Excel Copper Solutions

www.excel-networking.com/copper

Section 8

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.

Since 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 The UK and EU member states. 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			✓	✓	✓

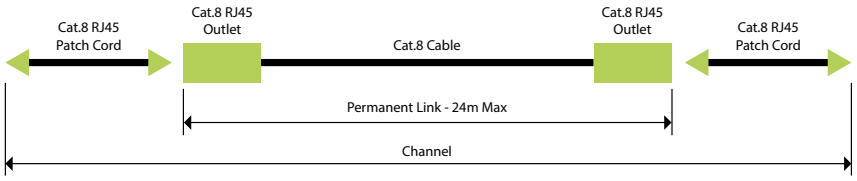
Note 1: Refer to 'Excel Copper Terminology Explained' for details of the anomalies between the standards.

The above is a summary list of the current Ethernet standards that are supported. Remote power is an application in the same way as 1000Base-T therefore all channels of Class D and above support up to 4PPOE (4 pair Power over Ethernet) IEEE802.3bt 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.

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 relates to 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 defined the application and the needs of the cabling system to support it. The 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 – Category 7 /7A currently on the market relate 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 attributes:

- 2000 MHz bandwidth
- RJ45 style connectors
- ≤ 2 connectors
- ≤ 30 m Channel

ISO

H as existing components that are Category 7A that form channels of Class FA that have a bandwidth of 1000 MHz. ISO developed two versions to support 40 Gigabit Ethernet. One based on developments of the Class FA increased to 1600 MHz and the other a 2000 MHz bandwidth.

ISO therefore have two versions of Category 8, which was published in ISO 11801:2017 at the beginning of 2018.

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 bandwidth
- RJ45 style connectors
- ≤ 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
- RJ45 style connectors
- ≤ 2 connectors
- ≤ 30 m Channel

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

CENELEC

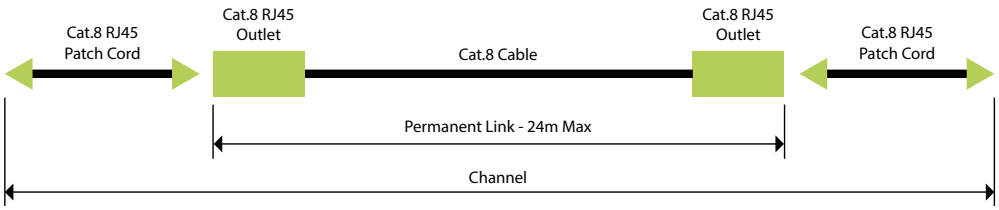
Ratified and published the same version as ISO in June 2018 under EN50173:2018 – Part 1 - General Requirements.

Usage

Category 8 has been 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 be remain as the RJ45 to ensure backwards compatibility with legacy equipment.



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!

UPDATED for V5

Both Cenelec and ISO/IEC have changed the wording the latest standards to state, 'a minimum requirement of Category 6 should be used with a recommendation that all future installs requiring more than 1GbE should be Category 6A'.

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".

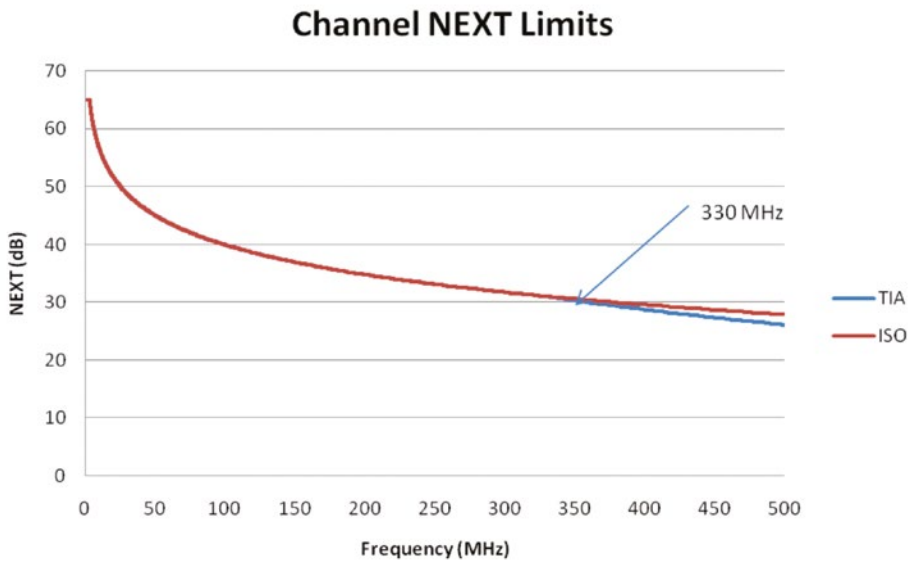
Regardless of Brexit the UK will continue to be a voting member of CENELEC, as the standards body has nothing to do with the EU.

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.

NEW for V5

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 11801:2017	Information technology – Generic cabling for customer premises. CENELEC EN
ISO 11801-1:2017	Part 1: General requirements
ISO 11801-2:2017	Part 2: Office Spaces
ISO 11801-3:2017	Part 3: Industrial Spaces
ISO 11801-4:2017	Part 4: Homes
ISO 11801-5:2017	Part 5: Data Centre Spaces
ISO 11801-6:2017	Part 6: Distributed Building Services

CENELEC - EN

EN 50173	Information technology – Generic cabling systems
EN 50173-1:2018	Part 1: General requirements
EN 50173-2:2018	Part 2: Office spaces
EN 50173-3:2018	Part 3: Industrial spaces
EN 50173-4:2018	Part 4: Homes
EN 50173-5:2018	Part 5: Data centre spaces
EN 50173-6:2018	Part 6: Distributed Building Services
EN 50174	Information technology – Cabling installation
EN 50174-1:2018	Part 1: Installation specification and quality assurance
EN 50174-2:2018	Part 2: Installation planning and practices inside buildings
EN 50174-3:2013 +A1:2017	Part 3: Installation planning and practices outside buildings
EN 50310:2016	Application of equipotential bonding and earthing in buildings with information technology equipment. *Note: the wording in this standard is replicated within both ISO and TIA versions of this standard*

The British Standards Institute - BS

BS 6701:2016: +A1:2017	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance. Note: This was republished on the 30th of November 2017 and contains the minimum class requirements for telecommunications cables for the UK implementation of the CPR
BS 7671:2018	Requirements for electrical installations. IET Wiring Regulations. Eighteenth edition.

