	23/3/2014
Test ID	002A
Wires used	8
Conventional test set-up	Yes
Cable type	LSOH Cat6 UTP
Cable diameter	6.2mm
Installation conditions	Free Air
Humidity at test end	40%
Average Conductor Resistance	0.075Ω/m
DC Loop Resistance	15 Ω/100m

Temperature Rise above Ambient

Power	T1	T2a	T3	T2b	T2c
Watts	°C	°C	°C	°C	°C
34.2	14.02	15.89	14.45	15.3	14.17
60	22.9	26.2	23.77	25.35	23.39
100	35.16	40.67	36.82	39.38	36.36

The testing of the Category 6 U/UTP with 0.58mm (23AWG) conductors followed the same process.

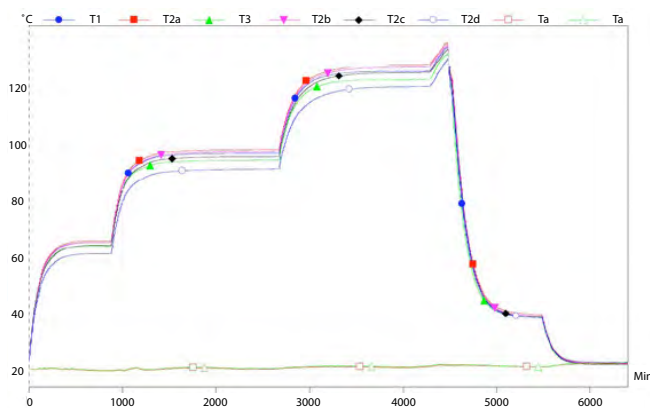
In 'Free Air' the larger cable reached very similar temperatures as the Category 5e of the previous test, however one major change was the time it took to reach 'Steady State' it took 4 times longer at 34.2Watts=720 minutes nearly twice as long for 60Watts at 986 minutes and 1446 minutes at 100Watts.

The insulated values followed a similar trend although we included one additional level for validation purposes of 80Watts.

Test Date	27/3/2014
Test ID	002B
Wires used	8
Conventional test set-up	Yes
Cable type	LSOH Cat6 UTP
Cable diameter	6.2mm
Installation conditions	28mm X 25mm Foam Insulation
Humidity at test end	40%
Average Conductor Resistance	0.075Ω/m
DC Loop Resistance	15Ω/100m

Temperature Rise above Ambient					
Power	T1	T2a	T3	T2b	T2c
Watts	°C	°C	°C	°C	°C
34.2	45.42	46.01	44.15	45.39	44.29
60	76.34	77.55	73.91	76.92	75.26
80	104.66	106.8	101.58	106.14	104.25
100	112.62	114.34	110.11	113.35	111.37

Again the time taken to reach 'Steady State' was much longer, 80% longer for 34.2Watts, twice as long for 60Watts and a full 4,500minutes before it also failed at roughly the same overall temperature as the Category 5e which is over 2.5 times as long.



Therefore whilst the larger conductor size and polyethylene cross filler has slowed the heating process it still reaches the critical mean temperature which appears to be somewhere between 135-140°C before cable failure, this slight variation could be accounted for by variations in the polyethylene compound used.

Category 6 U/UTP (Reduced Diameter)

Next we tested a reduced diameter Category 6 cable. 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 Category 5e.

As already established a combination of the conductor size and the overall outer diameter can have a major impact on the findings of these tests.

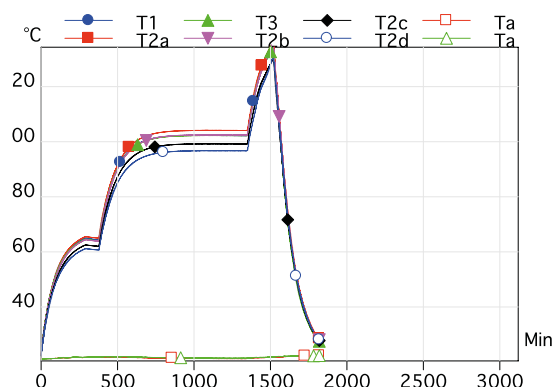
The first indication of the probable performance can be seen when you view the Conductor and DC Loop Resistance values, these are already higher than that of the 23AWG cable, part of which is due to the conductor size being closer to 24AWG at 0.52mm and an overall cable diameter of 5.4mm.

Test Date	5/5/2014
Test ID	006A
Wires used	8
Conventional test set-up	Yes
Cable type	Reduced Cat6 UTP
Cable diameter	5.4mm
Installation conditions	Free Air
Humidity at test end	40%
Average Conductor Resistance	0.082Ω/m
DC Loop Resistance	16.4Ω/100m

Temperature Rise above Ambient					
Power	T1	T2a	T3	T2b	T2c
Watts	°C	°C	°C	°C	°C
34.2	14.73	14.78	14.31	13.7	12.48
60	25.65	26.24	25.78	24.66	21.49
100	41.12	42.09	41.38	39.77	34.83

The next key observation is the time taken to reach a steady state is less than half the time when compared to 23AWG Category 6 cable.

When tested in insulation the Reduced Diameter cable actually failed overall quicker than the regular Category 5e cable.



Category 6 U/UTP (Copper Clad Aluminium)

This was a very intriguing set of test results, on the surface apart from not being solid copper, this cable did meet a number of the performance requirements for a Category 6 U/UTP cable, for example it had 23 AWG conductors, it also had a DC Loop resistance that was just standards compliant at 22.25 Ω/100m the limit being 25 Ω.

However once testing began we found that the heating effects had a huge impact on the resistance of the cable, at first it increased dramatically beyond the 25 Ω mentioned previously. We therefore ran the test once more, this time the cable did perform as expected with a 'Free Air' temperature some 5-6°C above that of the Category 5e and it failed at a temperature some 10°C less when contained within Insulation. The following chart demonstrates the issue that we encountered and the temperature increase appeared closer to one end rather than the middle as seen with every other. We have also included the details of the resistance as a further indication of the risks attached to installation of CCA based cables.

Test Date	8/5/2014
Test ID	007A
Wires used	8
Conventional test set-up	Yes
Cable type	Cat6 CCA
Cable diameter	6mm
Installation conditions	Free Air
Humidity at test end	40%
Average Conductor Resistance	0.11 Ω /m
DC Loop Resistance	22.25 Ω /100m

Temperature Rise above Ambient						
	T1	T2a	T3	T2b	T2c	Resistance/100m
	°C	°C	°C	°C	°C	Ω
Initial Resistance						89
34.2W	16.23	16.20	15.86	15.23	12.86	
60W	28.60	28.48	27.99	27.09	23.07	
92.4W	42.1	42.2	41.8	40.24	34.11	
Final Resistance						99.9
Initial Resistance						DC Loop 22.5
100W	45.50	46.01	44.81	44.16	36.92	
Final Resistance						DC Loop 25.7

Category 6 F/UTP, Category 6_A F/FTP & Category 7_A S/FTP

The remaining cables performed as expected with lower temperatures and longer time taken to reach steady state due to thicker conductors aligned with a larger outside diameter and screening construction. Full results can be made available upon request, however an indication can be found in the Summary Chart of all tests on this page.

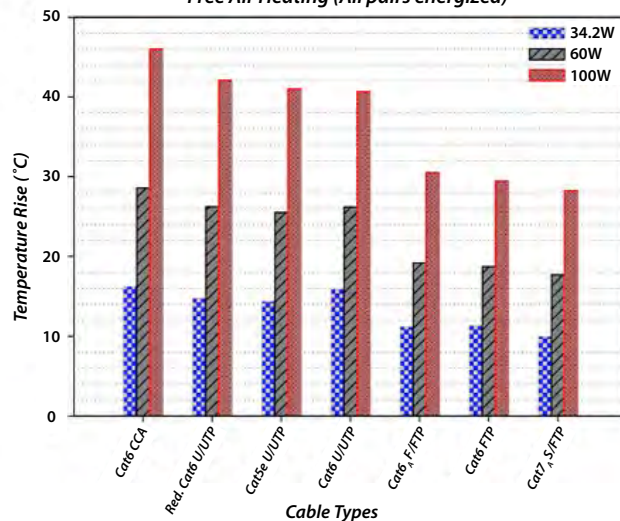
The Category 6 F/UTP is 7.2mm in diameter, as we started to discover the larger the overall diameter of the cable the less it actually heats up, this combined with the Foil screen meant that it reached a steady state at 100Watts without failing. Purely out of interest we pushed the power level up to 107Watts before we damaged the cable, even then it took over 15 hours or 9,000 minutes to reach the overall failure level, remember the reduced diameter cable took just over 1,500 minutes.

Whilst the overall diameter of the Category 6_A F/FTP cable is slightly smaller at 6.9mm along with a combination of more screening material and a lower conductor resistance to begin with meant that whilst the cable reached a higher temperature in Free

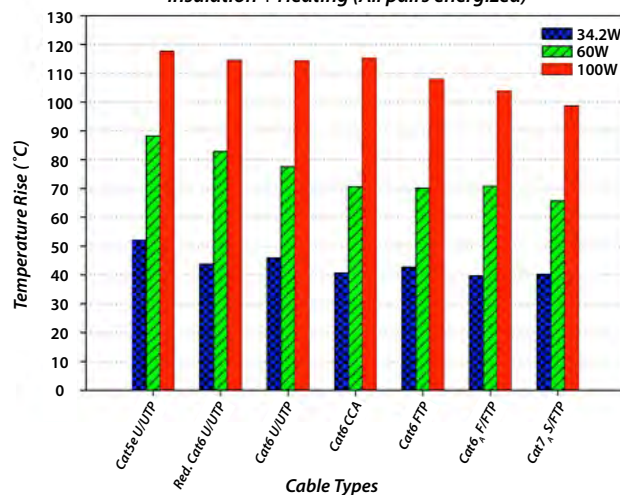
Air when in Insulation it performed better than the Category 6 F/UTP. Once a steady state was reached the cable continued to perform well for a long time, a decision was made not to try and continue to ramp up the power levels just to make it fail.

The same decision was taken with the Category 7_A S/FTP cable which has a 7.8mm OD and an even lower conductor resistance along with a large amount of screening. This cable recorded the lowest temperature level of 98.67°C above ambient at 100Watts as well as reaching a steady state at around 3,000 minutes and not showing signs of going above that point.

Comparison of Temperature Profiles
Free Air Heating (All pairs energized)



Comparison of Temperature Profiles
Insulation + Heating (All pairs energized)



The tables show the complete set of results for the cables tested whilst in insulation however they only indicate the maximum temperatures reached not the time it takes to get to that point, as previously mentioned the Category 5e, HD Category 6 and the Category 6 CCA, all failed very quickly after 100watts was introduced the 23AWG Category 6 U/UTP lasted much longer before it also failed. The common 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_A having both the largest conductors and outside diameter combined with a different screening construction.

continued overleaf



Conclusions

Whilst more analysis of these results will be needed by Cenelec and ISO/IEC before the full recommendations can be published we can certainly draw the clear conclusion that risk of degradation to system performance caused by the impact of remote powering devices over copper communications cables cannot be ignored and should be a key factor when specifying cable constructions, and performance categories.

During this testing we have highlighted that some cables have physically FAILED during the tests. The common temperature being approx 115°C above the ambient temperature, however you must also consider that not all cables are run in spaces that operate at 21°C some can be in air return spaces that have a far higher natural temperature.

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 which exhibit similar heating characteristics as Category 5e cable.

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

$$L_{>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004)$$

$$L_{>40^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004 + (T-40) \times 0,006)$$

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 unscreened cable and when it does the de-rating formula is much simpler as it is based upon 2%.

Screened

$$L_{>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0,002)$$

Taking these calculations at some of the higher operating heat levels we have put forward, an unscreened solution may only ever possibly work at less than 75% of the intended distance.

It gives another very major reason, if it was even needed, why products such as Copper Clad Aluminium should be removed from our market place, as the failure is not just at a lower level than all the others it had a more erratic behaviour.

It is also evident that 4 pair powering has a significant impact on the heat build up witnessed, therefore UPoE is going to have more of an impact as it is rolled out and becomes more common place. When it comes to the proposed 802.3bt it may well be a step too far.

Other proprietary systems should be avoided at all costs the level of power involved is just too much for communications cable intended to transmit data. They claim that it can be run over a standard Category 5e cable but anyone reading these results will think otherwise.

Furthermore as we demonstrated anyone thinking of using a 26AWG solid core cable should seriously think again as it is not just about today it is about tomorrow which brings us on to 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, when they are given an inch want to take a mile?

White Paper

Accelerated degradation of balanced twisted pair performance due to the use of remote powering (PoE+)



Overview

It had been observed during testing carried out in conjunction with De Montfort University in 2014 that heating due to remote powering over twisted pair cables appears to degrade the cable performance. With power heading towards 100W, this could be significant. In fact we even witnessed failure within the cable bundles when thermally insulated and operating at this high power and hence temperature, this was presented in the Proceedings of IWCS 2014.

In this present study, we assessed the performance degradation of balanced twisted pair cable by repeated heating cycles for both temperatures within the standards specification and beyond. It was suspected that repeated heat cycles would lead to accelerated ageing of the compounds used for the dielectric insulating materials around the conductors, which in turn would lead to changes in the performance values of the cables when tested.

Part of these assumptions were based upon work being carried out by SPIE the Specialist Plastics Industry group who are looking to launch similar research in conjunction with UL (Underwriters Laboratory) after they had related concerns regarding the performance of the cladding materials used in fibre cables.

The tests in the study thermally cycle the cable from an ambient of +20 degrees up to an ambient of +70 degrees to see if there is any substantial 'knee point' in behaviour. Also, to assess the performance degradation at elevated temperature, the thermal cycling was extended to about 120°C.

Background of Study

The specification of the IEEE 802.3at includes 60°C as the maximum acceptable operating environment for cabling supporting PoE+. However, the Addendum TIA TSB-184 specified 15°C as the maximum allowable temperature rise above ambient for any cable rated for 60°C. This means, no matter how much power is being pushed down the cable, the number of cables deployed per bundle, the cable type and the installation condition, temperature rise above 45°C for instance, will have to stay within the 15°C limit.

This specification remains a challenge for the Unscreened Twisted Pair (U/UTP) cables, specifically once installed in a restricted heat dissipation environment. This is because the lower categories of cable have smaller conductor sizes and their D.C loop resistance per unit length is higher than that of the higher categories of cable. Category 6_A has a larger cable diameter than the lower categories of cable and therefore does not heat up as much.

In a typical installation where cables exist in a number of bundles and are packed together, they will also possibly experience proximity of heat sources and that could lead to an excessive temperature rise within the cable itself and the surrounding cables. This has been suggested by SPIE as a contributing factor to heat-aging of the cable polymers and the potential performance degradation of the cabling system. Additionally, communication cables may be subjected to different operating and environmental conditions that can also alter their performance.

A study conducted near a return air plenum during the summer period suggested a peak temperature of 40°C. Cables installed in such areas may experience change in temperature that may lead to the modification of the cable properties and could cause attenuation issues in transmission, leading to increased signal attenuation and high bit error rate in some applications.

Experiment Description

The experiment into accelerated age testing was performed on a Category 6 U/UTP cable link. As shown in figure 5 below, the laboratory set up consists of a DSX-5000 Cable Analyzer, kindly supplied to the University by Fluke Networks, with the appropriate permanent link adapters, a set of thermocouple sensors of K type, a wire basket tray, a temperature data logger for the automatic temperature readings from the thermocouple sensors, some heating elements for the purpose of heating the cable externally, Power Supply Units (PSU) that were used for powering the heating elements, a constructed heat chamber and a 50m length of Category 6 U/UTP that was subjected to thermal degradation inside the constructed heat chamber.



Figure 5

The heat chamber is about 2m length and was constructed using a wooden box with a lid. The internal surface of the chamber was lined with an insulating foil. The wire basket tray was raised off the bottom of the box. The heat chamber had two openings on its sides. One opening was used to place the thermocouple sensors on different positions on the cable, while the other opening was used for the mounting of a faceplate that was housing the Category 6 keystone jacks.

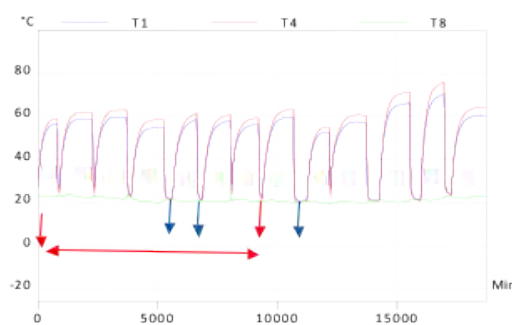
The tests were performed using the upper operating temperature specified within ISO/11801 of 60°C and were later increased to 80°C in order to observe the behaviour of the cable when operating at a temperature above the specified limit. The Category 6 cable sample was spooled loosely and on the wire basket tray and thermocouple sensors were placed in various locations of the cable jacketing material. The cable was kept at a permanent position, inside the heat chamber and without any movement throughout the test period. The measurement ends of the cable were terminated with standard Category 6 keystone jacks.

Before the test began, the main and the remote ends of the Cable Analyzer were connected using the Permanent Link Adaptors. ISO/IEC 11801 Class E test limit was selected on the Cable Analyzer, along with the correct cable type and Nominal Velocity of Propagation (NVP) value was set.

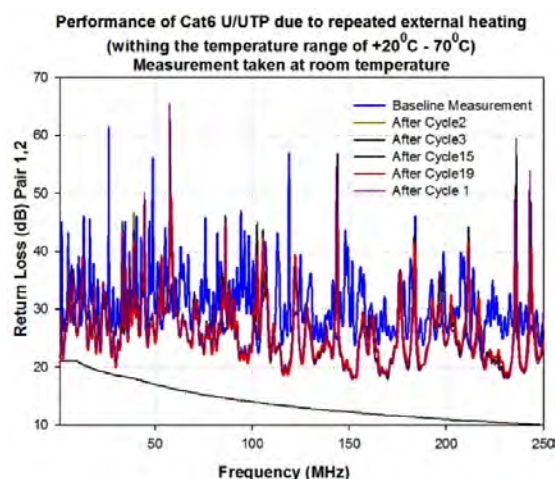
To establish a baseline cable performance and to verify the cable compliance with the ISO1811 class E standard limit, the permanent link adapters were attached to the outlets at the outside of the heat chamber and the certification tests were performed. The measurements taken at an ambient temperature of 23°C before the test began passed the certification tests.

Also, before the heating cycling began, the thermocouples placed on the various locations of the cable were connected to a data logger that allowed the temperature readings to be recorded automatically. During the first heating cycle, the cable sample was tested at an ambient temperature of 20°C. When the temperature on the cable under test had risen to about 10°C, measurements were taken again. For this initial experiment, 25 consecutive heating measurements were made with an increment of 10°C, up to a maximum operating temperature of 70°C. When the temperature on the cable had reached ~70°C, the cable was allowed to cool naturally by turning off the heat source and by taking the heat chamber lid off. The second heating cycle started when the temperature on the cable was at or near room temperature. This process was repeated for 10 heating cycles. After a trend in the cable performance had been observed for 10 heating cycles, another 2 heating cycles (cycle 11 and cycle 12) were carried out using the previous process but with a prolonged heating time.

To gain sufficient information in order to predict the effects of the repeated heating cycles on the cable performance, another 13 heating cycles were carried out. The temperature profile for the last 13 heating cycles is shown in the following.



Return loss has been used in this paper as a good illustration of the cable performance and the following figure shows the Return Loss for several of the heating cycles. It is interesting to observe that the first cycle of heating brought about changes to the overall profile which did not change for the other cycles.



In the previous study in 2014, the catastrophic effects associated with energizing U/UTP cable bundles with 100W were reported.

Similarly, a recent study on the performance of the U/UTP cables has reported high attenuation at elevated temperature. As a result of this, the performance of the U/UTP cables poses a great concern under extreme conditions.

Conclusion and Recommendation

Remote powering is a fact of networked life, aging and degradation is to be expected during remote powering. It can be minimized by avoiding extreme temperatures or by 'running in' the cables by powering them up to get them hot prior to installation (pre-aging) and then rechecking that they still meet specifications. There are two key aspects that this paper impacts. The first is the physical behaviour of the cabling and the second is the implications that this has on the integration of cabling within the building design.

While the reason for changes in the cable data is not specifically understood, some polymer degradation effect is likely, however further research to look at complex permittivity assessment of the dielectrics on their own and as part of transmission will be needed into the physical or chemical changes within the dielectrics.

The second aspect that comes out of this work is associated with integrated building design. As data services in 'smart' buildings become more fundamental to the operation and management of the building, health monitoring and management of the data infrastructure becomes vital to ensuring that other services and operations of the building do not become impaired. This paper has looked at the effects of repeated and extended heating of Ethernet cables. It has demonstrated that while changes to the performance within the 'usual' range of temperatures can cause changes to the performance profile, these are generally within specification. However, should the temperature extend beyond this, the safety margin is not terribly large, with only something like 30 degrees of headroom. This, in itself should be sufficient for most operations. However, consider a bundle of cables

remote powering end equipment and passing through a roof space in a non-air-conditioned building: a bundle core temperature exceeding 100°C may be a possibility. So, what is the implication of this? It is typical that new buildings will be modelled for air-flow, insulation and temperature (for the comfort of those who use the building). The conclusion from this paper is that the simulation also needs to include data cable pathway temperature simulation, which includes potential self-heating effects and those areas with greatest risk of excess heating are monitored and the temperature controlled with the same attention that the equipment at either end of the cable is thermally managed.

Credits

- Florence Akinnuoye – MSc Communications Engineering (De Monfort Univ) studying for PhD
- Professor Alistair Duffy BEng(Hons), MEng, MBA, PhD, CEng, FIET, IEEE Fellow
- Professor of Electromagnetics, De Montfort Univ
- Paul Cave RCDD, RTPM, CDCDP, CNID – Technical Manager - Infrastructure

White Paper

The Use of System Assured Manufacturers Patch Leads in Warranted Channel Systems



Overview

I really didn't know where to start when researching this white paper as the initial background work I did in other facets of Manufacturers Warranties, threw up a number of different ideologies.

Some manufacturers insist that the Warranty is only valid with their patch and work areas cords installed, others take a more pragmatic approach, their testing is based on the permanent link and treat the patch lead almost as a necessary 'disposable' item, certainly at the work area.

However, from personal experience I have found that the majority of the 'reported' faults in a cabling system can be traced back to aftermarket and incorrect category patch cords. I have even witnessed a customer who had spent a six figure sum on the installation of a Category 6A solution, then install Cat6 patch cords to save themselves a few hundred pounds.

In the long term this will be a major false economy!

It is clear that the performance of the channel is most impacted by noise generated in the area of the channel closest to the end devices equipment; therefore it is critical that patch cords properly support the performance requirements of the entire structured cabling system.

Why when making such a major investment to support critical business applications do some organisations risk continued performance by using un-branded patch cords.

It is important that patch cords have the following design features:

- Mated performance through design with connecting hardware to ensure the maximum cancellation of near-end-crosstalk
- A construction that ensures long-term reliability of the network under day-to-day moves, adds and change conditions
- Certified component performance to match the rest of the system

Investing in high quality patch cords ensures the channel components work together as an end-to-end solution to maximize performance and reliability. Various testing scenarios, not least of which is highlighted below provide quantifiable results to support the importance of high quality patch cords.

Mechanical Testing

Besides having properly mated patch cords and connectors to ensure maximum performance during initial installation, patch cords also have to be designed to easily handle frequent moves, adds, and changes. Due to the handling that patch cords receive, it is recommended that mechanical stress testing of patch cords to ensure they continue to operate under real-world conditions be carried out. Patch cords should also be mechanically tested for performance after bending in various configurations.

Conclusions

Patch cords are an integral component impacting the performance of the entire structured cabling system. Investment should be made in patch cords that utilize advanced features to deliver maximum reliability and usability of the network.

As we have seen, some will try and run the risk of saving a few pennies by not using the systems manufacturers patch cords; however before doing so they should take the time to read the freely downloadable 'Copper Cabling Troubleshooting Handbook' from Fluke Networks to see all of the potential pitfalls.

The following will show the test parameters most impacted by poor patch cords. Whilst in the overview the Handbook lists Bad Patch Cords as the number 5 reason, they do go on to clarify that by saying that it would be much higher up the list, as patch cords are not usually present when the installation testing is taking place.



The Test Parameters that can be affected by Bad Patch Cords are:

Insertion Loss – (Attenuation)

- Excessive length
- Non-twisted or poor quality patch cables
- High impedance connections
- Inappropriate cable category

As frequencies increase these factors become even more crucial, so using a patch cord that has not been supplied by the manufacturer of the system may be one false economy too far.

NEXT and PSNEXT

- Poor twisting at connection points
- Poorly matched plug and jack
- Poor quality patch cords
- Bad connectors
- Bad cable
- Excessive compression caused by plastic cable ties

RETURN LOSS

- Patch cord impedance not 100 ohms
- Patch cord handling causing changes in impedance
- Installation practices (untwists or kinks of cable)
- Excessive amount of cable jammed into the Telecom Outlet box
- Bad connector
- Cable impedance not uniform
- Impedance mismatch at junction between patch cable and horizontal cable
- Poorly matched plug and jack

RESISTANCE

- Excessive cable length
- Poor connection due to oxidized contacts
- Poor connection due to marginally attached conductors
- Thinner gauge cable
- Incorrect patch cord type

White Paper

The potential impact of IEEE 802.11ac on copper cabling systems (Part 2)



Further to the Whitepaper we published in early 2015 on the impact of the new IEEE 802.3ac wireless systems, Excel Networking commissioned additional testing in conjunction with De Montfort University, Leicester, UK. This paper will look to outline the initial findings and provide some insights on how any potential effects can be mitigated.

Overview

For obvious reasons the vendors of this new technology, specifically the Ethernet Alliance, do not want to be limited to the number of customers they can sell these devices to because the potential bandwidth implications require an upgrade to the existing cabling installation.

They want to remove the roadblock of legacy cabling effecting higher performance Wifi which has lead to the NGBase-T working group developing new Ethernet speeds.

Therefore the emerging 2.5GBase-T and 5GBase-T standards are designed to support such applications as wireless access points (WAPs). The intended target is for 2.5GBase-T to operate over Category 5e and 5GBase-T over Category 6, whilst there is current debate about whether Category 5e cable should actually be used at all for such applications due to the uncertainty of whether the Category 5e cable (and to extent unscreened Category 6) would not only be effected by the external interference induced by the WAP or other WAPs in the vicinity of the cable, but whether they can support the level of remote powering required to drive the units.

Furthermore, where data cables are used to support intentional radiators, such as wireless hotspots, the cable may become an antenna in its own right and signals will couple to the cable and can be transmitted along it, which could cause a potential problem further down the link.

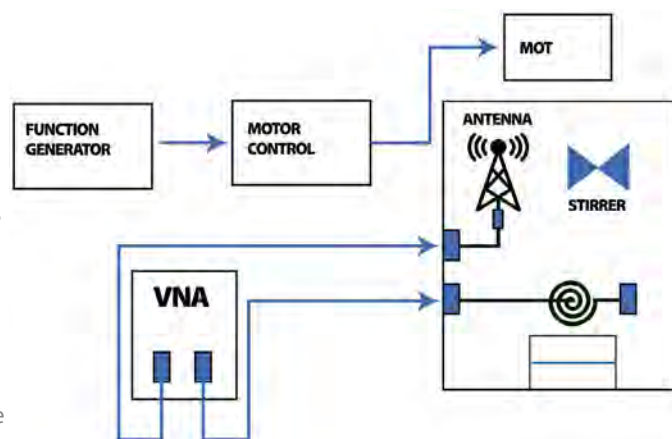
Method Used

A mode stirred reverberation chamber is a useful environment in which to assess cables for such interference because it provides a statistically uniform 'worst case' environment in which to place a cable under test. In this case, the reverberation chamber provides noise coupling to the entire length of the cable under test, finding the most vulnerable coupling points, as might happen in an actual installation.

Because of the unpredictability in the real world environment, a high frequency test method was required rather than using a current probe or the tri-axial method. The reverberation chamber approach was chosen as it is very accurate over a

large frequency range and is tolerant to minor changes.

In using the reverberation chamber, a rotating reflective stirrer altered the 'boundary condition' within the chamber; the purpose of which was to cause large amounts of changes in the standing wave patterns



Test Reverberation Chamber

- Frequency range- 100MHz-6GHz
- Mode tune operation was used.
- Transmitter antenna excited the chamber.
- Receive antenna measured the generated field.
- VNA was used to measure the coupling between the transmit antenna, the receive antenna and the twisted pair under test.

In laypersons terms, we induced a signal to the chamber. We used a stirrer to induce fluctuation into the signal and then we tested the impact on the cable sample.

Given the understanding that screened cable would be fundamentally immune to the effects during this test, both Category 5e and Category 6 unscreened cable were used and the impact was further modified and sampled by just screening the point of termination.

Testing

The frequency range used was between 100 MHz-6GHz and the peak value at each frequency was obtained and that provided the worst case response.

First, all the measuring instruments used in this test were calibrated. Next, the noise floor measurement of the network analyzer was taken. This was done with no source of signal connected to the vector network analyzer. The noise floor is the level of background noise in a signal or the level of noise introduced by the system below which the signal being coupled cannot be isolated from the noise.

TEST 1

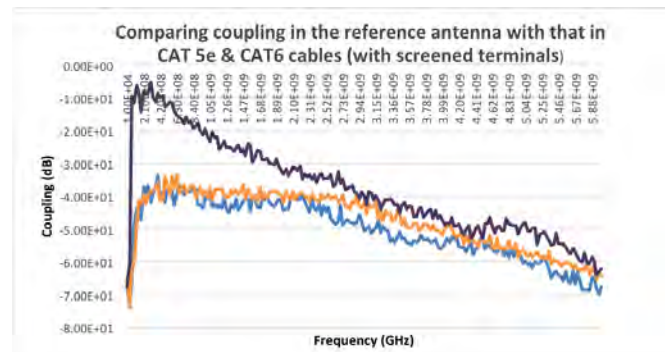
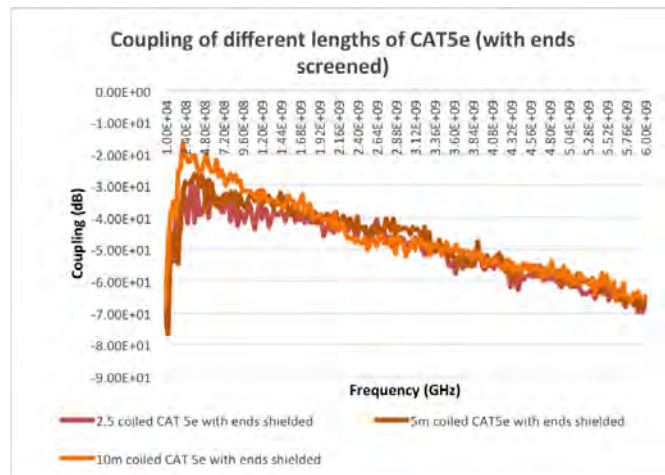
In the first test, 2.5m, 5.0m and 10.0m coiled lengths of Category 5e and Category 6 cables were prepared as described and tested for noise coupling in the chamber with the terminals and connections exposed to electromagnetic waves in the chamber. This test was to investigate if there was any length dependence on the coupling to the cables.

TEST 2

In the second test, 2.5m, 5.0m and 10.0m lengths of Category 5e and Category 6 cables were laid straight instead of coiled (change of orientation) and the same coupling tests were repeated. Here the test was to investigate whether there was any limitation on the way the cable is laid out in the chamber.

TEST 3

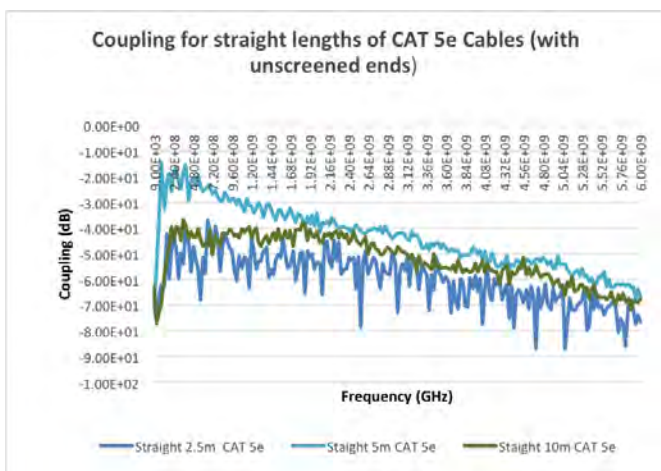
In the third test, the same 2.5m, 5.0m and 10.0m lengths of coiled Category 5e and Category 6 cables were tested with the cable ends and terminations screened. Here the aim was to investigate the influence of exposing the cable ends and terminations from dominating the coupling.



Reference Antenna

Category 5e

Category 6



Conclusion

- The result of test 1 showed that the coupling of noise conducted in the reverberation chamber is length independent. This is shown clearly from the very close resemblance and trend of the couple signals in the three lengths of cables tested. From the result of test 2, there is marginal difference in coupling between Category 5e and Category 6 cables when laid straight rather than when coiled. However, in this test Category 6 coupled less than Category 5e.
- Screening the cable ends and terminations resulted in less coupling in the category cables. This result can be seen in the results from test 3. By screening, the ends and terminations were protected from dominating the coupling.
- Finally, coupling in both category cables were compared with a reference antenna. The result showed that Category 6 coupled less noise than Category 5e.
- Overall, while the rate of coupling is strongly dependent on frequency, the shape of the coupled noise did not significantly change much with respect to cable category.

This research demonstrates that high power wireless APs operating at 5GHz have the ability to induce noise coupling with the cabling. However it is unclear as to the scale of the potential problem this might cause when combined with the higher bandwidths of 2.5Gb and 5Gb, also whether this level of noise coupling will cause an increase in the BER (bit error rate) encountered.

It is commonly accepted that the higher the frequency the structured cabling is operating at, the higher the risk of interference from outside sources, therefore it is clear that screening the terminations and ultimately the cable itself has a significant impact.

The next step for this research is to actively test a permanent link whilst it is being subjected to the same levels of signal as used in this initial research.

Additional Credits

- **Edwin C Arihilam** is currently reading for a PhD in EMC. His main research interests are in EMC, Antenna systems at De Montfort University (DMU), Leicester
- Alistair Duffy is a professor of Electromagnetics at De Montfort University (DMU), Leicester

White Paper

2.5 & 5Gb -A step too far?

– You decide.



Overview

In the last few weeks we have seen a major announcement coming out from the IEEE, followed by the supporting marketing hype from certain switch technology vendors, making several very bold claims which border on the irresponsible.