Telecommunications Industry Association - TIA

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

- TIA-568-2.D components of balanced twisted-pair cable systems
- TIA-568-3.D components of fibre optic cable systems, and
- TIA-568-4.D coaxial cabling components

TIA-598 – Optical Fibre Colour Coding

UPDATED for V5

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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 50173-1:2018 is published in the United Kingdom as BS EN 50173-1:2018 and as DIN EN 50173-1:2018 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	БДС
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 f✓r Normung e.V.	www.din.de	DIN
Greece	Hellenic Organisation for Standardisation / Ελληνικός Οργανισμός Τυποποίησης	www.elot.gr	ΕΛΟΤ
Hungary	Hungarian Standards Institution / Magyar Szabvány✓gyi Test✓let	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 / Asociatia 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 / T✓rk Standardlari Enstit✓s✓	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 50173-2:2018

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.

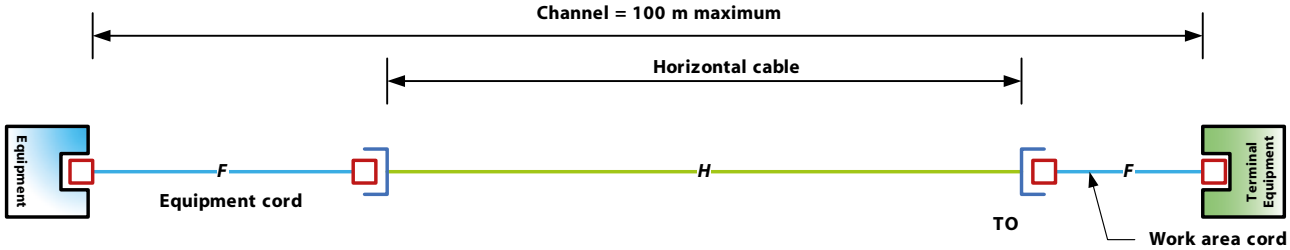
The maximum length of the Horizontal Cable is calculated based on the Class of the system and the lengths of the attached cords and links. The following general restrictions apply:

- 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.

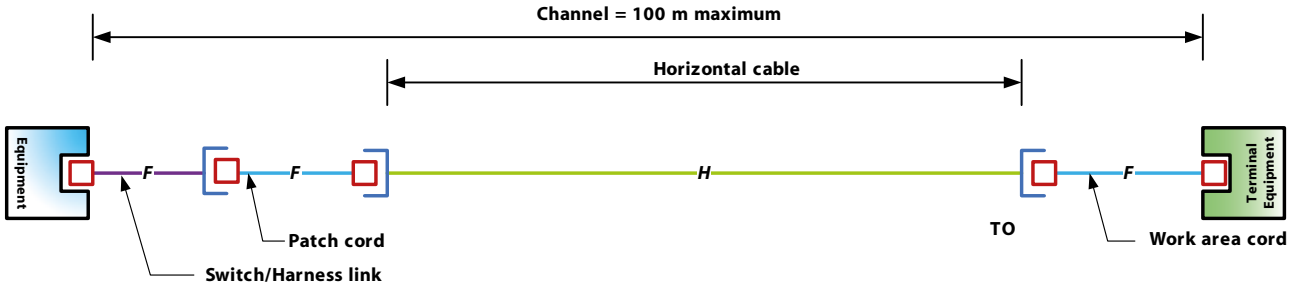
Value		Note
H	maximum length of the fixed horizontal cable (m)	
F	combined length of patch cords, jumpers, equipment and work area cords (m)	
C	length of the CP cable (m)	
X	ratio of flexible cable insertion loss (dB/m) to fixed horizontal cable insertion loss (dB/m)	1.5 for stranded cable 1 for solid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



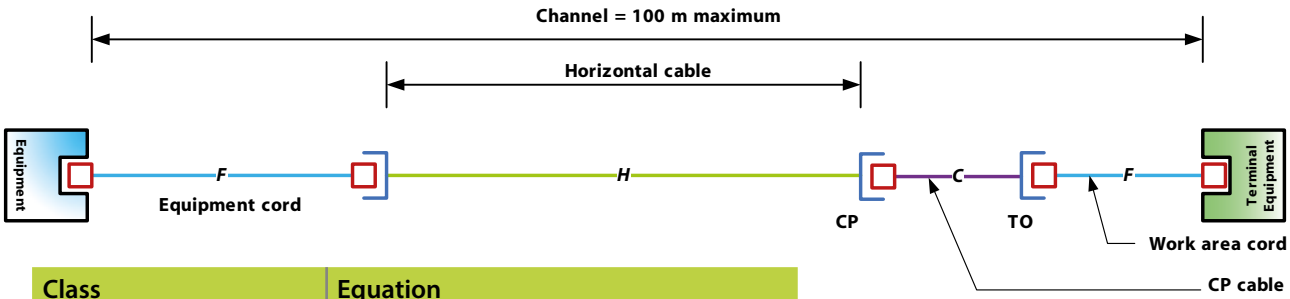
Class	Equation
Class D (Category 5e)	H = 109 – (F x X)
Class E (Category 6)	H = 107 – 3 – (F x X)
Class E_A (Category 6_A)	H = 107 – 3 – (F x X)
Class F (Category 7)	H = 107 – 2 – (F x X)
Class F_A (Category 7_A)	H = 107 – 2 – (F x X)

Cross-connect to Telecommunications Outlet (TO)