Back in 2013 the IEEE set up a task force under the designation of NGBase-T which set out to investigate getting higher and higher speeds over copper twisted pair cables. The first task was to try and get 40Gb Ethernet over what has become Category 8 cabling. This was given the designation 802.3bq, the background of which was more about the economics of copper vs fibre interfaces in the switch, rather than anything around a performance upgrade.

The second task, driven by the Ethernet Alliance, came along more recently which saw some additional requirements under the banner of 802.3bz. Its members had realised that there was a potential hurdle in the deployment of Wave 2 802.11ac wireless. This has a theoretical bandwidth limit that far outstrips what can be delivered by existing 1Gb Ethernet provided by Category 5e and Category 6 cabling. Therefore anyone wanting to upgrade their systems and deploy this new technology would also have to re-cable their building.

This has made some companies think twice, due to the additional cost as well as the major disruption it would cause to upgrade the cabling. Not a good result for the equipment vendors.

So, in October 2016 we have seen one of the fastest developed standards being published, which states that 2.5 and 5Gb can be deployed over legacy Category 5e and Category 6 twisted pair cabling. A significant development you might think, unfortunately whilst it may be well intentioned, it is poorly thought out.

The reason for this statement is based on the premise that these Categories of cabling are now going to be asked to support parameters they were never designed for. When the standards were developed the Category 6 standard improved various values including Next and Return Loss values and introduced ACR-F (attenuation to crosstalk ratio – far end) as can be seen below. When Category 6A was introduced, this further introduced AXT (alien crosstalk), so we are now asking the cable to do more than it was intended for. Furthermore the Category 5e cable we installed 10 years ago, as well as the way it was installed, is not the same as what we have and do today, purely because we have had 10 years to learn and make improvements in both aspects.

Channel Performance Comparison

Parameter	Category 5e	Category 6	Category 6A
Propagation Delay	548ns	546ns	546ns
Delay Skew	50ns	50ns	50ns
Insertion Loss	24dB	21,7dB @100MHz 35,9dB @250MHz	12dB @100MHz 8dB @250MHz 6dB @500MHz
Next	30,1dB	39,9dB @100MHz 33,1dB @250MHz	39,9dB @100MHz 33,1dB @250MHz 27,9dB @500MHz
PSNext	27,1dB	37,1dB @100MHz 30,2dB @250MHz	37,1dB @100MHz 30,2dB @250MHz 24,8dB @500MHz
Return Loss	10dB	12dB @100MHz 8dB @250MHz	12dB @100MHz 8dB @250MHz 6dB @500MHz
1PSACR-F	14,4dB	20,3dB @100MHz 12,3dB @250MHz	20,3dB @100MHz 12,3dB @250MHz 6,3dB @500MHz

Above values taken from BS EN 50173-1

Also, note there is no mention in the above table above regarding anything to do with ANEXT as this only appears as a parameter for Category 6A and above.

What has been the reaction of the cabling groups?

Whilst not with the same fanfare, the cabling standards groups have not been sat on their hands either, work has been progressing both within the TIA and ISO/IEC, the former being slightly ahead of the latter.

TIA TR42.7 has been developing TSB 5021

Guidelines for the Assessment and Mitigation of Installed cabling to support 2.5GBASE-T and 5GBASE-T

ISO/IEC TR 11801-9904 is also underway.

Guidelines for Installed Cabling to Support 2.5G/5GBASE-T

continued overleaf

Please understand the titles of both the TIA and ISO/IEC documents, they are Technical Reports or Technical Service Bulletins, are not standards, they are used for mitigation and assessment NOT design, you cannot use them to design a new installation, as explained further in this document.

These documents lay out how to test and assess the existing installation to see if it is possible to support either 2.5 or 5Gb Ethernet on any of the links. TSB 5021 provides details for this testing and if we thought AXT (Alien Crosstalk) testing for 10Gb over unscreened Category 6_A was complex, it has nothing on this latest development.

The basis of the calculations is as follows. You create a 6 around 1 bundle in the same manner as AXT testing and test all victim/disturber combinations, however this should now also be done for 10Mb, 100Mb, 1Gb, 2.5Gb and 5Gb. In total there are 4096 calculations, you then take your worst value which cannot have a value less than 28dB.

5GBps Cat 5e Structured Cabling		Bundling Distance (Metres)											
Victim and Disturber Lengths (Metres)		5	50	45	40	35	30	25	20	15	10	5	0
	100	V	V	V	V	V	V	V	V	V	V	V	Y
	95	V	V	V	V	V	V	V	V	V	V	V	Y
	90	V	V	V	V	V	V	V	V	V	V	V	Y
	85	V	V	V	V	V	V	V	V	V	V	V	Y
	80	V	V	V	V	V	V	V	V	V	V	V	Y
	75	V	V	V	V	V	V	V	V	V	V	V	Y
	70	V	V	V	V	V	V	V	V	V	V	V	Y
	65	V	V	V	V	V	V	V	V	V	V	V	Y
	60	V	V	V	V	V	V	V	V	V	V	V	Y
	55	N/A	V	V	V	V	V	V	V	V	V	V	Y
	50	N/A	N/A	V	V	V	V	V	V	V	V	V	Y
	45	N/A	N/A	N/A	V	V	V	V	V	V	V	V	Y
	40	N/A	N/A	N/A	N/A	V	V	V	V	V	V	V	Y
	35	N/A	N/A	N/A	N/A	N/A	V	V	V	V	V	V	Y
	30	N/A	N/A	N/A	N/A	N/A	N/A	V	V	V	V	V	Y
	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	V	V	V	V	Y
	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	V	V	V	Y
	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	V	V	Y
	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y

= Application Assured, N= Application Not Assured, V=Validate Application with Testing

Table Courtesy of TIA TSB 5021

28dB of what?

Because the IEEE would not agree to it being called AXT we have a new parameter to contend with - Alien Limited Noise to Signal Ratio (ALSNR), in simple terms it is the ratio between Insertion Loss and Alien Crosstalk.

This calculation is also length dependent, both the length of the link as well as the length the cables are bundled together. Within TIA TSB 5021 they do try to provide some form of guidance regarding whether the cable might work or not, unfortunately in the table above these are only single cables or very short links that are only bundled for a very short distance.

For clarification, every combination in Green requires the calculations to be run and only the Grey are said to work.

Unfortunately, there is no simple fix for testing, whilst Fluke have got 2.5 and 5 Gb application tests in the latest DSX, it's only an application based test on the single cable. ALSNR is looking at the impact of the noise coming from the cables around the victim cable, so will require an extension to the existing AXT testing to be able to do that.

Another consideration we must look at is the fact that whilst we have the 'get out of jail card' for Screened Cables when it comes to Category 6_A & AXT the problem is that the vast majority of the Category 5e and Category 6 cable installed,

especially in the UK, is unscreened so susceptible to external noise.

The scale of the potential problem could be huge with customers complaining that their wireless networks are failing to provide the bandwidth their equipment vendor has promised. The blame is likely to be placed on the cabling infrastructure, however the cabling system they installed 5-7 years ago was never intended to support these new parameters.

Conclusion

One saving grace for the cabling community will be the 'Standards' there will be no retrospective action by any of the standards committees to include 2.5Gb and 5Gb Ethernet as supported applications in the Category 5e and Category 6 sections of ISO 11801 or BS EN 50173. Only under Category 6A will they be listed.

Furthermore, there is a clear move within the cabling standards to recommend that all new installations should be of a minimum category to support the latest technology, therefore it should be Category 6A. So the simple answer for anyone considering upgrading their wireless infrastructure to support a higher bandwidth should be, to ignore the marketing hype and factor in the cost of re-cabling if they want guaranteed performance.

White Paper To Screen or not to Screen? – A subject re-visited.



Should Class E_A /Category 6_A cabling installations be Screened?

Overview

The debate rages on in many sectors of the market concerning whether ISO/IEC 11801 Class E_A or Category 6_A 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.

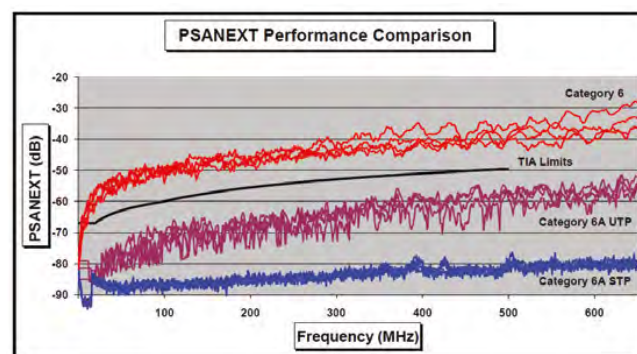
The IEEE 802.3an-2006 standard for 10GBASE-T operation was ratified in June 2006. It defined an application standard for 10 Gb/s data transmission over copper twisted pair cabling of up to 100 metres, it includes the use of both unscreened twisted pair (UTP) and screened twisted pair (STP) copper cabling 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_A and TIA-EIA-568-C.2 Category 6_A 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_A 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_A 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_A 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.

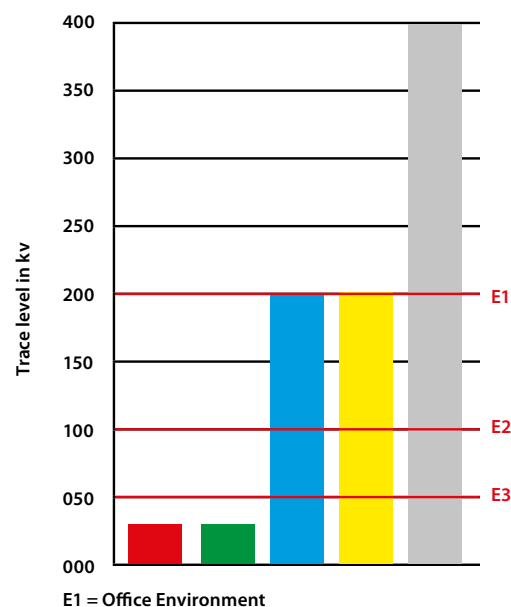
	System 01	System 02	System 03	System 04	System 05
Channel type	U/UTP	U/UTP	F/UTP	S/FTP	S/FTP
Insertion loss (margin) [db]	8.8	8.6	8.6	10.5	15.5
PS NEXT (margin) [db]	5.5	8.2	7.8	5.8	6.2
TCL (margin) [db]	9.2	8.9	9.6	5.45	10.4
RL (margin) [db]	8.8	9.5	3.4	6.9	8.2
PS ANEXT (margin) [db]	-7.6	0.93	27.44	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



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 ed2.2 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

$$L_{t>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004)$$

$$L_{t>40^{\circ}\text{C}} = L / (1 + (T-20) \times 0,004 + (T-40) \times 0,006)$$

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%.

Screened

$$L_{t>20^{\circ}\text{C}} = L / (1 + (T-20) \times 0,002)$$

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 305mm 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

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.



Technical Note

Excel Cable – Liquid Contamination



Author: Simon Robinson

Date: March 2012

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 pigtails, 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 contaminants may have effects 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.

This Technical Note has been produced by Simon Robinson, Product Manager, on behalf of Excel

Technical Note

Installation Guidelines Update – BS7671 Electrical Regulations, 17th Edition, Amendment 3 - 2015



Title: TN21
Author: Paul Cave
Date: February 2015

This technical note covers the changes to the Electrical Regulations that must be followed to comply with installation practices moving forward.

Chapter 52 – Selection and Erection of Wiring Systems

In particular this section of the regulations has seen the significant addition of the following Regulation:

521.11 Wiring Systems in escape routes

521.11.201 Wiring systems in escape routes **shall**⁽¹⁾ be supported such that they will not be liable to premature collapse in the event of fire. The requirements of the Regulation 422.2.1 shall also apply⁽²⁾, irrespective of the classification of the conditions for evacuation in an emergency.

- **Note 1:** Non-Metallic cable trunking or other non-metallic means of support can fail when subject to either direct flame or hot products of combustion. This may lead to wiring systems hanging across access or egress routes such as that they hinder evacuation and firefighting activities.
 - **Note 2:** This precludes the use of non-metallic cable clips, cable ties or cable trundling as the sole means of support. For example, where non-metallic cable trunking is used, a suitable fire-resistant means of support/retention must be provided to prevent cables from falling out in the event of fire.
1. In standards and regulations terminology SHALL means MUST or Mandatory.
 2. 422.2 – **Conditions for evacuation in an emergency (from the existing Regulations and not amended)**

The following regulations refer to conditions:

BD2: Low density occupation, difficult conditions for evacuation

BD3: High density occupation, easy conditions for evacuation

BD4: High density occupation, difficult conditions for evacuation.

Note: Authorities such as those responsible for building construction, public gathering, fire prevention, hospitals etc. may specify which BD condition is applicable.

This Technical Note has been produced by Paul Cave, Technical Manager – Infrastructure, on behalf of Excel

Technical Note

Installation Guidelines Update – BS7671 Electrical Regulations, 17th Edition, Amendment 3 - 2015



422.2.1 In conditions BD2, BD3 or BD4 wiring systems shall not encroach on escape routes unless the wiring in the wiring system is provided with sheaths or enclosures, provided by the cable management system itself or by other means.

What this means.

Escape routes as defined within these regulations could be interpreted as any routes used by the occupants to get into and out of the building both in normal as well as emergency conditions. To avoid any confusion or risk this should therefore be considered as all corridors or passageways within buildings.

This is now of particular importance as it is common practice for these routes to also be used for the distribution of communication cables at high level.

Therefore effective from January 2015 any cables being run at high level shall now be supported by metallic supports along their full length when installed in these areas. This will include, cable tray, metal basket tray and metal 'J Hooks' the latter will be spaced at recognised regular intervals of every 1.5m.(5ft).

Amendments to Excel Installation Guidelines

The use of nylon and 'hook n loop' cable ties to retain communication cables from the underneath of cable or basket tray will not be acceptable.

The use of nylon or 'hook n loop' cable ties to suspend communications cables, irrespective of the quantity, from 'anchor systems' driven into the floor slab at high level will also not be acceptable

Finally, the use of Non-Metallic 'Anchor Systems' for supporting communications cables will not be acceptable.

Technical Note

Changes in US Conec Single-mode MTP Connectors



Title: TN22

Author: Paul Cave – Technical Manager

Date: February 2015

This technical note covers the changes carried out by US Conec to their Single-mode MTP Connectors in the second half of 2014.

Change to APC (angled physical contact) Polish for US Conec MTP Single-mode connectors

In June 18, 2014 – US Conec, a global leader in the design and development of high-density optical interconnections, announced the immediate availability of single-mode pre-angled thermoplastic MT ferrules. The unique pre-angled design eliminates a polishing fixture, minimizing the polishing time during the production process, all while improving the overall performance of the MT ferrule.

At the same time they also announced they would be phasing out support of PC (physical contact) for single-mode applications. As of September 2014 we could no longer source PC ferrules for single-mode MTP connectors.

The 8 degree APC polish on single mode MTP connectors has improved the overall performance of the connector as well as providing a route for other future enhancements in performance.

What this means.

As of October 2014 Excel Networking will only be supplying APC MTP connectors for all Single-mode applications, this includes, Trunk Cables, MTP Patch/Equipment Leads, Cassettes and Fan-out assemblies.

All Single-mode part numbers will remain unchanged.

NOTE:

- This action will have no affect on any Multi-mode products or part numbers.
- Excel Networking only uses the low loss MTP Elite connector from US Conec in its systems.

Technical Note

Change to Excel Multi-Fibre Colour Code Standard



Title: TN24

Author: Paul Cave – Technical Manager

Date: May 2016

This technical note covers changes to all standard Excel multi-fibre Tight-Buffered and Loose-Tube cables.

Excel Tight-Buffered and Loose-Tube cable fibre colour coding will be changed from the current DIN standard to TIA-598. The change will be implemented over the following 12-months beginning June 2016.

Existing stocks of DIN colour standard cables will be depleted over the coming months.

NOTE that this change affects the fibre colour coding only. There are no other changes except the printing on the cable jacket will now include 'TIA-598'.

NOTE that the 12-fibre cables are unaffected.

A cross reference list showing the colour sequence of both TIA and DIN is below.

TIA-598			DIN		
1		Blue	1		Red
2		Orange	2		Green
3		Green	3		Blue
4		Brown	4		Yellow
5		Slate	5		White
6		White	6		Slate
7		Red	7		Brown
8		Black	8		Violet
9		Yellow	9		Aqua
10		Mauve	10		Black
11		Pink	11		Orange
12		Aqua	12		Rose
13		Blue with markers	13		Yellow with LONG markers
14		Orange with markers	14		White with LONG markers
15		Green with markers	15		Slate with LONG markers
16		Brown with markers	16		Aqua with LONG markers
17		Slate with markers	17		Orange with LONG markers
18		White with markers	18		Rose with LONG markers
19		Red with markers	19		Yellow with SHORT markers
20		Black with markers OR Clear	20		White with SHORT markers
21		Yellow with markers	21		Slate with SHORT markers
22		Mauve with markers	22		Aqua with SHORT markers
23		Pink with markers	23		Orange with SHORT markers
24		Aqua with markers	24		Rose with SHORT markers

Technical Note

Class E / Category 6 Extended Distances



Title: TN02a_Cat6_Over_length

Author: Simon Robinson

Date: December 2010

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

100BASE-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).

This Technical Note has been produced by Simon Robinson, Product Manager, on behalf of Excel

Excel Partner Programme

Section 15

In this Section:

- [Excel Accredited Partners](#)
- [Benefits and Requirements](#)
- [Excel Partner Services](#)
- [Excel Toolbox Training](#)
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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, Enbeam 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 Enbeam 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, St Neots, Scotland 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 3 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

Sign up to become an Excel Partner

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_A 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_A 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.

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.

Excel System Warranty

Section 16

In this Section:

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- [What is covered by the warranty?](#)
- [What isn't covered by the warranty?](#)
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Excel System Warranty - Terms & Conditions

This document covers:

- Excel Copper



- Excel Enbeam Fibre Optic



- Excel Voice Cabling



- Excel Environ Range

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 that benefit from a warranty, 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.

[Find out more about the Excel Partner Programme](#)



Excel System Warranty

The Excel System Warranty provides a 25-year product and applications warranty, providing 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.

[Find out more about the Excel Warranty](#)



How does it work?

Once site testing has been completed, the Excel Partner visits the [Excel Partner Area](#) 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 Application Process' segment or the '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)
- Modified Permanent Link (Patch Panel to Field terminated RJ45 plug)
- 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 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 a blown fibre solution are covered by the Excel 25 Year Warranty. The blown fibre system, including, but not limited to multi-tube cables and the blowing of the fibre element, shall be installed by personnel trained and certified by the manufacturer.

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.

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.

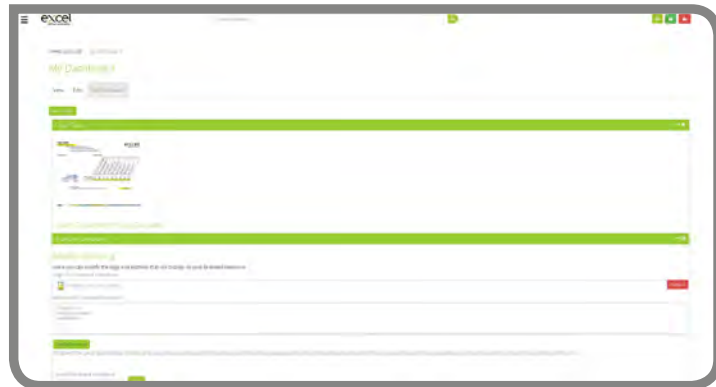
Click on the 'Partner Area' – you will be required to enter your email and password to enter this area. The link to the 'Partner Area' is at the very top of the webpage.

If you are an accredited Excel Partner and you haven't yet registered for the 'Partner Area' please email admin@excel-networking.com 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**

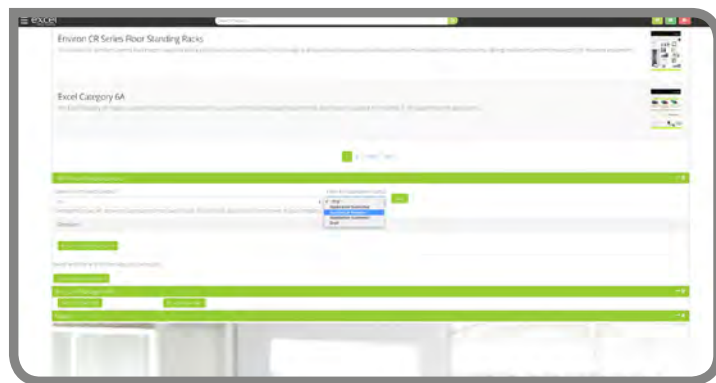


Step Three

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 'Create Warranty Application'



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.

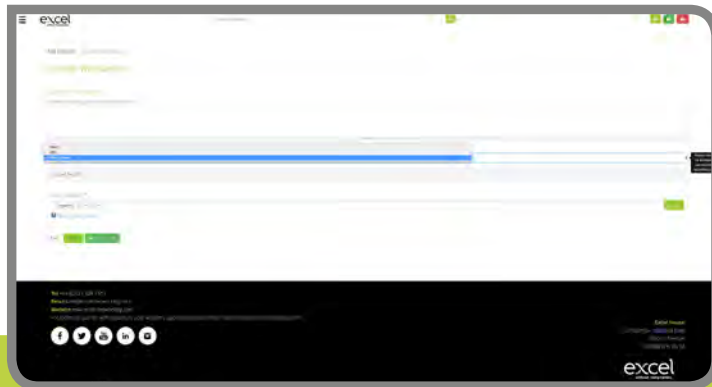
Please take care to include correct and accurate information as these details will be checked against the test results and inconsistencies in the information will result in your application being rejected.

These details will also be listed on the Warranty Certificate that is produced at the end of the process.

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.

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.

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) – Shall be tested as a modified permanent link.
Switch links shall be made from Excel patch leads (solid or stranded) and patch panel ports. The warranty does not cover non Excel 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.

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 G/Category 8 warranty

An installation must be tested to Category 8 performance and 100% link tests must be performed using Level IV 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:

<https://www.excel-networking.com/25-year-warranty>



Requirements for Class G/Category 8 warranty

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class II.

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class G protocols.
- Guaranteed backward compatibility.

Class F_A/Category 7_A warranty

An installation must be tested to Category 7_A performance and 100% link tests must be performed using Level IV 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:

<https://www.excel-networking.com/25-year-warranty>



Requirements for Class F_A/Category 7_A warranty

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class F_A or EN50173 Class F_A

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class 7_A protocols.
- Guaranteed backward compatibility.

For a full list of protocols supported by the Excel Category 7_A warranty, please refer to Appendix A.

Class E_A/Category 6_A warranty

An installation must be tested to Category 6_A performance and 100% link tests must be performed using Level IIIe 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:

<https://www.excel-networking.com/25-year-warranty>



Requirements for Class E_A/Category 6_A warranty

- A copy of your Excel training certificate.
- Excel or approved equivalent patch cords must be installed.
- Test to ISO11801 Class E_A or EN50173 Class E_A.

Successful warranty applications will receive a 25-year certification confirming:

- Compliance with the standard tested.
- Support of current and future Class E_A protocols.
- Guaranteed backward compatibility.

For a full list of protocols supported by the Excel Category 6_A warranty, please refer to Appendix B.

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:

<https://www.excel-networking.com/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 C.

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:

<https://www.excel-networking.com/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 D.

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, OM5, OS1, OS2	2.55	1.95	1.8	1.8
OF-500	OM1, OM2, OM3, OM4, OM5, OS1, OS2	3.25	2.25	2	2
OF-2000	OM1, OM2, OM3, OM4, OM5, 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:

- Length
- Continuity report
- Cable construction type and pair data



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 7_A/Class F_A – defined 1000 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 ₁ /S ₂	ITU-T I.431
ISDN	S ₀ Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S ₀ Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S ₀ -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_A/Class E_A – 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 ₁ /S ₂	ITU-T I.431
ISDN	S ₀ Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S ₀ Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S ₀ -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 C

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 ₁ /S ₂	ITU-T I.431
ISDN	S ₀ Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S ₀ Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S ₀ -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 D

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 ₁ /S ₂	ITU-T I.431
ISDN	S ₀ Star	EN 50098-1:1998/A1 (ITU-T I.430)
ISDN Basic Access (Physical Layer)	S ₀ Point-to-Point	ITU-T I.430
ISDN Basic Access (Physical Layer)	S ₀ -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

End User Client			
Project:			
Company:			
Address:			
Contact:		Tel No.:	
Excel Partner			
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?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	n/a <input type="checkbox"/>

Installed Cabling

Copper System	Cat 5e <input type="checkbox"/> Cat 6 <input type="checkbox"/> Cat 6 _A <input type="checkbox"/> Cat 6 _A (with 7 _A Cable) <input type="checkbox"/> Cat 7 _A <input type="checkbox"/> Cat 8 <input type="checkbox"/>	Unscreened <input type="checkbox"/> Screened <input type="checkbox"/>	No. of outlets:
Enbeam Fibre System	OM 1 <input type="checkbox"/> OM 2 <input type="checkbox"/> OM 3 <input type="checkbox"/> OM 4 <input type="checkbox"/> OM 5 <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 _A <input type="checkbox"/> Cat 6 <input type="checkbox"/> Cat 5e <input type="checkbox"/>			

Enbeam 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				

Environ 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"/> Environ CL <input type="checkbox"/>			
	Other (specify)			
	Green	Amber	Red	Notes
Rack grounded				
Patch Panel individually bonded to rack				
Cables dressed correctly and neatly in racks				

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

Copper	
Tester used	
Configuration	Permanent Link <input type="checkbox"/> Channel <input type="checkbox"/>
Standard	EN <input type="checkbox"/> ISO <input type="checkbox"/> TIA <input type="checkbox"/>
Correct NVP	
Test adapters used	
Firmware/Software version	
Fibre	
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:

You can download an electronic version of this form for your own use or for sending out on a USB. The form is available to download from www.excel-networking.com.

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Excel Reference Sites

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Listed below are examples of projects across various vertical markets and countries.

Automotive	Country	Copper	Fibre	Environ Racks
Audi Aberdeen	UK	Category 6 _A	OM3	Environ CR Racks
Campus Motor Noia	Spain	Category 6 _A UTP	-	-
Enterprise Rental Car - Egham	UK	Category 6, Category 5e	OM3	-
Leyland Digitech	UK	Category 6 _A U/FTP	OS2, OM1	-
Lookers	UK	Category 5e, Category 6	-	Environ CR & WR Racks
Renault Nissan	UK	Category 6 _A	OM3	Environ SR Racks
Rolls Royce Aerospace Divison	UK	Category 6 _A F/FTP	OS2	-
Rolls Royce Derby 2015	UK	Category 6	OM3	-
Salon de l'automobile	Belgium	Category 6 UTP	-	-
SMP Mercedes	Hungary	Category 6 _A	OM4	-
Volvo	Spain	Category 7 + Category 6 _A FTP	OS2	-
VW HQ	UK	-	-	Environ ER Racks
VW Milton Keynes	UK	Category 6A	OM4, OS2	-
Volkswagen	Spain	Category 6 UTP	-	-

Banking and Finance	Country	Copper	Fibre	Environ Racks
ACCA	UK	Category 6 _A	OS2, OM3	-
Ardian	France	Category 6 _A	OM3	Environ CR Racks
Ascor	France	Category 6 _A F/FTP	OM3	Environ CR Racks
Cecabank	Spain	Category 6 _A U/FTP	-	-
Collier Capital	UK	Category 6 _A F/FTP / U/FTP	OM4	-
Creston Insurance	UK	Category 6 UTP LOSH	OM3	Environ Racks
Edificio Camoes-Porto CGD	Portugal	Category 6 UTP	-	-
Emirates NBD Bank	UAE	Category 6 U/UTP	OM4	Environ ER Racks
FCA	UK	Category 6 _A F/FTP	OM4, OS2	-
FTI Consulting	UK	Category 6, Category 6 _A U/UTP	OM3, OS2	-
Grant Thornton	France	Category 6 _A	-	Environ CR Racks
Ince & Co	UK	Category 6 UTP	OM4	Environ ER & CR Racks
ING Bank	UK	Category 6 UTP	OM3	-
JLT	UK	Category 6 _A F/FTP	OM3	-
Mako	UK	Category 6 _A U/FTP	-	-
National Bank of Oman	Oman	Category 6 _A F/FTP	OM4	-
Price Forbes	UK	Category 6 UTP	OM3	Environ SR & ER Racks
Real Insurance HQ Building	Kenya	Category 6	OM3	Environ ER Racks
Rokos/ Mergermarket	UK	Category 6 U/UTP	OM4	Environ SR Series
Stanbic Bank	Ghana	Category 6 LSOH	OM3	Environ SR Racks
UBAF	France	Category 7 _A	OM4	-
West Bromwich Building Society	UK	Category 6 _A F/FTP, U/FTP	OM4	-

Central Government	Country	Copper	Fibre	Environ Racks
Astro	Belgium	Category 6 _A U/UTP	OM3	Environ ER Racks
Castellon Prison	Spain	Category 7	-	Environ ER Racks
CMA Lille	France	Category 6 _A U/FTP	OM2	-
Cuba Government Infra	Cuba	Category 6 _A UTP, Category 5e UTP	-	-
Cuba Main	Cuba	Category 5e F/UTP	-	Environ WR Racks

Customs Chamber Krakow	Poland	Category 7 _A	-	-
DGCA	Kuwait	Category 6 _A	OM3	Environ ER Racks
Doha Souq	Qatar	Category 6 LSOH	OS2	Environ ER Racks
Ethiopian Press Agency Ministry	Ethiopia	Category 6 UTP	OM2 Armoured	Environ ER Racks
Ethiopian Road Authority	Ethiopia	Category 6 UTP	OM2 Armoured	Environ SR Racks
General Prosecutor	Azerbaijan	Category 6 U/UTP	-	Environ ER Racks
Glasgow Recycling Centre	UK	Category 6 SWA	OM3	Environ ER Racks
Leeuwarden Town Hall	Netherlands	Category 6 _A U/FTP	-	Environ CR Racks
Lens Prison	France	Category 6 _A U/FTP	OM3	Environ SR Racks
Ministry of Industry & Commerce	Bahrain	Category 6 _A U/UTP	OM3	-
Prison Aix En Provence	France	Category 6 _A U/FTP	OM3	Environ CR Racks
QBC 05	Austria	Category 6 _A F/FTP	-	Environ CR Racks
RAF Marham	UK	Cat 6 U/UTP, Cat 6 F/UTP	OM1, OM3, OS2	Environ CR Racks
ROP Accommodation	Oman	Category 6 U/UTP	OM3	-
Statens Kartverk	Norway	Category 6 _A F/FTP	OS2	-
Victoria Street	UK	Category 6 _A U/UTP	OM4	Environ ER Racks
World Trade Center Gibraltar	UK	Category 7	OS2	Environ ER Racks

Commercial	Country	Copper	Fibre	Environ Racks
Abertis	Spain	Category 6 _A U/FTP	OM4	Environ ER Racks
Air Liquide	France	Category 6 _A U/FTP	OM3	Environ ER Racks
Akers Project	UK	Category 6 _A U/FTP	-	-
C.C. Atrium Bengela (Angola)	Angola	Category 6 FTP & UTP (No cable)	-	Environ Racks
Capital Market	Kuwait	Category 6 _A U/UTP	OM3	Environ Racks
Chesterford Research Park - Plots 600 & 700	UK	Category 6 UTP	-	-
DAMAC, Corner Tower	UAE	Category 6	OM3	Environ Racks
Duke Street	UK	Category 6 UTP	-	Environ CR Racks
Egee Tower	France	Category 6 _A U/FTP	OM3	Environ CR Racks
Messe Congress Graz	Austria	Category 6 _A F/FTP	-	-
Mutuelle Des Motards	France	Category 6 _A U/FTP	OM3	Environ CR Racks
Project Everest	UK	Category 6 _A U/FTP S/FOIL	-	-
Southbank Tower	UK	Category 6 U/UTP	OS2, OM4	Environ ER & CR Racks
Sunguard St Matthews House	UK	Category 6 UTP, Category 6 _A U/UTP	OM3	Environ ER Racks
Office Refurb		Category 6 U/UTP		
Witchem Project	Poland	Category 6 U/UTP	-	-

Construction	Country	Copper	Fibre	Environ Racks
Al Raha Developments	UAE	Category 6 _A	OS2	Environ ER Racks
Baku Shipyard Project	Azerbaijan	Category 6	-	Environ ER Racks
Beagle	UK	Other	OS2	Environ CR & SR Racks
CityWalk - Plot 2,3,4,7	UAE	Category 6	OM3, OS2	Environ ER Racks
Company Facilities Development	UAE	Category 6 UTP	OS2	Environ ER Racks
Conexdata	France	Category 6 _A F/FTP	-	-
Fibre Lima	Peru	-	OM4	-
Habtoor Residences	UAE	Category 6 UTP	OS2	Environ ER Racks
Marina Gate Tower	UAE	Category 6 UTP	OM3, OS2	Environ ER Racks
Mott McDonald	UK	Category 6, Category 6 _A U/FTP	OM4	Environ ER Racks
Saint Gobain	UK	-	-	Environ CR Racks
Saint Gobain	France	Category 6 _A	-	-
Sugar Factories Phase 2	Ethiopia	Category 6 UTP	OS2	-
Thames View	UK	Category 6 _A U/FTP	-	Environ CR Racks
Wasl Buildings	UAE	Category 6	OS2	-



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Data Centre	Country	Copper	Fibre	Environ Racks
Ark	UK	Category 6 _A	OM4	-
Bristol Data Centre	UK	Category 6 _A U/UTP MTP	OM4	-
CDL Hindley Street Data Centre	UK	Category 6	-	-
Costain Data Centre	UK	Category 6 _A F/UTP	OM4	Environ ER Racks
Department of Economic Development - Datacentre	UAE	Category 6 _A F/FTP	OM4, OS2	-
Infinity Data Centre 2013	UK	Category 6 & Category 6 _A	OM3, OM4, OS2	-
Mazoon Data Center	Oman	Category 6A U/UTP	OM4	-
MSM Data Center	Oman	Category 6 U/UTP	OM3	-
Rackspace DC	UK	Category 5e UTP	OS2, OM4	-
Rackspace Hayes	UK	Category 5e	OM3, OS2	-
RAX Phase 2	UK	Category 5e	OM4 & OS2	-
Schroders HQ	UK	Category 6 _A U/FTP	OM4 & OS2	-