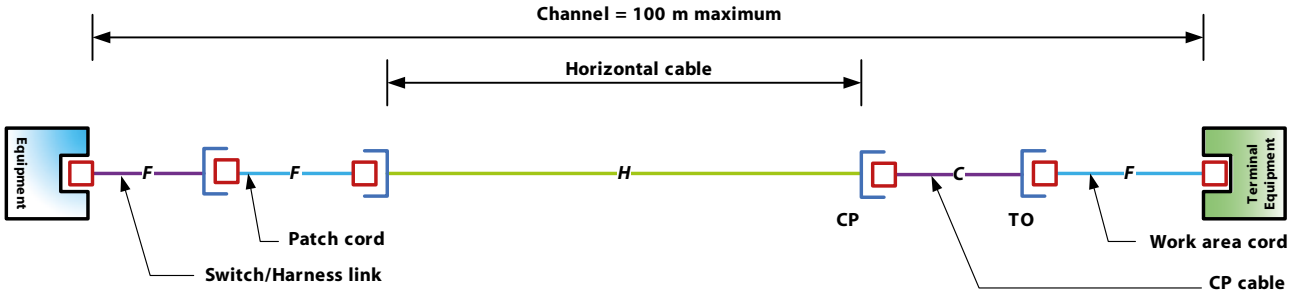
Class	Equation
Class D (Category 5e)	H = 107 – (F x X)
Class E (Category 6)	H = 106 – 3 – (F x X)
Class E_A (Category 6_A)	H = 106 – 3 – (F x X)
Class F (Category 7)	H = 106 – 3 – (F x X)
Class F_A (Category 7_A)	H = 106 – 3 – (F x X)

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



Class	Equation
Class D (Category 5e)	H = 107 – (F x X) – (C x Y)
Class E (Category 6)	H = 106 – 3 – (F x X) – (C x Y)
Class E_A (Category 6_A)	H = 106 – 3 – (F x X) – (C x Y)
Class F (Category 7)	H = 106 – 3 – (F x X) – (C x Y)
Class F_A (Category 7_A)	H = 106 – 3 – (F x X) – (C x Y)

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



Class	Equation
Class D (Category 5e)	H = 105 – (F x X) – (C x Y)
Class E (Category 6)	H = 105 – 3 – (F x X) – (C x Y)
Class E_A (Category 6_A)	H = 105 – 3 – (F x X) – (C x Y)
Class F (Category 7)	H = 105 – 3 – (F x X) – (C x Y)
Class F_A (Category 7_A)	H = 105 – 3 – (F x X) – (C x 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 4PPoE in accordance to IEEE 802.3bt released in 2017.

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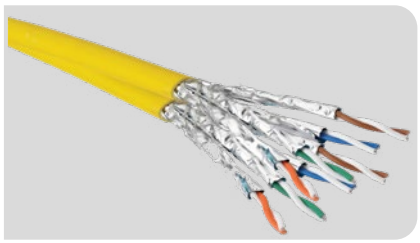
The Excel Copper Product Portfolio

Excel Category 8 Range

- 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

Our Category 5e unscreened and screened systems are also available. Please contact your sales representative or local distribution or installation partner for details. Alternatively, browse the **website**.

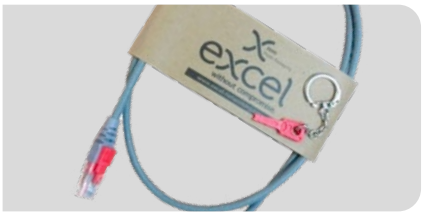
Comparison

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

Discover more about our plastic free packaging in Section 2.

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 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.

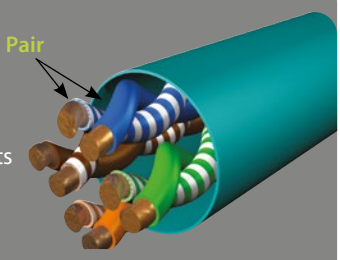
The effect of crosstalk within the cable has been known about, and therefore measured, since the early Categories and Classes of cabling systems. This was always in the form of Near End Crosstalk (NEXT) as measured from each end. NEXT is the influence from the signal of one pair to another within the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

UPDATED for V5

Excel ExpressNet Solution

The Excel ExpressNet Panel provides the ability to have fibre and copper presented in one panel offering complete flexibility in the installation. The Excel ExpressNet 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
Introducing the ExpressNet Solution

Watch
How to terminate a Category 6 Unscreened ExpressNet Module

Watch
How to terminate a Category 6 Screened ExpressNet Module

The Excel ExpressNet 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 ExpressNet Patch Panel Frames - 4 Module - Unloaded
100-231	Excel 1U ExpressNet 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 (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 (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 (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

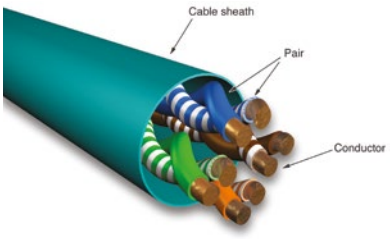
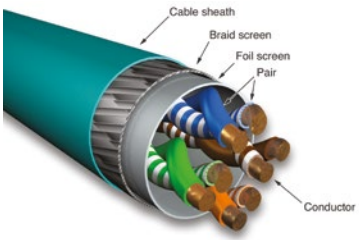
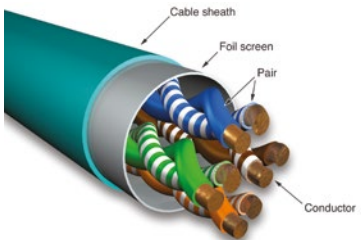
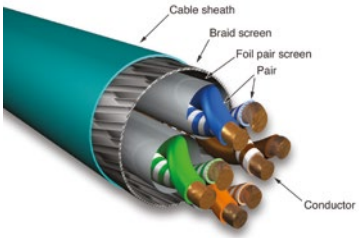
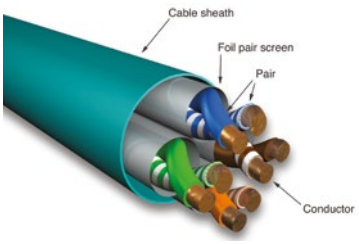
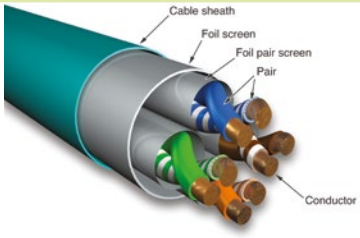
The first letter of the acronym describes the overall screening. The second letter describes the screening of individual pairs and the TP refers to the Twisted Pairs.