Education	Country	Copper	Fibre	Environ Racks
BAM Schools	UK	Category 6 UTP	-	-
Bradford College	UK	Category 6 UTP	-	-
Catalunya Schools	Spain	Category 6 _A UTP	-	Environ CR Racks
City University 2015	UK	Category 5e	OM3	-
Compton School	UK	Category 5e Category 6	OM1	-
DBS Schools	UK	Category 6 U/UTP	OM3	-
Edukáció	Hungary	Category 5e	-	-
Hawassa University	Ethiopia	Category 6 _A F/FTP	OM4	Environ CR Racks
Interserve Schools	UK	Category 6 UTP	OM3	Environ ER & WR Racks
Kayseri Integrated Hospital	Turkey	Category 6 U/UTP	-	-
KCL Bush House	UK	Category 6 _A F/FTP	-	-
Kings College Frame work	UK	Category 5e U/UTP, Category 6 _A F/FTP	OM4, OS2	Environ ER Racks
London BSF Schools	UK	Category 6 UTP, Category 6	OM3	-
LOR 3 Project	UK	Category 6 UTP	-	-
Maura & Nordkisa schools	Norway	Category 6 _A U/FTP	-	-
North London Schools	UK	Category 6 UTP	-	-
Oxford Uni Institute	UK	Category 6 _A U/UTP	OM3	Environ Racks
Pembroke Learning	UK	Category 6 _A U/FTP	OM4	Environ ER Racks
PPP Campus	France	Category 7 _A	OS2	Environ CR Racks
Priority Schools Building Programme	UK	Category 6 UTP	OM3	Environ ER Racks
Red.es Spanish Schools Rioja	Spain	Category 6 _A U/UTP	-	Environ WR Racks
Richardson Road, Newcastle Uni	UK	Category 6 _A U/FTP	OS2	Environ ER Racks
Schools Project	UK	Category 6 UTP, Category 5e UTP	OM3	Environ CR Racks
Schools Project UCS	UK	Category 6 UTP	-	Environ SR & CR Racks
Schools Project 2015	UK	Category 6	OM3	Environ ER Racks
Unite Student Accommodation 2015	UK	Category 5e	OM3	Environ Racks
Univ of Northampton	UK	Category 6 _A F/FTP	OM4, OS2	Environ ER Racks
Urban Sciences, Newcastle Uni	UK	Category 6 _A U/FTP	OS2	-
Bow School				Category 6 U/UTP

Enterprise	Country	Copper	Fibre	Environ Racks
ADP	Spain	Category 6 _A UTP	-	Environ Racks
CLH	Spain	Category 6 _A (U/UTP)	-	-
Coca Cola	UK	Category 6 _A	-	-
Cofidis	Spain	Category 6 _A UTP	-	-
GE Green office building	Hungary	Category 6 UTP	OM1	Environ Racks
GE new office Budapest	Hungary	Category 6 U/UTP	-	Environ Racks
GWC Warehouse	Qatar	Category 6 LSOH	-	-
Hogan Lowells	Spain	Category 6 _A UTP	-	-

Ingram Micro	Spain	Category 6 UTP	-	-
K23 Business Park	Norway	Category 7 _A	-	-
London Metal Exchange	UK	Category 6 U/UTP	OM3	Environ ER Racks
MNCT Project	Poland	Category 6 _A U/UTP	OS2	Environ Racks
Mostoles Industrial, S.A. (Moinsa)	Spain	Category 6 FTP	-	-
Nueva Sede Aecom	Spain	Category 6 _A U/FTP	-	-
Nuevas Oficinas Tecnomcom	Spain	Category 6 UTP	-	-
PepsiCo	UK	Category 6	-	Environ CR Racks
PT Export Project	Portugal	Category 6 U/UTP	-	-
Sony Project	UK	Category 6 _A F/FTP / U/FTP	-	-
Teschnisches Rathaus KA	Germany	Category 7	-	-
TMA	France	CAT6a S/FTP	OM3	-

Health	Country	Copper	Fibre	Environ Racks
Birmingham NHS	UK	Category 5e Category 6 _A	OS2	Environ CR Racks
Blood Bank	Kuwait	Category 6 U/UTP	OM3	Environ CR Racks
BUPA T3	UK	Category 5e	OM3	Environ CR Racks
Bupa T4	UK	Category 5e U/UTP	OM3, OS2	Environ CR & WR Racks
Childrens Hospital	Finland	Category 6 _A U/FTP	OM3 / OS2	-
EBI / PH2	UK	Category 6 _A FTP	OM3 & OS2	-
Ehpad Plougastel	France	Category 7 _A	OM2	Environ CR Racks
Glan Clwd Hospital Phase 4B	UK	Category 6	OS2	-
Health Care Group	UK	Cat 5e U/UTP, Cat 6 U/UTP	-	Environ CR & WR Racks
Hopital Herlev	Denmark	Category 6 _A (U/UTP)	-	-
Muhas Medical Centre	Tanzania	Category 5e	OM2	Environ Racks
Primary Health Care Center(PHCC)	Qatar	Category 6 _A U/UTP	OM3	Environ Racks
Project Care Homes	UK	Category 6 UTP	-	-
Royal Liverpool Hospital	UK	Category 6 _A Category 7 _A	OS2 OM3	-
Scottish National Blood Transfusion	UK	Category 6 _A U/FTP	OS2	Environ ER Racks
BUPA Salford	UK	Category 6 _A F/FTP	OM4	Environ ER & SR Racks
Servicio salud Castilla León (Local NHS in a Castilla-León)	Spain	Category 6 UTP	-	-
Siilaisten Terveyskeskus	Finland	Category 6 _A U/FTP	-	-
Spire Hospital	UK	Category 6	OM3	Environ CR Racks
Tartu Univ. Clinic	Estonia	Category 6 UTP	OS2	Environ Racks
TPP	UK	Category 6 _A U/FTP	OM4	-
Ulster Hospital - Castlecourt	UK	Category 5e	OM3	Environ ER Racks
Wolverhampton NHS/Wifi Roll Out	UK	Category 5e U/UTP	-	-

Local Government	Country	Copper	Fibre	Environ Racks
4 Ministries - Phase 2	Ethiopia	Category 6	OM2	Environ Racks
Albi theatre	France	Category 6 _A F/FTP	OM3	Environ Racks
Ayuntamiento de Vitoria	Spain	Category 6 UTP	OM3	Environ CR Racks
Bergen City Hall	Netherlands	Category 7 _A	OM3	Environ Racks
Cargate Police Station - West Yorkshire Police	UK	Category 6	-	-
DGA Toulon	France	Category 6 _A	OM3	Environ SR Racks
Eastleigh and Wessex House	UK	Category 6 _A U/FTP	OM3	Environ Racks
Gdansk Police Station	Poland	Category 6 U/UTP	-	-
Mairie De Paris	France	Category 6 FTP	-	Environ Racks
NTIIP	UK	Category 6 U/UTP	OS2	Environ CR Racks
PMC	France	Category 6 _A F/FTP	OM3	Environ CR Racks
Police Sports Unioun	Safat	Category 6	OM3	-
Police Stations Rollout	UK	Category 6	-	Environ Racks
Syddanmark	Denmark	Patchcords	Patchcords	-
Täby Kommun	Sweden	Category 6 UTP	-	-

Wakefield Police HQ	UK	Category 6	-	-
Wolverhampton Civic Centre	UK	Category 6 _A F/FTP	OM4	Environ ER Racks

Manufacturing	Country	Copper	Fibre	Environ Racks
Araymond	France	Category 6 _A U/FTP	OM3	-
Biodata Innovation Centre	UK	Category 6 _A F/FTP	-	-
Changan	UK	Category 6 _A	OM3	-
DS Smith Packaging	UK	Category 6	OM4	Environ CR Racks
Dyson 3	UK	Category 6	-	Environ CR Racks
EMAL - Emirates Aluminium	UAE	Category 6 LSOH	OM3, OS2	Environ Racks
Faist Insonit	Spain	Category 7, Category 6 FTP Components	-	-
Fanuk	UK	Category 7 _A S/FTP	OS2	-
Fjernvarme Fyn	Odense	Category 6 _A	-	-
Heineken Breweries	Ethiopia	Category 6	-	Environ Racks
HJ Enthoven	UK	Category 6 _A	-	-
Imperial Tobacco Phase 2	UK	Category 6 U/UTP	OM4	-
MOOG Warehouse Tewkesbury	UK	Category 6 _A F/FTP	-	Environ Racks
MWW Birmingham	UK	Category 5e U/UTP	-	Environ CR & SR Racks
QCON Factory	Qatar	Category 6 U/UTP	OM4, OS2	Environ CR Racks
TATA	UK	Category 6	OM4	Environ ER Racks
TEEKAY Petrojarl	UK	Category 6 _A U/UTP	OM3	Environ ER Racks
Transfix	France	Category 6 _A F/FTP	OM3	Environ CR & ER Racks

Media	Country	Copper	Fibre	Environ Racks
Al Arab News Channel	Bahrain	Category 6 _A F/FTP	-	-
Anuntis	Spain	Category 6 UTP	-	-
BBC	UK	Category 6 _A U/FTP	OM3	Environ CR Racks
Clear Channel	UK	Category 6 _A U/FTP / F/FTP	-	Environ ER & SR Racks
Editorial Planeta	Spain	Category 6 UTP	-	-
FRANCE 5 (french channel)	France	Category 6 _A	-	-
France Television	France	Category 6 FTP	-	Environ Racks
Havas Village	Spain	Category 6 UTP	-	Environ CR Racks
IMG Media Chiswick	UK	Category 6	OM3	Environ ER Racks
ITV Trafford Wharf	UK	Category 6 UTP	OS1	-
MCS	France	Category 6 _A U/FTP	-	-
News UK	UK	Category 6 _A U/FTP	OM4	-
PUBLICIS 2	UK	Category 6 UTP	OM3	Environ ER Racks
Publicis/40 Chancery Lane	UK	Category 6 UTP	OM3	Environ ER Racks
Streym International Broadcasting Centre	UK	Category 5e	-	-
Which Magazine	UK	Category 6 UTP	OM4, OM3	Environ SR Racks
Yoigo	Spain	Category 6 U/UTP	-	Environ CR Racks

Petrochemical	Country	Copper	Fibre	Environ Racks
ADNOC Buildings	UAE	Category 6 _A	OS2	Environ Racks
ALSTOM	France	Category 6 _A	-	Environ CR Racks
BP Building E.	UK	Category 6 _A U/FTP	-	-
BP MTP Project	UK	Category 6 _A U/FTP	OM3, OS2	Environ Racks
C M Leeds	UK	Category 6 UTP	OM3	Environ Racks
Drengsrudbekken	Norway	Category 7 _A	-	-
Exxon Mobil	Iraq	Category 6 UTP	-	-
Paint Factory	Safat	Category 6 _A U/UTP	-	-
Refineria Repsol	Spain	Category 6 UTP	-	Environ Racks
Schlumberger Total	France	Category 6 _A F/FTP	OM3	-

Property	Country	Copper	Fibre	Environ Racks
CBRE	France	Category 6 _A	OM4	-
Cundalls	UK	Category 6 UTP / Category 6 _A UTP	-	Environ SR Racks
DAMAC Water Edge Serviced Apartments & Hotel	UAE	Category 6	OM3, OS2	Environ Racks
Howard de Walden Estates	UK	Category 6 U/UTP	-	Environ CR Racks
London Apartments Hampstead	UK	Category 6 UTP	-	Environ CR Racks
Stockholm Apartments	Sweden	Category U/UTP	-	-
Urban Village Swansea	UK	Category 6 _A FTP	OM3	Environ CR Racks
Your Homes Newcastle	UK	Category 6 UTP	OM3	Environ Racks
Zoopla	UK	Category 6 UTP	OM3	Environ CR Racks

Residential	Country	Copper	Fibre	Environ Racks
55 Villas	Doha	Category 6	-	Environ Racks
Al Difaf City	Sudan	Category 6 UTP	-	-
Al Jumanah Tower	Qatar	Category 6 U/UTP	-	Environ WR Racks
Al Raha Towers	UAE	Excel Category 6 (U/UTP)	OS2	Environ WR Racks
Blackfriars	UK	Category 6	OM3	-
Broadgate Leeds	UK	Category 6	OM3	Environ Racks
Burj Al Shaya / Mahboul Residence	Kuwait	Category 6 UTP	-	-
C15 City of Light	UAE	Category 6 _A F/FTP	OM3	Environ ER Racks
C98 Building	UAE	Excel Category 6 (U/UTP)	OM3	-
Chiswick Apartments	UK	Category 5e	OM3	-
Dubai Municipality - Staff Accommodation Kifaf	UAE	Category 6 _A (U/UTP)	OS2	Environ CR Racks
Link Tower	UAE	Category 6 _A U/UTP	OS2	Environ WR Racks
Marina Gate Tower2	UAE	Category 6 (U/UTP)	OS2	Environ CR Racks
Prospect Heights	UAE	Category 6 _A F/FTP	OM2	Environ Racks
The Hills by Emaar	UAE	Category 6 (U/UTP)	OS2	Environ ER Racks
Viva Bahriya 12 & 13	Qatar	Category 6 U/UTP	OS2	Environ WR & ER Racks

Retail, Leisure and Hospitality	Country	Copper	Fibre	Environ Racks
ACCOR	UK	Category 5e UTP LSOH	-	-
Al Maryah Mall	UAE	Category 6 UTP	OS2	Environ Racks
Aldi Stores Phase 2	UK	Category 6 UTP	-	Environ CR Racks
Arcadia	UK	Category 6 _A U/FTP, F/FTP	OM3	-
Asda Scales	UK	Category 6 UTP, Category 5e UTP	-	-
Aviapolis	Helsinki	Category 6 _A U/FTP	-	-
Iceland	UK	Category 5e UTP LSOH	-	Environ WR Racks
Bateen Marina Hotel & Resort	UAE	Excel Category 6 _A (U/UTP)	OM3	Environ CR Racks
Boomerang	Sweden	Category 6 UTP	-	-
Burberry - 1 Page Street	UK	Category 6 _A U/FTP	OM4	-
Dunkin Donuts & Taco Bell	UK	Category 6 _A (U/UTP)	-	-
H & M 2016	UK	Category 6 UTP / FUTP	OM3	Environ CR Racks
Heron Food Store	UK	Category 5e U/UTP	-	-
Mandarin Hotel & Resort	UAE	Category 6 _A U/UTP	OM3	-
Primark-Reading	UK	Category 6 _A F/FTP	OS2, OM4	-
Radisson Blu Hotel, Dubai Silicon Oasis	UAE	Category 6 _A U/UTP	OM3	Environ ER Racks
Salwa Beach Resort - Hilton	Qatar	Category 6 U/UTP	OS2	Environ ER Racks
Snow Hill Offices	UK	Category 6	OM3	Environ CR Racks
Stella Hotel	UAE	Category 6 U/UTP	OM3	Environ CR Racks
Stoke On Trent CBD	UK	Category 6 UTP	OM3	Environ CR Racks
Tottenham FC	UK	Category 6 _A F/FTP	OS2	Environ ER Racks
Turku Theatre	Finland	Category 7 _A S/FTP	-	Environ WR Racks
Warsan Souk (Village)	UAE	Category 6 _A U/UTP	OS2	Environ ER Racks



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Woolsley Roll Out	UK	Category 5e U/UTP	-	Environ Racks
Al Wathba Resort & Hotel	UAE	Category 6 _A / Category 6 U/UTP	OM3	-
Aloft Hotel	UAE	Category 6 U/UTP	-	-
Bright Start Beach Resort	UAE	Category 6 LS0H	-	-
Carlson Wagonlit Travel	France	Category 6 _A U/FTP	OM3	Environ CR Racks
Double Tree by Hilton	UAE	Category 6 UTP	OM3	Environ Racks
Four Seasons Hotel	UAE	Category 6	OM3 & OS2	Environ Racks
Four Seasons Hotel	UK	Category 6	OM3	-
Hyaat Regency Paris	France	Category 6 F/UTP	-	-
Hyatt Rostov on Don, Russia	Russia	100-191, Category 6 _A U/FTP	OM3	-
Madinat Jumeirah - Phase IV	UAE	Category 6	OM3	Environ ER & SR Racks
Marriott Hotel	UAE	Category 6	-	-
Park Plaza Hotel	UK	Category 6 UTP	OM3	Environ ER Racks
Premier Inn Roll Out	UK	Category 5e, Category 6	OM3	Environ Racks
Roomz Hotel	Austria	Category 6 (U/UTP)	-	-
Stadium Wifi	UK	Category 6 UTP	OM3	Environ WR Racks
Tala Hotel & 4 seasons Resi	Kuwait	Category 6 LS0H	OS2	-
Walt Disney - Hammersmith	UK	Category 6 UTP, Category 6 U/FTP, Category 6 _A	-	-
Warner Bros Theme Park	UAE	Category 6 _A U/UTP	OM3 / OS2	Environ Racks

Transport	Country	Copper	Fibre	Environ Racks
Abell and Cleland	UK	Category 5e	-	-
Aeroport Marseille	France	Category 6 F/utp	-	Environ Racks
AQABA Port	Jordan	Category 6 _A U/UTP	OS2	-
AVANCAR	Spain	Category 6 _A UTP	-	-
Brakes Portabury Docks	UK	Category 6 UTP	OM4	Environ ER & CR Racks
Bristol Airport	UK	Category 6 _A U/FTP, Category 5e	OM3 / OS2	Environ CR Racks
Clipper Northampton	UK	Category 5e UTP	OM4	Environ CR Racks
DHL East Midlands Airport	UK	Category 6 U/UTP	OS2, OM4	-
Highways Agency	UK	Category 6 UTP	OM3	Environ ER Racks
HQ ADP	France	Category 7 _A	OM3	-
JNIA Cargo Expansion	Tanzania	Category 6	-	Environ Racks
Kapsch Carrier Com	Austria	Category 6 _A U/UTP	-	-
Luton Airport Redevelopment	UK	Category 6 _A F/FTP	OS2	Environ ER Racks
National College High Speed Rail	UK	Category 6 _A U/FTP	OM3	-
Oman International Container Terminal (OICT)	Oman	Category 7 _A	OS2	Environ Racks
Puerto de Algeciras	Spain	Category 6 UTP	OS2, OM3	-
Renfe	Spain	Category 5e UTP	-	-
SBG	Oman	Category 6 PVC	OM4	-
Stockholm Underground	Sweden	Category 7 _A	-	-
Terex Trucks	UK	Category 6	OS2	Environ CR Racks
Thameslink Hornsey	UK	Category 6 FTP	-	-
Zublin Ports	UAE	Category 6	OM3	Environ Racks

Case Study

Elior Group HQ in Egée Tower

Customer	Elior Group HQ in Egée Tower
Location	Paris, France
Equipment	Excel Category 6 _A U/FTP 1x4p and 2x4p Cabling, Environ SR Racks, Excel Enbeam Fibre Optic OM3 Cabling, Excel PDUs, 9,000 toolless butterfly-style keystone jacks with all the connectivity and accessories.

Customer's View

"Elior Group Headquarters made the decision to move into new offices in the Egée Tower across 15 floors (from 24th to 39th), and wanted to ensure a smooth transition so as not to disturb the day-to-day operations of the company within the fast-moving and competitive food services industry. With the installer, GTIE Tertiaire, being an accredited Excel Cabling Partner, Elior Group was confident that the Excel solution would satisfy all requirements of the project, which had been designed specifically with the Group's transformation plan in mind. Among other things, the plan focussed on accelerating business growth into wider international markets, optimising costs and supporting operational excellence. The high performance, quality reputation and renowned reliability of the Excel product portfolio were critical in the Excel products being the chosen solution for this project."

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Elior Group is a global player in the contracted food and support services industry. As the caterer of choice in the world of business, education, healthcare, travel and leisure, they operate in 16 countries as a leader in their main markets; Europe, North America and Latin America. In keeping with the Group's 2016-2020 Strategic Plan, the Group plans to bring their activities under the same roof in the Egée Tower in a bid to offer a collaborative, innovative and ergonomic workplace designed to foster team spirit and optimise efficiency.

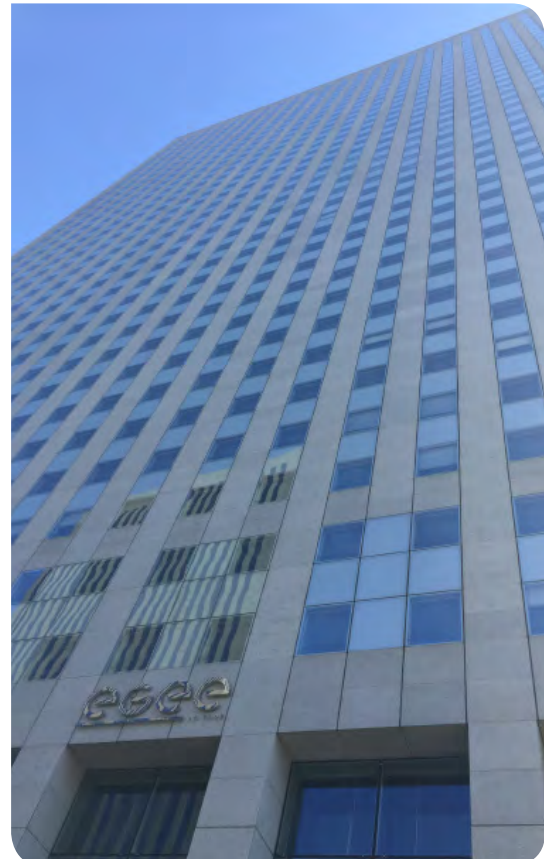
The Requirement

To optimise the performance of the organisation to exceed customer expectations in a competitive and fast-moving industry, by installing a brand new cabling system with top quality products.

Sourcing a Partner

GTIE Tertiaire is a general contractor in electrical works who have been operating in the Parisian region for a number of years. With experience in a diverse range of markets (energy networks, lighting, security, fire detection and centralised technical management), GTIE Tertiaire have a strong level of expertise to produce high quality installations.

Having been an accredited Excel Cabling Partner for a number of years, GTIE Tertiaire are also entitled to a 25 year warranty for all their installations, providing piece of mind to clients such as Elior Group. Having worked with Excel's comprehensive range of products for a



number of years, they are up-to-date on the latest additions to the product portfolio and are in a strong position to promote and recommend the full solution as they trust the quality of the Excel product range. With this knowledge of the products and the brand, GTIE Tertiaire was able to specify and install products based on their ability to fulfil the end user requirements.

The Right Product

The nature of the business operations in this project meant that it was essential for the chosen solution to boast end-to-end capability, high quality, reliability and simplicity to install. The Excel solution was chosen for these reasons. With accolades across a diverse spectrum of vertical markets including a host of similar installations in tall office tower environments, the installer and end-user could rest assured that the Excel range was suitable for the purpose.

The product portfolio from Excel constitutes an end-to-end solution where performance and ease of installation are pre-requisites. With an emphasis on compatibility and standards compliance from cable to cabinet, reliability and product availability, Excel is the complete trusted solution. With a strict deadline by which Elior Group's employees needed to be transitioned into the new building meant it was crucial that the chosen solution was flexible to meet changing requirements easily, which Excel was. Not only was there a tight timeline for the project, but the offices were also on and above the 24th floor of the Egée Tower, which made the installation trickier, however the versatility of the packaging options of the Excel product portfolio helped to alleviate the difficulties that could have been encountered. What's more, the products are covered by a 25 year warranty because they were installed by an accredited Excel Partner, providing the end user with the assurance that they were receiving a high quality, trusted solution at the right price.



Excel products are Delta verified. Excel has invested in such test and verification programmes for over 15 years, Third party verifications are seen as an independent tick in the box. As well as testing the component and channel, the manufacturing facilities are visited for spot checks to ensure the consistent quality in the manufacturing process. The certification, compliance to standards and full warranty for the installing party contributed to Excel Networking Solutions being chosen as the right product for the project.

Design and Installation

APM, an Excel Distribution Partner and specifier for this project, designed the complete infrastructure solution to meet the requirements of Elior Group. It was crucial that the employees' transition into the new building was as smooth as possible, and that the end result helped to facilitate an improved efficiency of the organisation's various activities through high-speed connectivity across reliable equipment and infrastructure.

Excel Enbeam Fibre Optic OM3 cabling was chosen to support the future proofing of the installation. Excel's OM3 cabling solution has been designed to be compact, lightweight and extremely flexible and simple to install. The cables are constructed around swellable reinforced yarns as common strength members containing up to 24 colour coded 900µm tight buffered fibres, covered with a flame retardant, low smoke zero halogen, outer sheath. Fibre also provides an extremely reliable backbone for data transmission back to the core, whilst also being immune to lots of interference, caused by other services within a building, there are no issues with the data transfer. This was especially important for this project, where the Elior Group offices would sit within the

Egée Tower in amongst other company offices. A solution that supported the reduction of interference and the improved transference of data was vital. The capabilities of the fibre allowed the network to be design to work with the vast size of the facility and installation, giving the ability to offer 1000BASE-SX (Gigabit) Ethernet in the backbone of distances up to 550 meters, or 10GBASE-SR/SW (10 Gigabit) up to 300 meters.

Excel Category 6_A cabling was chosen as it takes the performance capabilities of copper infrastructure to new levels, which was a particular requirement for this project. The cable is designed to exceed the ISO/IEC, TIA and CENELEC for Category 6_A component requirements, delivering high performance over distances of up to 90 meters, which is essential for a site such as this which spreads across 17 floors of an office tower. The new system supports several applications including 10GBASE-T, (10 Gigabit Ethernet) adding to the future proofing nature of the installation. This product also lends it-self to any high definition bandwidth hungry video footage requirement, making it perfect for Unified Communications (UC), where emerging technology can be leveraged to its full potential, within a progressive and forward think company. Each cable consists of two sets of two pairs wrapped together in an "S" configuration with high quality, strong, aluminium/polyester foil tape providing screening for each pair. The "S" Foil configuration ensures separation of the pairs that ensures the performance. The individual pairs are set to different lay lengths to ensure optimum performance.

9,000 Excel Category 6_A Keystone Jacks were loaded into 230 unloaded Excel patch panel frames. A rear management tray with purposely designed cable tie positions is supplied with each panel for added longevity and protection of the installed cabling. These accessories perfectly accompanied the Excel Environ ER Racks that housed the installation in the Egée Tower Comms Room, protecting the infrastructure equipment and keeping the connections safe and secure in a locked environment thanks to the dedicated Environ Locking Solution. The ER Series offers 600Kg load rating, and exceptional mounting space allowing the installation to house the structured cabling and accompanying switches, servers or networking equipment. The Environ ER Racks were complemented by 110 Excel PDUs, which are each composed

of 8 NFC (French Style) plug sockets. Horizontally mounted into the Environ cabinets for a higher density solution, the PDU units supported the appropriate management and distribution of power across the entire installation.

The duration of the project lasted from March until October 2016. Given this tight timeline, it was important that the installation was accurate and professionally finished with minimal interruptions, hence the accredited installer being chosen to ensure maximum project efficiency and allow for employees to be able to "move in" to their new premises by August. This was not achieved without its challenges; there were delays on completing the renovation of the comms room, which inevitably caused a delay to the installation of the racks and consequently the remaining equipment and accessories. However, despite these adversities, the project was completed on time, and the 1,200 staff members were able to situate themselves in the new offices by October 2016, benefitting from high-speed connectivity, minimal interference and complete efficiency in terms of networking.

The Result

Following the successful installation of the Excel products into the designated Egée Tower office areas, Elior Group has transitioned 1,200 employees over 15 floors of the Egée Tower in the La Défense business district of Paris. This transition encompasses the move of three of the Group's core activities; Elior France, the contract catering brand (Business & Industry, Education and Healthcare), Areas (France and Northern Europe), the concession catering brand, and Elior Services. Furthermore, Elior France, in conjunction with up-market brand Arpège, will manage all the inter-company catering activities in the Tour Égée. The catering spaces and concepts will be accessible all day long to meet the demand of all employees occupying the 1 floors of the tower building. Elior has also set up a room service for VIPs attending meetings and to accommodate working lunches, as well as a catering service for the Tour Égée business center.



Case Study

The Ritz Paris

Customer The Ritz Paris

Location Paris, France

Requirements An end to end solution offering high performance

Equipment Category 7_A S/FTP Cable, Category 6_A jacks, Environ Racks, Excel Fibre

Installers Comment "We needed a product that could meet our technical specifications and provide a quality solution at the same time as being sympathetic to the character and history of our unique building. The Excel solution installed surpassed our expectations and provided us with a 25 year warranty, giving us peace of mind for the future".

Phillippe Vareille, Technical Director, the Ritz, Paris

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The Ritz Paris is a hotel in central Paris, in the 1st arrondissement. It overlooks the octagonal border of the Place Vendôme at number 15. The hotel is ranked among the most luxurious hotels in the world and is a member of "The Leading Hotels of the World".

The hotel, which today has 159 rooms, was founded by the Swiss hotelier, César Ritz, in collaboration with the chef Auguste Escoffier in 1898. The new hotel was constructed behind the façade of an 18th century town house, overlooking one of Paris's central squares. It was among the first hotels in Europe to provide a bathroom en suite, a telephone and electricity for each room. It quickly established a reputation for luxury, with clients including royalty, politicians, writers, film stars and singers. Several of its suites are named in honour of famous guests of the hotel, including Coco Chanel and Ernest Hemingway who lived at the hotel for years.

The grandest suite of the hotel, called the Imperial, has been listed by the French government as a national monument in its own right.

The Requirement

The Ritz Paris was undergoing a total refurbishment which required a network infrastructure which could support a whole host of guest services including wireless networking, telecoms, lighting and a state of the art CCTV system. The chosen solution also needed to offer substantial future proofing and have the backing of a reputable warranty.



Sourcing a Partner

The hotel was working closely with OGER International who were the consultants overseeing the entire system renovation project and also in conjunction with Bouygues Construction, the general contractor involved with this grand project. Bouygues Construction is a global player in its field and is active in 80 countries. Their team design, build and operate buildings and structures which improve the quality of the living and working environment of their users.

CCF Distribution, a specialist distributor of infrastructure solutions, amongst other things, has been in business for many years and has a very strong presence in the Paris region but also throughout France due to its 10 agencies. They were chosen for this prestigious project due to their ability to provide the right products and support required and expected by the customers.

The Right Product

CCF is an Excel Distribution partner and has been working on major projects with the Excel product range for almost 10 years. They were more than happy that the Excel product portfolio could deliver what was required by The Hôtel Ritz. 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 cabinet', reliability and product availability, Excel is the complete trusted solution.

When a system is installed by an Excel Cabling Partner a 25 year warranty can be awarded. The Excel warranty provides a 25 year product and applications assurance of compliance with industry

Performance standards appropriate to the class of cabling being installed. It covers copper, fibre, voice and even the Environ range of racks.

Design and Installation

The character and history of the building needed to be preserved but the infrastructure installed needed to support the very best of services that clients would expect from this type of establishment.

This needed to be taken into consideration when selecting the right Excel products to deliver the levels of service required by the hotel.

Excel Category 7_A S/FTP cables both single and dual versions formed the basis of the network infrastructure. These cables are designed and manufactured to meet and exceed ISO, CENELEC and TIA standards. This delivers Class FA link and channel performance supporting all applications detailed and proposed within the standards. The cables are also ETL verified.

A Category 7_A cable has increased performance levels, opposed to a category 6 or 6_A system, when operating devices via PoE (Power over Ethernet). This made the Excel cables a perfect choice for the hotel when taking into consideration the requirement for WiFi access throughout and the CCTV system to be implemented.

Excel OM3 50/125µm tight buffered optical fibre cables have been designed specifically for internal and external applications. These compact, lightweight cables are extremely flexible and are quick and easy to install.

Excel Category 6A low profile screened keystone jacks, were mounted into Excel keystone jack patch panel frames. The low profile jacks are a reduced size toolless termination RJ45 socket. The reduced size allows for multiple cable entry directions to be accommodated when this jack is mounted in a standard depth back box. This permits many mounting options including flush shutters at the outlet as well as more common angled shutter used with keystone jacks. The socket itself is housed in a high quality zinc die cast housing, which opens at the rear in a butterfly manner to reveal the IDC termination points.

Excel Environ ER Racks were chosen to house all of the equipment. Forty black 42U 800 x 800 racks were used, each with ventilated mesh front doors. The Excel ER rack has advanced vertical management which allows for the racks to operate extremely effectively as a solution when bayed together as they aid inter rack connectivity.

CCF held stock of the Excel products being used on this project and shipped products directly from their distribution centre based in Nanterre. The location of the distribution centre allowed for deliveries to be made as and when required without experiencing any hold ups or delays.

The Result

The Ritz Paris reopened on 6 June 2016 after a major four-year, multimillion-dollar renovation. A hospitality technology platform has also been implemented within the hotel which has enabled staff to gain access to the various services available via any device whatever their location. All of these additional services have contributed to the hotel being able to consistently deliver first class customer service, all supported via the Excel infrastructure solution installed.





Case Study Top Interieur

Customer	Top Interieur
Location	Antwerp, Belgium
Requirements	An end to end solution for a new system with a full warranty
Equipment	Excel Category 6 _A U/UTP and OM3 Fibre

Customer's View

The end client needed a first class offering for their high end furniture store and required a system that was not only reliable but also guaranteed, if anything was to go wrong. The entire project lasted one year and came up against a number of challenges which needed a resolution in a short space of time. The Excel solution offered this and gave our client peace of mind. Overall the design and installation was carried out to their exceptionally high standards.

Werner Moens, Sales Manager 4K NV



Top Interieur is a large high end furniture store with a number of outlets throughout Belgium. Their showrooms present the latest interior design ideas, for all areas of the home, accommodating a wide range of tastes and budgets.

The company was expanding to open a new branch in the Antwerp region. They needed to ensure the look and feel of their store and the furniture it displayed and sold was backed up with a high tech end to end solution, to guarantee that its customers experience of shopping with Top Interieur was a first rate one.

The Requirement

Their 30 000m² new building required a high performance system to operate their entire network. A continuous running system with multi-functional capabilities was essential for the store with reassurance that the installation could be backed up by a 25 year warranty. The project needed to be completed to a strict deadline as the opening date for the store was set and could not be moved.

Sourcing a Partner

Electro Zwijsen a technical service provider that specialises in all branches of electrical engineering and data communication was chosen for the project. Electro Zwijsen offers its customers a total solution with the installation of active components and copper and fibre optic cables.

All of their engineers have been coached and trained by manufacturers themselves, to keep up to date with the latest techniques. This is how Electro Zwijsen guarantees reliable and high quality results for each project.

Electro Zwijsen worked closely with 4K. Established in 1993, 4K started out as a solution provider in passive components such as cabling, heat shrink tubes and connectors on the Belgian market.



Nowadays 4K is considered a full-service company, well known amongst broadcasting, data networking and telecom as well as industrial market segments on the Belgian market and abroad for both its active and passive solutions.

4K prefers to develop long term business relationships and only works with selected partners who are authorities in their specific field, Electro Zwijsen fitted this criteria and has worked with 4K for over 10 years.

4K themselves have been distributing the Excel product range for over 5 years as an official Excel Distribution Partner.

The Right Product

Excel structured cabling products provide an end-to-end solution where products are designed, manufactured, supported and delivered without compromise. Excel is the complete trusted solution as it offers compatibility and standards compliance 'from cable to cabinet', reliability and product availability.