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.

U/UTP Unscreened outer with unscreened twisted pairs		**SF/UTP** Screened braid and foil outer with unscreened twisted pairs	
F/UTP Screened foil outer with unscreened twisted pairs		**S/FTP** Screened braid outer with individual screened foil twisted pairs	
U/FTP Unscreened outer with individual screened foil twisted pairs		**F/FTP** Screened foil outer with individual screened foil twisted pairs	

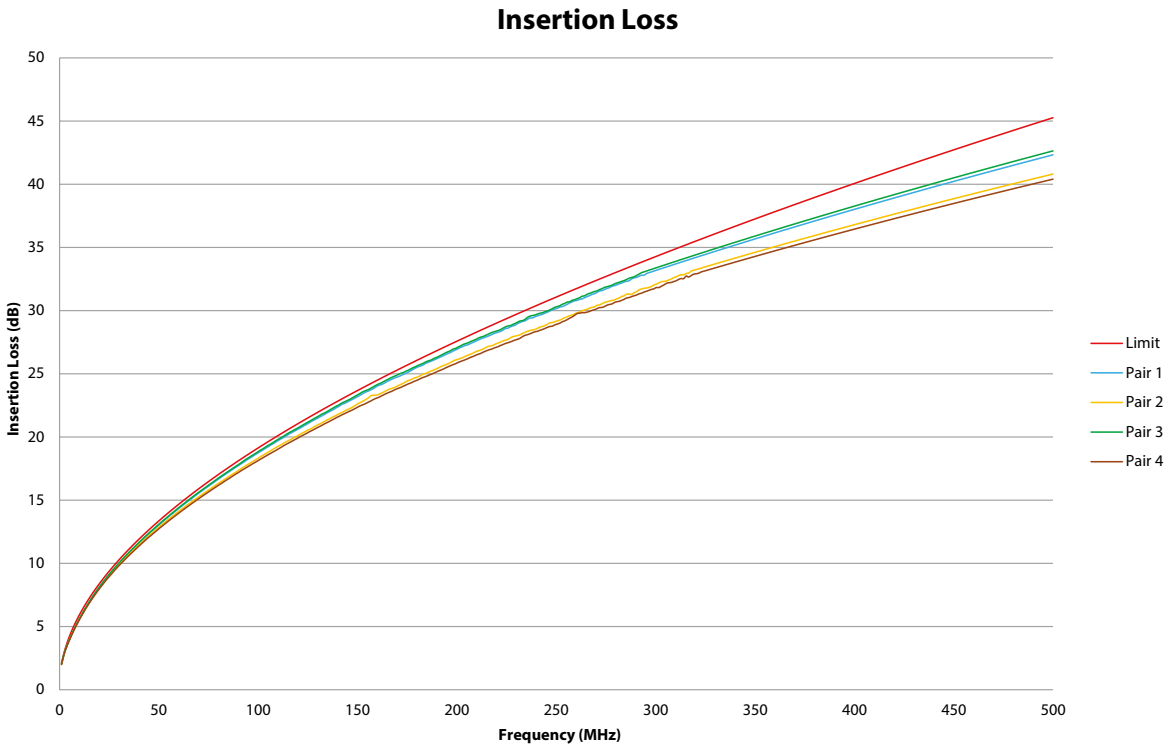
UPDATED for V5

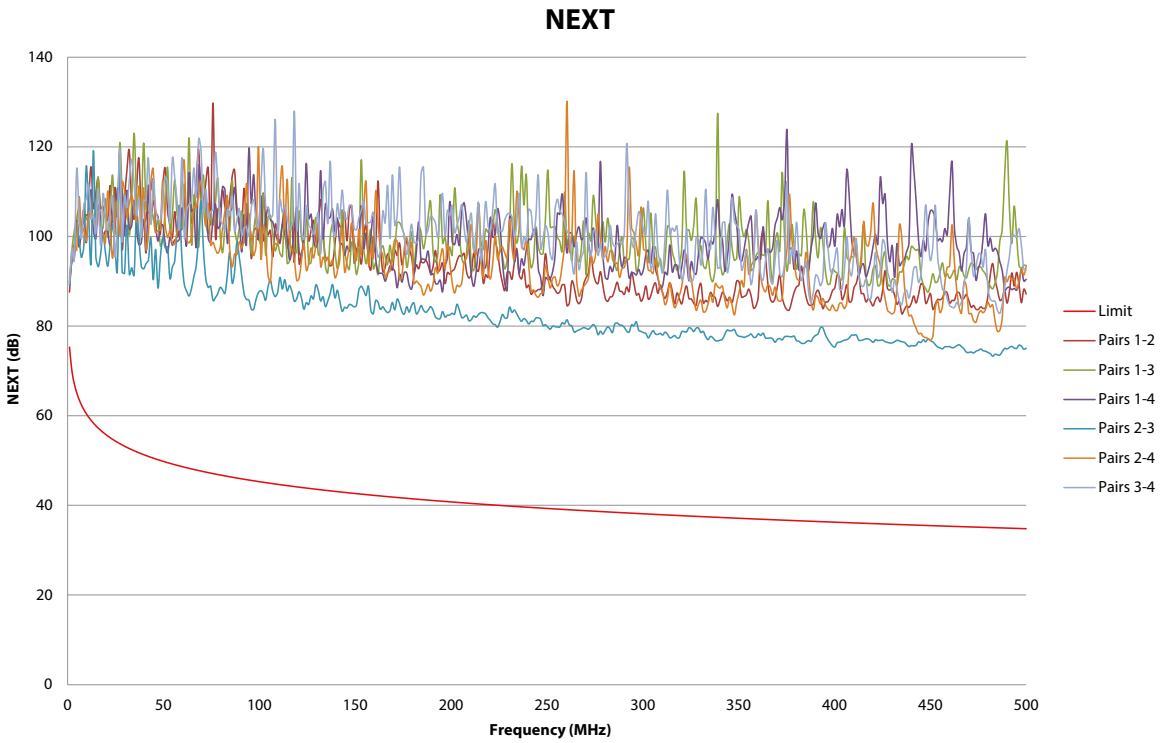
S8

Excel Category 6_A Typical Performance Charts

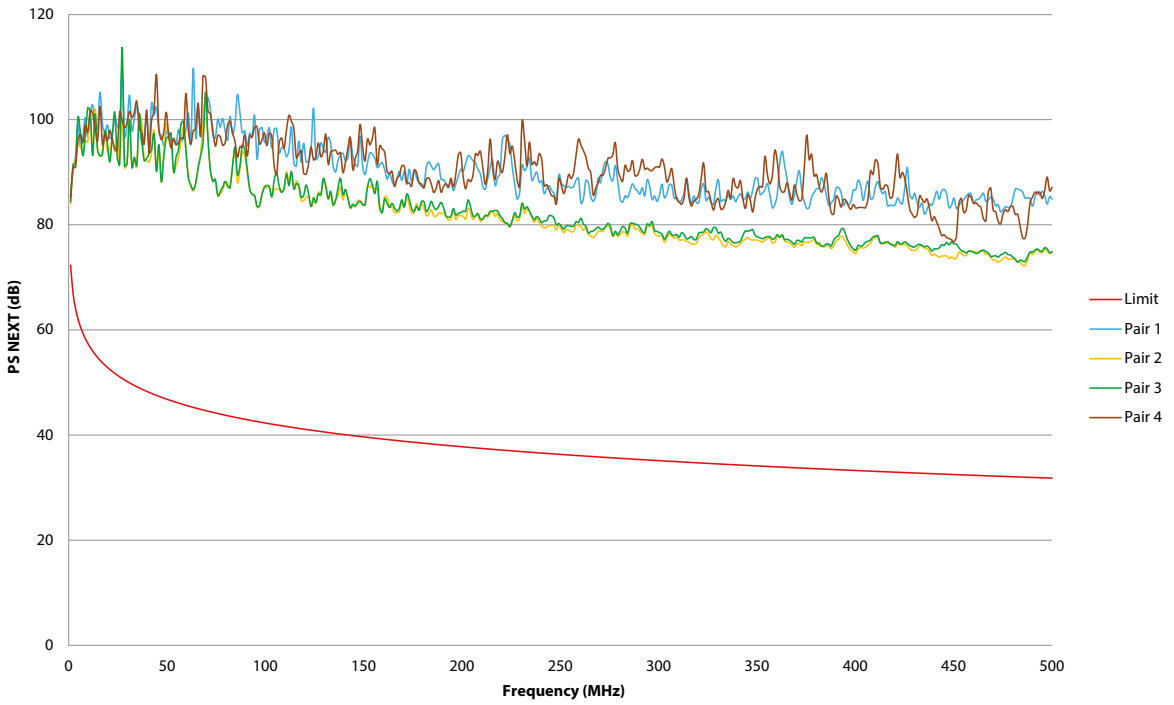
100-196 Excel Category 6_A Screened (F/FTP) Cable - LSOH

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 11801:2017/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.