A 25 year warranty can be awarded, when a system is installed by an Excel Cabling Partner. The quality and support delivered by partners are of a key importance and due to this Excel continually assess their partners throughout EMEA by providing classroom and online training courses.

The Excel warranty provides a 25 year product and applications assurance of compliance with industry performance standards appropriate to the class of cabling being installed. It covers copper, fibre, voice and even the Environ range of racks.

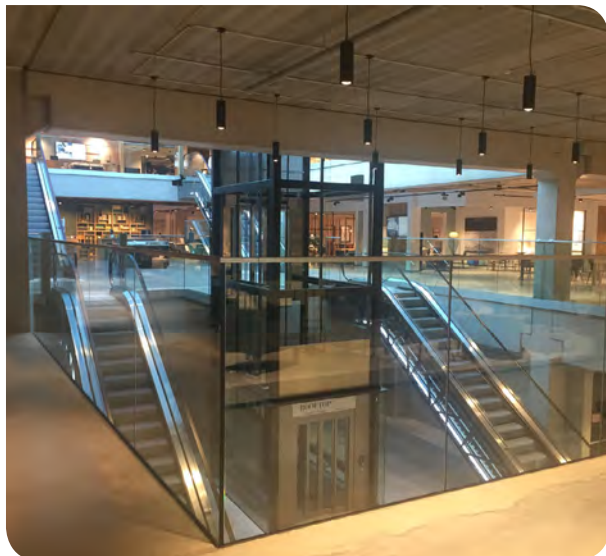
Design and Installation

Excel Category 6A cabling was chosen to form the basis of the solution. This 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, 6A/Augmented component requirements. This delivers Class EA/ Augmented Category 6 link performance over distances of up 90 metres which supports the applications including 10GBASE-T, (10 Gigabit Ethernet). This product also lends it-self to any high definition bandwidth hungry video footage requirements.

The cable is metre marked which counts down from 500 metres to 1 metre, on each drum to reduce waste. This was useful for Electro Zwijsen as there was a strict budget in place and being conscious and careful of waste was a priority.

Excel Category 6A Low Profile Unscreened Keystone Jacks where loaded into keystone jack patch panel frames. A rear management tray with purposely designed cable tie positions is supplied with each panel which is fitted without the need for any tools or fixings by simply snapping it into place.

One of the largest challenges that Electro Zwijsen faced was the sheer size of the facility that the system was being deployed in. This created the need for very careful, thoughtful planning of rack locations, to ensure all links standard were



maintained and all cable runs were within the max distance and performance parameters.

Finally Excel OM3 50/125µm tight buffered optical fibre cables were installed. These fibre cables have been designed specifically for internal and external applications. These compact, lightweight cables are extremely flexible and are quick and easy to install. The cables are constructed around swell able reinforced yarns as common strength members containing up to 24 colour coded 900µm tight buffered fibres.

The use of fibre gave some significant benefits in completing the job. The fibre was deployed to link the comms racks situated in various locations throughout the store, together which in turn negated any issues with runs that would have been over length for a traditional copper link. Fibre optics allow for large amounts of bandwidth to be transmitted, so it was the ideal choice for the backbone when linking the racks together.

Fibre provides an extremely reliable backbone for data transmission back to the core, whilst also being immune to



lots of interference, caused by other services within a building, there are no issues with the data transfer.

The installation took place in a huge building where numerous contractors were working on different aspects of the system, each working to tight deadlines to ensure the project was delivered on time.

The Result

The Top Interieur is an extravagant furniture store providing their customers with a unique shopping experience. The future proofed infrastructure system, installed in its new store ensures that its facilities can deliver a unique shopping experience at all times for its visitors.



topinterieur®

Case Study

Zoopla and uSwitch

Customer	Zoopla and uSwitch
Location	London, England
Requirements	Infrastructure System capable of hosting networking, wireless and audio visual systems
Equipment	Excel Category 6 _A cable and modules, Category 6 cable and modules, 12 Core OM3 fibre cable, Patch Panels, Environ ER and OR racks

Customer's View

"The project carried out by NM Cabling Solutions was delivered to schedule with no hold-ups. The provision of a 25 year warranty due to their Excel Cabling Partner status was one of the reasons why we decided to work with them and the Excel product range again".

Mr Joel Callaway, IT Operations Manager, Zoopla

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Zoopla is the UK's most comprehensive property website, focused on empowering users with the resources they need to make better informed property decisions. Zoopla helps consumers both find their next home and research the market by combining hundreds of thousands of property listings with market data, local information and community tools.

Zoopla's aim is to make the market more efficient for both property consumers and advertisers alike. Zoopla has rapidly become the UK's leading online destination for property consumers to search for homes and do their market research and the favoured online marketing partner for UK estate agents, letting agents and property developers.

Launched in 2008, Zoopla has since been one of the fastest growing websites in the UK, now attracting over 40 million visits per month. Zoopla has also collected numerous awards and accolades along the way, including being named one of the Top 10 UK Tech Companies (Guardian) and one of the Top 10 Most Innovative UK Companies (Smarta).

Zoopla is part of Zoopla Property Group Plc which was founded in 2007 and has a highly-experienced management team, led by Founder & CEO, Alex Chesterman.

Zoopla also own the price comparison website uSwitch.

The Requirement

Zoopla's existing operation was based out of three separate buildings in London SE1. Due to continued growth and expansion, Zoopla and uSwitch had outgrown their existing offices. The decision was made to re-locate and bring together all employees into one larger headquarters situated next to Tower Bridge on London's south bank into a 44,000 sq ft self-contained building that could not only easily accommodate existing staff but grow to meet all future requirements.

Choosing the right solution is critical, as it no longer provides just the connectivity for an IT system, it is the foundation of a modern building





management system (BMS). Making the right choice at this stage creates a future proof, high performance, flexible platform which supports efficiency and cost benefits. These newly converted offices needed to incorporate a network infrastructure solution that was capable of supporting voice, data, audio visual and network access to users quickly and efficiently. As not only did Zoopla want to run its main network from this system but also the Wi-Fi, audio visual, cinema room and IP telephony.

Sourcing a Partner

Zoopla needed a reliable installation partner to carry out this major project. Having worked with NM Cabling Solutions whilst occupying its existing offices, they once again decided to go with them for this major project.

NM Cabling Solutions is an established Data and Network structured cabling installer for Category 5e Category 6 and Category 6_A cabling, AV and Fibre Optic systems. NM Cabling Solutions has a specialist team who are ready to provide expert advice and suggestions for installations and all of their designers are RCDD & CNIDP accredited.

The company focuses on quality and reliability, supplying hassle free network cable and AV installations guaranteed to meet the highest standards of data traffic handling.

The Right Product

Having already worked with Zoopla at their existing premises where the Excel product range had been installed, NM Cabling Solutions was happy to direct their client down that route once again. Zoopla had been extremely happy with the products installed and the way in which they delivered the services their business required to function successfully.



The Excel product range is a world class premium performance end-to-end infrastructure solution which is designed, manufactured, supported and delivered without compromise. Excel has a focus on system performance, independent verification and a 25 year product and application warranty when installed by an accredited partner.

NM Cabling Solutions are an Excel Cabling partner which means they were able to install and back this project with a 25 year warranty. Excel trains and continually assess its installation partners via classroom and online training courses and assessment programmes. Partners must also attend annual Excel briefing events where attendees get updates on products, the industry, best practice and sales and marketing updates.

NM Cabling Solutions designed and specified the solution to meet the client's exact requirements, utilising the full range of Excel infrastructure products available.

Design and Installation

Excel Category 6_A Screened (U/FTP) cable was installed for the Audio Visual requirements and a cinema room.

This 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, 6_A/ Augmented component requirements. This delivers Class EA/ Augmented Category 6 link performance over distances of up 90 metres which supports the applications including 10GBASE-T, (10 Gigabit Ethernet). Lending itself to the high definition bandwidth hungry video footage requirements.

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 providing screening for each pair. The "S" Foil configuration ensures separation of the pairs which promotes optimal performance whilst creating a reduced O/D construction.

Excel Category 6 UTP cable was also used for this project. It was chosen for its optimal support of high speed data protocols delivering 1 Gbps performance to the workstation, while still delivering high power PoE if and when required for wireless AP's. Excel Category 6 panels were also installed. These products have been designed to meet or exceed the latest ISO and TIA requirements for Category 6 compliance. Excel Category 6 panels also come with rear management as standard. This small but important feature offers great benefits to the overall quality of a network installation, the unit allows for the cables to have a uniform and smooth bend radius, aiding the system to give the best possible performance.

An Environ ER800 Equipment Rack was used to house the main IT equipment. These racks are a versatile range of 800mm wide racks with features suitable for a wide range of applications within the data, security, audio visual and telecommunications markets.

A number of OR racks were situated in smaller comms rooms on different floors of the building. OR 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. This solution offers the ultimate in patching flexibility.

The backbone was constructed of Excel OM3 50/125µm tight buffered optical fibre cable. These compact, lightweight cables are extremely flexible and are designed specifically for internal and external applications. The cables are constructed around swellable reinforced yarns as common strength members allowing them to be installed in both vertical riser runs to link floors and the horizontal links to the remotely deployed racks.

The use of fibre gives some significant benefits when completing a project such as this. The fibre was deployed to link the racks together, negating any issues with runs that would have been over length for a traditional copper link. Fibre optics allow for large amounts of bandwidth to be transmitted, making it the ideal choice for the backbone when linking the racks together.

This high grade fibre optic cable offers the ultimate in future proofing the core and backbone of the solution, with the cable offering performance levels of 10GBASE-SR/SW over 300 metres and 40GBASE/SR4 over 100 metres.

The Result

The Excel solution installed offers Zoopla peace of mind that their infrastructure network is backed with a 25 year product and application warranty. They now have a headquarters that they can be assured is able to grow with them as they continue to expand their operations and add more people to their network in the coming years.

Zoopla
Smarter property search



Case Study Granada University

Customer	Granada University
Location	Granada, Spain
Requirements	First class, future proof network infrastructure
Equipment	Category 6A UTP LSOH cable, Category 6A low profile keystone jacks, Environ ER racks and MTP fibre cables, cassettes and accessories.
Customer's View	<p>We wanted to provide a first class facility, which would offer each of our residents their own 'technology city' type of environment. In order to do this we needed a reliable and trusted network infrastructure system.</p> <p>The Excel system that we have in place allows each of the 30 companies located within the facility to integrate with our MultiGigabit RedUGRNova. They can also make the best use of the latest technologies, reliably and consistently without any interruptions to service or quality levels experienced.</p> <p><i>Antonio Ruiz Moya, CTO, Granada University (CSIRC-UGR)</i></p>



The University of Granada (UGR) is a public university located in the city of Granada, Spain, and founded in 1531 by Emperor Charles V. With approximately 85,000 end users, it is the fourth largest university in Spain. Apart from the city of Granada, UGR also has campuses in Northern Africa.

Every year over 2,000 European students enrol in UGR through the Erasmus Programme, making it one of the most popular European destinations. The university's Centre for Modern Languages receives over 10,000 international students each year. In 2014, UGR was voted the best Spanish university by international students.

The University also provides the University Community with a wide range of cultural activities such as musical concerts, poetry, various conferences, cinema, courses, seminars, exhibitions etc. The aim of all these activities is to provide a link between university life and the other elements of the city, society and culture. The University is also the first organisation in the world to use an Ethernet network designed for 160Gbps connectivity.



The Requirement

The University had invested in a new building the purpose of which was to house IT Companies developed by the very best quality individuals who are engaging in R & D, teaching and management services.

These types of business demand high speed, reliable networks, whilst also providing mobility for network users, something that the new mobile generation expects and demands.

Sourcing a Partner

The university worked with a number of local distribution and installation partners to source a suitable solution which would provide the infrastructure required by these bandwidth hungry clients.

The university was already aware of the Excel product range having heard about its proven track record, its technical capability which is backed up by independent third party verification from Delta and the fact that is backed by a 25 year warranty, from the installers it had developed a working relationship with.

Case Study - Granada University

Choosing the right solution is critical, as it no longer provides just the connectivity for an IT system, it is the foundation of a modern building management system (BMS). Making the right choice at this stage creates a future proof, high performance, flexible platform which supports efficiency and cost benefits. Not only did the University want to run its main network from this system but also the Wi-Fi, CCTV, video conferencing and access control.

The Right Product

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 Cable to cabinet', reliability and product availability, Excel is the complete trusted solution.

When a system is installed by an Excel Cabling Partner a 25 year warranty can be awarded. Partners are key to the quality of service and support delivered. Excel continually assesses its partners throughout EMEA by providing classroom and online training courses and assessment programmes. Training and accreditation is renewed bi-annually, on demand or at the launch of new Excel solutions or industry standards.

The Excel warranty provides a 25 year product and applications assurance of compliance with industry performance standards appropriate to the class of cabling being installed. It covers copper, fibre, voice and even the Environ range of racks.

Design and Installation

The system design for the new University building has been based on current international and European standards for structured cabling. It is also based on Andalusia's Standards and the University of Granada's own standards.

4 data centre comms rooms, each containing 8 racks were situated throughout the building. Each rack distributed a high density copper network, emanating from the main DC comms room to the termination outlets. A fibre optic backbone was run from each DC comms room to connect the network together.

A wide range of Excel products were used across the campus site including Category 6A cable. These 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 6A/Augmented Category 6 component requirements. This delivers Class EA/Augmented Category 6 link performance over distances of up to 90 metres 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 providing screening for each pair. The "S" Foil configuration ensures separation of the pairs that ensures the performance. By using two sets of two pairs has resulted in a reduced diameter and weight cable. The smaller cable diameter has reduced the cable cross-sectional area by 14.5%.

Excel Category 6A cables and associated connectors, take the performance capabilities of copper infrastructure to new levels. These products are intended to deliver reliable, high network performance over distances of up to 90 metres and channels up to 100m, including applications such as 10GBASE-T, 10 Gigabit Ethernet. Each cable consists of 4 unscreened twisted pairs which are formed around a specifically designed X filler. The use of the X filler makes the spacing and positioning of each pair consistent which helps to address issues such as crosstalk.

Nowadays installations need to provide not only data, but power as well in the form of PoE. Utilising the Excel Category 6A cabling allows for the end user to utilise PoE, whilst still delivering 10 Gigabit Ethernet. This makes the network perfect for taking on IoT deployments, where it can be used for Wireless Access points, IP Access Control, Alarms, IP CCTV, helping the new building to become more of an intelligent workspace.



Case Study - Granada University



The Excel Category 6A Low Profile Screened Keystone Jack, is a reduced size toolless termination RJ45 socket. The reduced size allows for multiple cable entry directions to be accommodated when this jack is mounted in a standard depth back box. This permits many mounting options including flush shutters at the outlet as well as more common angled shutter used with keystone jacks.

With the system being used by IT start up companies there was an absolute requirement and prerequisite that the system must be state of the art offering the highest possible connectivity speeds if and when required. With the deployment of the Category 6A system, a 10GbE copper to desk connection can be achieved, making it the perfect solution.

Excelerator MTP Elite trunk cables offer pre-terminated optical fibre that is factory tested in a range of core counts. The university campus deployed OS2 grade fibre cable which offers network connection over vast distances, allowing for the 4 data centres to be connected, but not just connected, connected at 1GbE, 10GbE, 40GbE or even 100GbE. This gives the system longevity and future proofs the universities investment in the system. The Excel solution offers flexibility within its core design. The MTP trunks can be deployed as standard parallel optics today, and move to multi transmit and receive optics for the higher speed connectivity by simply changing the cassettes at one end of the link to deliver the correct polarity when needed.

Excel Excelerator 1U High Density Angled MTP Cassettes Patch Panels were fitted into each of the Environ racks. The front drop down panel offers protection to the installed patch cords and also a large labelling field. Further, panel identification labelling, may be fixed to the drop down panel in the closed position.

Finally Environ ER800 racks were installed in the comms rooms throughout the university campus. The Environ ER800 is a versatile range of 800mm wide racks fitted with a wave design mesh front door and wardrobe style double mesh rear doors, for optimal air flow and heat displacement. Designed to accommodate a load of up to 600 kg, they offer features that make this rack suitable for a wide range of applications within data centre deployments.



The Result

This new unique facility provided by the University of Granada has been in operation since early 2016. The variety of companies housed within this facility have been given a head start into the world of commerce with access to a first class network.

Case Study

London Luton Airport Operations Ltd (LLAOL)

Customer	London Luton Airport Operations Ltd (LLAOL)
Location	London Luton Airport
Requirements	Provide a resilient, highly secure cabling infrastructure as the platform to run a new security search area within the airport.
Equipment	Excel Category 6 _A F/FTP, Excel Fibre, Environ Racks and Excel Intelligent PDUs
Customer's View	<p>The security of our passengers and staff is critical to our operation and as part of our redevelopment we needed to find the right infrastructure solution and partner to make the most of the technology available to us today, as well as providing the infrastructure for technology that will be available to us in the future. We feel that we have more than achieved our objectives with Excel and DWM.</p> <p><i>Neil Thompson, Operations Director London Luton Airport</i></p>



London Luton Airport is one of the UK's largest airports and carried 10.5 million passengers in 2014. In July 2014 final planning consent was granted for a £110m development that will increase the annual passenger capacity from 12 million to 18 million by 2020 and enable London Luton to become a leading airport serving those living in London, Luton and the surrounding regions.

The plans, include an expanded and modernized terminal building and improved surface access all of which are forecast to increase the airport's annual contribution to the national economy by £1billion to £2.3billion.

The Requirement

One element of the refurbishment was to take advantage of the latest technologies for the security screening of passengers as well as being able to provide up to date flight information to passengers via the screens. To enable these works the existing infrastructure and the design of the network to accommodate the new equipment needed to be upgraded, as well as future proofed for emerging technologies.

Sourcing a Partner

DWM Technical Solutions Ltd is an innovative organisation striving to research, design and install cutting edge technology into the networking, audio visual and electrical sectors. Since inception over 14 years ago DWM have steadily grown from strength to strength, supplying a high quality service to an expanding high profile customer base. They aim to deliver and integrate solutions for their clients across a network platform to provide high quality, efficiency and control.



DWM has been working with LLAOL for 12 years and was chosen to work on this part of the project for its proven knowledge and expertise. With the design having to incorporate the migration of critical IT services with minimum downtime and maintaining full airport operations, it was really important to LLAOL that they picked the right partner for the job.

The Solution

DWM recommended the Excel solution to LLAOL due to its proven track record, its technical capability which is backed up by independent third party verification from Delta and the fact that it is backed by a 25 year warranty.

DWM is an authorised Excel Cabling Partner and has undergone regular technical training and, as a result, is able to offer the 25 year warranty on all of its installations.

Due to the nature of the products being installed within the enhanced security area at the airport, an Excel screened Category 6A (Class E A) solution was chosen which provides 10 Gigabit Ethernet to ensure the network is future proofed and with it being screened cable, it ensures that there is no electromagnetic noise and mitigates the chance of alien cross talk within the cable bundles, as well as protecting the cable from potential interference from the various equipment being installed.

Excel OS2 singlemode armoured fibre cable, panels, patch leads and connectors were installed to provide the fibre optic backbone of the network. With the armoured fibre this ensures that it's protected from the chance of any rodents biting through the cable. By utilising OS2 fibre cable, LLAOL was able to future proof its business operations as this fibre has the capability to run up to 10 / 40 and 100 Gigabit Ethernet applications over vast distances. A deployment of 10GBASE-ER/EW (10 Gigabit) can be installed over 22,250 m, where as OS1 would be limited to 2,000 m.

Excel Environ ER Racks were chosen to house all of the equipment. Three black 42U 800 x 800 racks were used, each with ventilated mesh front doors and ventilated rear wardrobe doors providing 70% ventilation within the rack. The racks have advanced vertical management which allows for the racks to operate extremely effectively as a solution when bayed together as they aid inter rack connectivity.

Within the racks Excel Intelligent PDUs were installed with temperature and humidity sensors to provide continual monitoring of the installation and to allow for the remote management of the power within the rack if required. Each PDU is capable of having 7 temperature sensors deployed as standard, allowing for monitoring at the top, middle and bottom of a rack at both the front and rear to gain

maximum and more accurate measurements, to make better management and maintenance decisions relating to the network. The remote management can be done through a standard web browser, making deployment as simple and easy as possible.

The Result

The installation took part in the summer of 2015 as phase 1 of 14 campus wide infrastructure upgrades. DWM worked to a tight programme as directed by LLAOL and had to co-ordinate its engineers on site around the other contractors who were providing additional services at the time. The installation ran smoothly with minimal disruption to the everyday workings of the airport.

London Luton Airport now has one of the most up to date and technically advanced security solutions available, which helps to ensure the safety of its passengers and staff every single day with the added knowledge that the Excel infrastructure platform is backed by the comprehensive 25 year warranty.



Case Study News UK

Customer	News UK
Location	London
Requirements	Fully networked new office build
Equipment	<ul style="list-style-type: none"> ● Excel Category 6_A U/FTP Screened Cable ● Excel Category 6_A Screened Keystone Jacks ● Excel U/FTP Screened Solid Harness Cable Links ● Excel U/FTP Screened Patch Leads ● Excel GOP Boxes and Copex Assemblies ● Excel Power Distribution Units ● Excel Voice Pair Cable
Why Excel?	<ul style="list-style-type: none"> ● Screened System Design ● Breadth of 3rd Party Verification ● Breadth of the product range, and design options ● Cradle to grave programme of support services ● Ability to meet the fast track installation programme
Customer's View	<p>"We had a huge challenge to bring the News UK group of companies under one roof, within a year of the first cable being installed. The Excel solution delivered on all levels and allowed us to meet every deadline and get the 4,500 members of staff up and running within the required timescales."</p> <p><i>Paul Ovall – Programme Manager</i></p>

excel
without compromise.

News UK is part of News Corp – a global media business focused on creating and distributing content that educates, entertains, informs and inspires its customers. News UK includes such prestigious media brands as The Times, The Sunday Times, The Sun and TLS. News Corp includes Harper Collins and Dow Jones.

Previously located in various offices in and around London, the new News UK building allowed all of the media titles to be brought together under one roof. This prestigious building, also sometimes referred to as the 'Baby Shard', due to its exterior glass construction and close proximity to The Shard, is located at London Bridge, providing a perfect central location.

The Requirement

News UK needed a structured cabling system that could support the technical requirements of the 4,500 staff that would be based in the office, including journalists, photographers, web developers, TV studios etc. A Category 6_A solution with a fibre back bone to support 10 Gigabit Ethernet was required, with proven, standards compliance, strong UK support and a robust warranty programme.



Case Study - News UK

An experienced project team, comprising of in-house and external advisors, evaluated a number of systems on the market. As a result of this assessment process, Excel was chosen for a number of reasons including, the advantages of the screened system design, the breadth of the product range which also carry 3rd Party Independent Verification and that fact it was backed by strong support services and had the ability to meet the fast track installation programme.

Once the News UK team had finalised their decision to go with Excel, goods began to ship within a month.

The Integrator

LMG was chosen by the main contractor and News UK as the preferred integration company. This was due to their experience and proven success in delivering large scale, fast track, prestigious projects.

At the height of the project LMG had day and night shifts of approximately 80 engineers working on the project in order to meet the tight deadlines.

LMG has worked with Excel for a number of years and are one of a few companies who carry the Excel Solutions Partner status due to their commitment to Excel and the fact they offer a total integrated IP solution.

Design and Installation

The design of the infrastructure was led by John Hunt of the News UK IT team with a SER room located on each floor and larger CER rooms on two of the lower floors. A mix of open frames and bespoke racks were used to house the equipment in each room. Where power was required in the cabinets, bespoke Excel Power Distribution Units were installed.

To meet current and future performance requirements of the users at News UK, an Excel Category 6_A U/FTP screened solution was chosen with over 1.25 million metres of cable installed.

Excel provides a wide choice of frames and compatible keystone jacks, after a thorough evaluation process, including Excel support with demonstrations and proof of concept sample provision, News UK opted for the unloaded Excel Keystone Jack Patch Panel Frame populated with angled Keystone 6_A F/FTP jacks.

Excel Support

A key factor in the decision to specify Excel was the 'cradle to grave' approach that the Excel team apply to supporting both the integrator and stakeholders in projects of this type. Using years of experience and a customer first approach, the Excel team assisted with the product choice, installation training was provided on site, bi-weekly site audits were completed, bespoke products were designed, and a site specific approach to the system warranty was adopted.





The Excel angled jack design directs patching naturally to either side of the frame, reducing stress and bend radius on the patch cable and allows the patch leads to flow neatly, at the rear cable entry remains perpendicular to the panel via the integrated cable management, allowing for an extremely neat and tidy finish.

In total 35,000 points were installed including the panel to panel links, together with over 5,500 20mtr U/FTP harness leads.

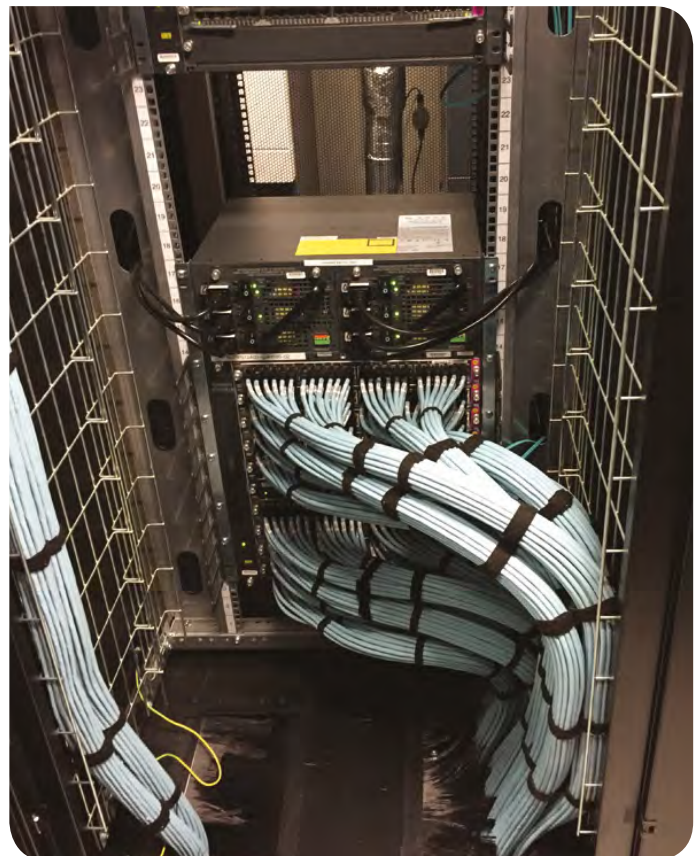
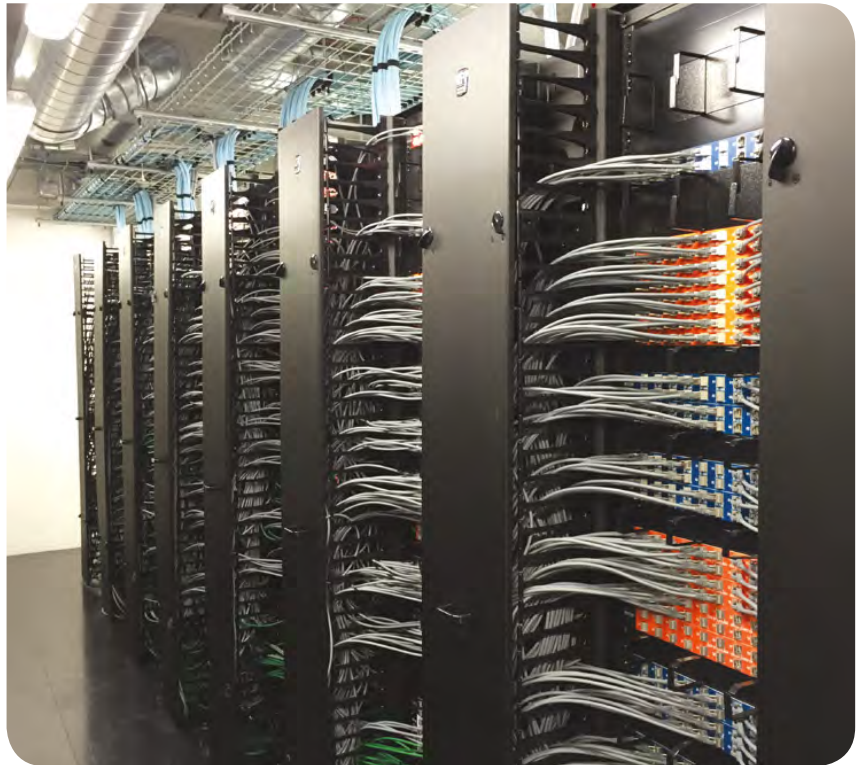
In the work areas standard Excel screened tool free keystone jacks were installed to both floor, ceiling and desk positions, where appropriate Excel GOP (Grid Outlet Position) Boxes and Copex style assemblies were used.

Both the Excel Category 6_A U/FTP cable and screened jacks are independently verified by leading test house Delta, which gave News UK further confidence that the Excel products were the right choice for the installation. The verification is applicable at both individual component, and channel level, a value not available from the competition considered for this project.

The back bone of the installation was based on Excel OM4 24Core LSOH Tight Buffered fibre cable and Excel 50 pair Category 3 LSOH.

To ease the installation time, much of the system was pre-terminated off site and then brought in and installed overnight. On average two floors were completed by LMG every month which then allowed staff to be moved in, in a phased manner. In total 11 floors of the 17 floor building were cabled, together with the Ground and Basement floors.

As an Excel Accredited Partner, LMG was able to provide News UK with the Excel 25 Year Warranty that covered the Copper, Fibre and Voice elements of the installation. Because of the size of the project after each floor was completed, the warranty was applied for to cover that particular floor. Once the overall project was finished a final warranty application was made to cover the total site.



The Result

From the first cable being laid in January 2014 the last cable was laid in January 2015 making this one of the fastest turnarounds seen on a project of this size in London.

Every programme and move date was achieved and all of the technology handovers were met. Due to the fact that no work could stop for any of the media titles moving across, around 150 people were moved each weekend until around 4,500 members of staff were moved into the new building.

Paul Ovall was the Programme Manager for the project. *"Although the project wasn't without its many challenges, everything ran very smoothly. We were extremely pleased by the LMG team that worked on the installation, much of the time they had teams working both day and night and at the weekends."*

We've been delighted with the Excel solution and impressed by the support provided by the entire Excel team, and its partnership with the LMG delivery team. From pre tender, throughout the selection process, to on-site support and warranty programme we have been very pleased with the knowledge, professionalism and enthusiasm from all involved."



Excel Website

Section 18

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[Excel Partner Area](#)

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Excel Website

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 continually adding to the content with educational information as well as details on Excel. Launched in October 2016, the new, mobile-friendly responsive website makes it easier to locate specific information.

The Excel site is currently available in English, French, Spanish, Dutch, 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 or product keyword, which is the quickest way to find a product or alternatively navigate through the categories to narrow your search. Each product is accompanied with an image so you can see exactly what it looks like. Where available there are also specification sheets, third part verification certificates and DOPs 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.

- **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. We are regularly adding to our video library and more products will be featured in the future. Our full portfolio of videos is also available on the Excel Youtube channel.

- **Blog**

The Excel multi-lingual 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 LinkedIn, Instagram, Twitter and Facebook. You can scan this QR code with your smartphone to view the full portfolio of Excel blog posts.

[View our recent blog posts](#)



LinkedIn





• Downloads

We offer an extensive range of literature and collateral to help sell and support the Excel solution. Under the Resources menu you can find:

- White Papers
- Specification Sheets
- Change Notifications
- Third Party Certificates
- Encyclopaedia
- Installation Guidelines
- Technical Notes

We also provide a range of catalogues and brochures covering various sections of the Excel product range:

Excel Corporate Brochure | Product Catalogue | Environ Catalogue | Environ Digital Locking Solution Brochure | Residential Brochure | Data Centre Brochure | Understanding CPR Guide | Excel Pre-Terminated Solutions | Configured Rack and On-Site Assembly Brochure | Engraved Labelling Solutions Brochure.

Excel Partners can personalise a large amount of Excel literature with their own logo and address details – see the [Partner Area](#) for further details.



View our recent case studies

• Case Studies

A range of Excel case studies based on previous projects is available on the Excel website. Drawn from a variety of projects across EMEA in a plethora of markets and industries, the case studies show just how flexible and scalable a solution Excel can be. The full portfolio of case studies is available online by scanning this QR code with your smartphone.

• News

Read the latest press releases and [Excel Express newsletters](#) to 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 16 for step by step instructions on how to use this facility.

- **Branded Literature**

A selection 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. The Excel Partner simply needs to upload their company logo and address details and every PDF will automatically be personalised with their details.

- **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. For access to the latest technical notes, you can scan this QR code with your smartphone.

- **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.

Make sure you add the www.excel-networking.com to your favourites and if you need any information on the products then please visit the site.



Glossary of Terms

Section 19

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Glossary of Terms

International System of Units (SI)

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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.
ACP	Area Connection Point
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.
BD	Building Distributor - main comms room for distribution of services throughout the building.
BEF	Building Entrance Facility - used by service providers such as BT, Virgin Media etc.
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.
BMS	Building Management System
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.
BO	Broadcast Outlet (TV Outlet).
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 _A , Cat 6 _A	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 _A , Cat 7 _A	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.
CATV	Community Antenna Television.
CCTV	Closed Curcuit TV.
CD	Campus Distributor - Main campus communication room or facility.
CDDI	Copper Distributed Data Interface A version of FDDI that uses copper wire media instead of fibre optic cable.
CENELEC	European Committee for Electrotechnical Standardization. www.cenelec.eu The UK is a voting member so adopts all Cenelec standards as National Standards
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 _A	ISO/IEC 11801 designation for twisted pair cabling rated to 500 MHz. Using Category 6 _A components it corresponds to the TIA/EIA Category 6 _A 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 _A	ISO/IEC 11801 designation for twisted pair cabling rated to 1000 MHz. (1Ghz) corresponds to the proposed TIA/EIA Category 7 _A 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.
CO	Control Outlet - outlet used by the Building Control System such as BMS.
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.
CPR	Construction Products Regulation
CPR	Coupled Power Ratio which is used when testing optical fibre cables.
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.
ENI	External Network Interface - link to external internet providers service.
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.
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).
FD	Floor Distributor for distribution of service throughout the floor of a building.
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
GPON	Gigabit Passive Optical Network

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.
HBES	Home & Building Electronic System - Residential version of BMS.
HD	Home Distributor - Residential version of main buildings distributor used in commercial buildings.
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. www.iso.org
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 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.
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.
MATO	Multi Application Telecommunications Outlet.
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 μm .
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 μm 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.
NB	Notified Body
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".
OLT	Optical Line Terminal

ONT	Optical Network Terminal
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
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
PON	Passive Optical Network
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
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 FIORL 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.
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.

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 = millimetre



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