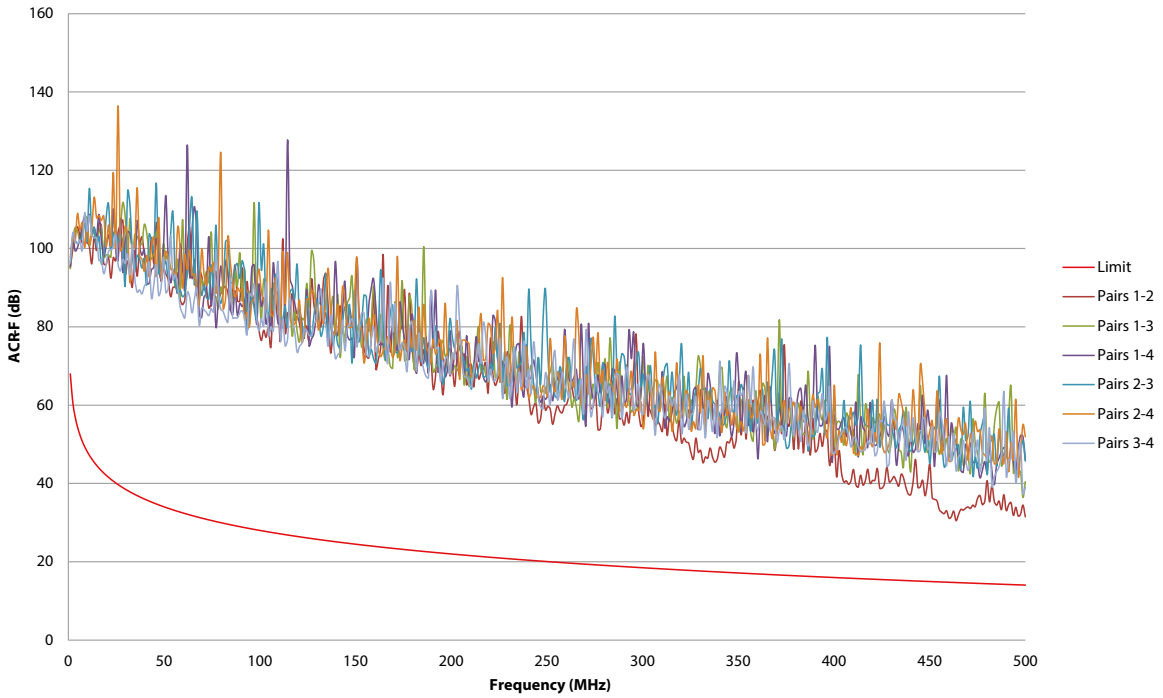




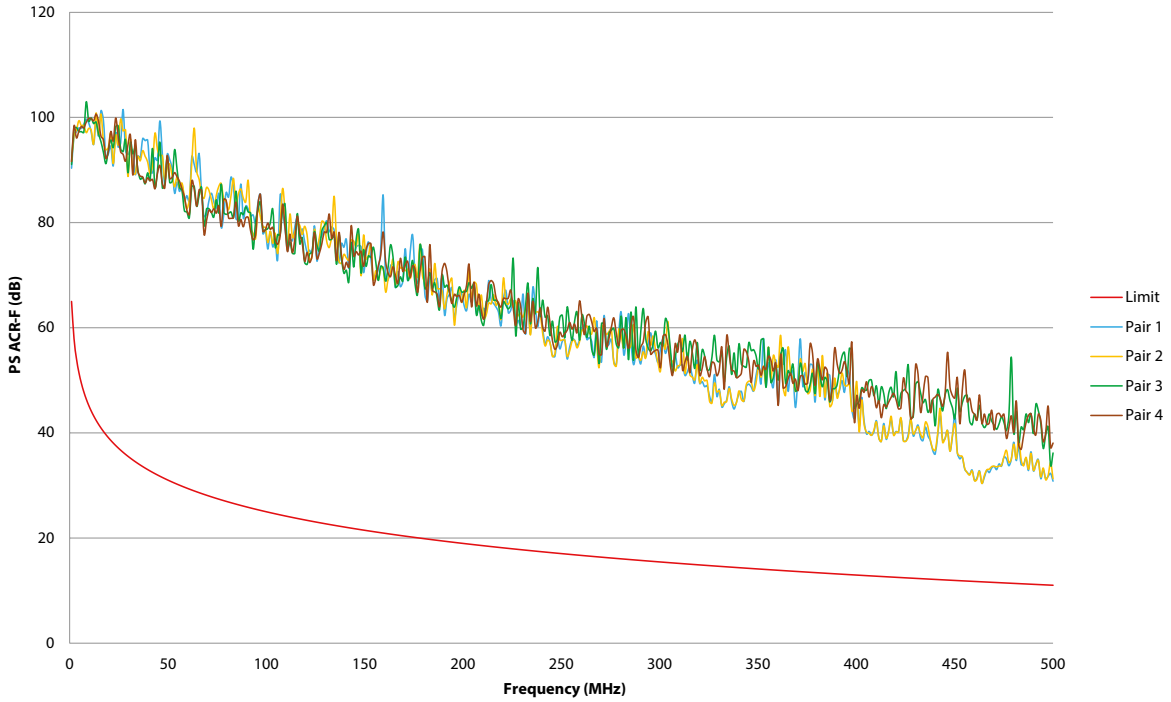
Power Sum NEXT



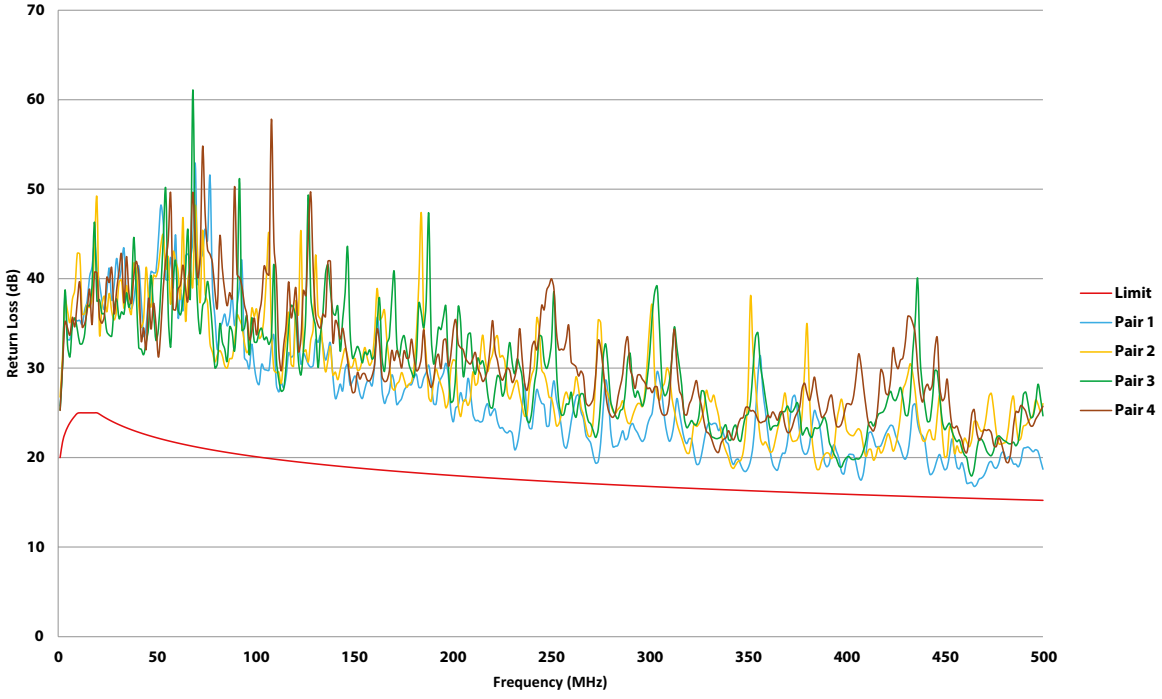
ACR-F



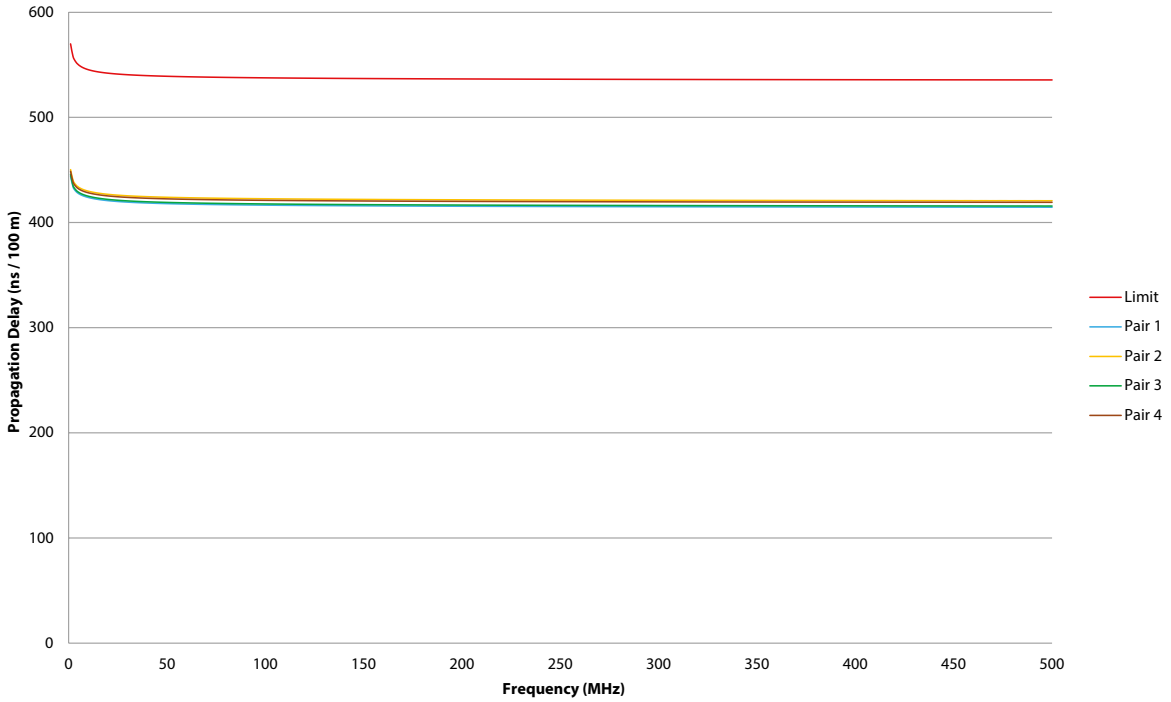
Power Sum ACR-F



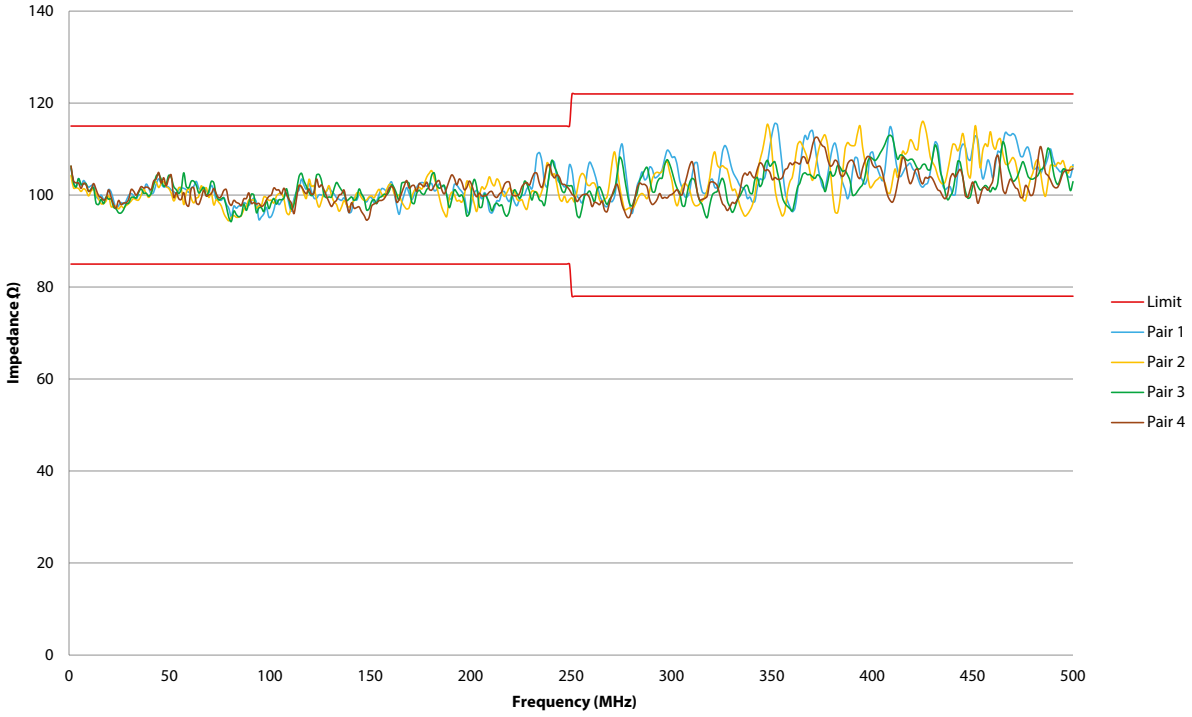
Return Loss



Propagation Delay



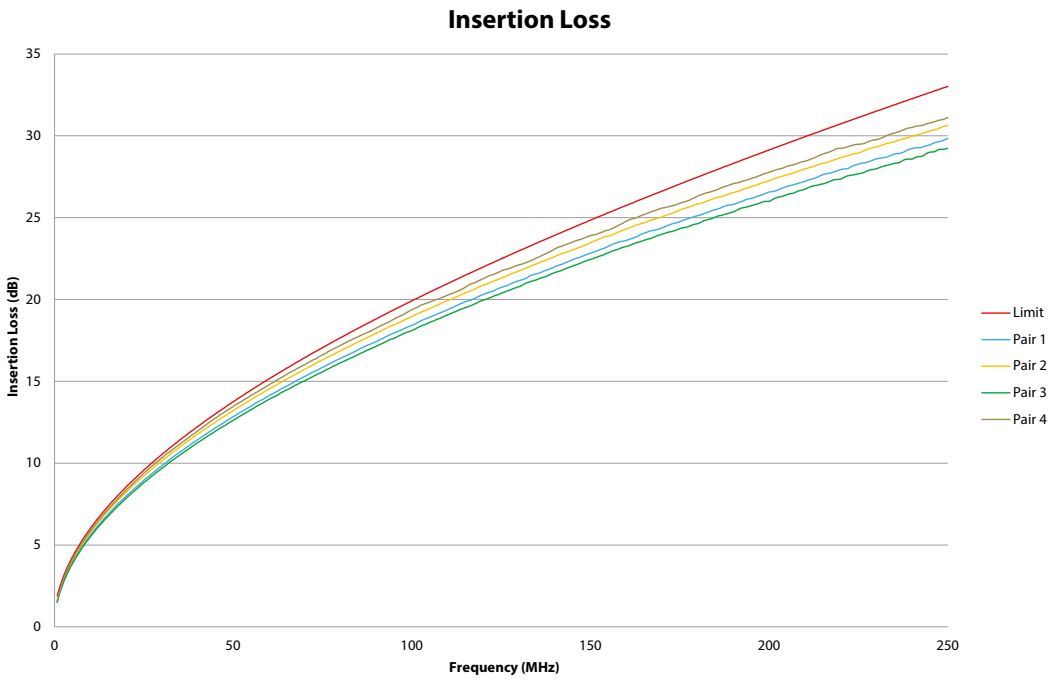
Impedance

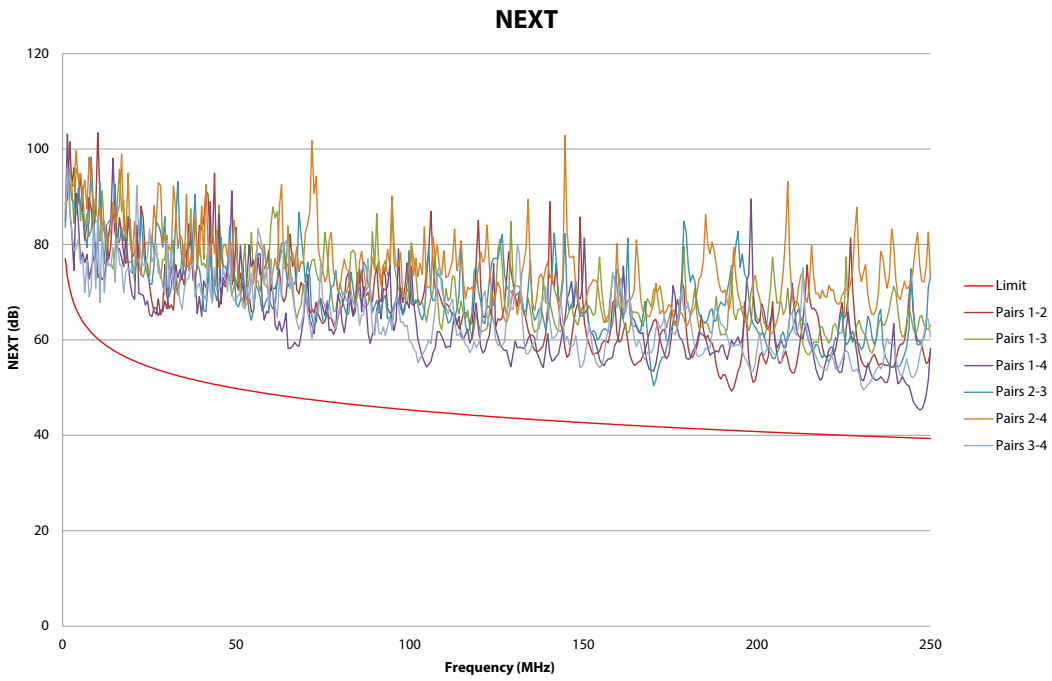


Excel Category 6 Typical Performance Charts

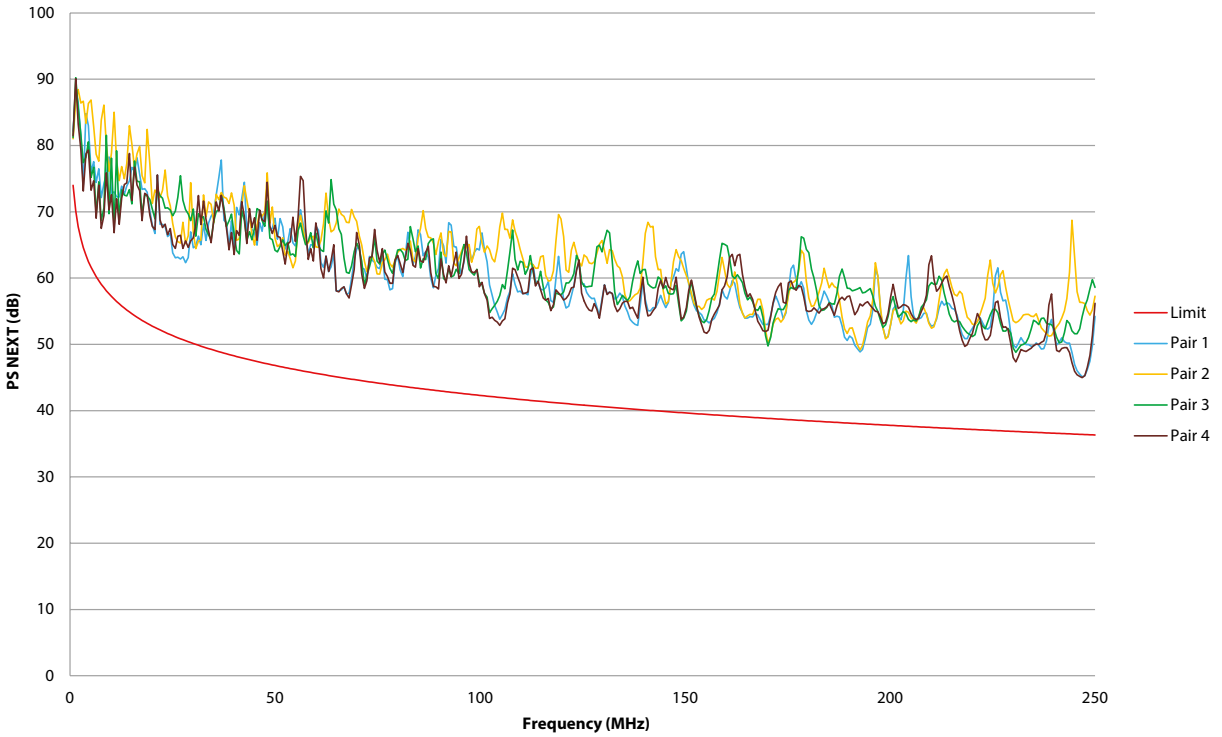
100-071 Excel Category 6 U/UTP LSOH Cable

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 11801:2017/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.

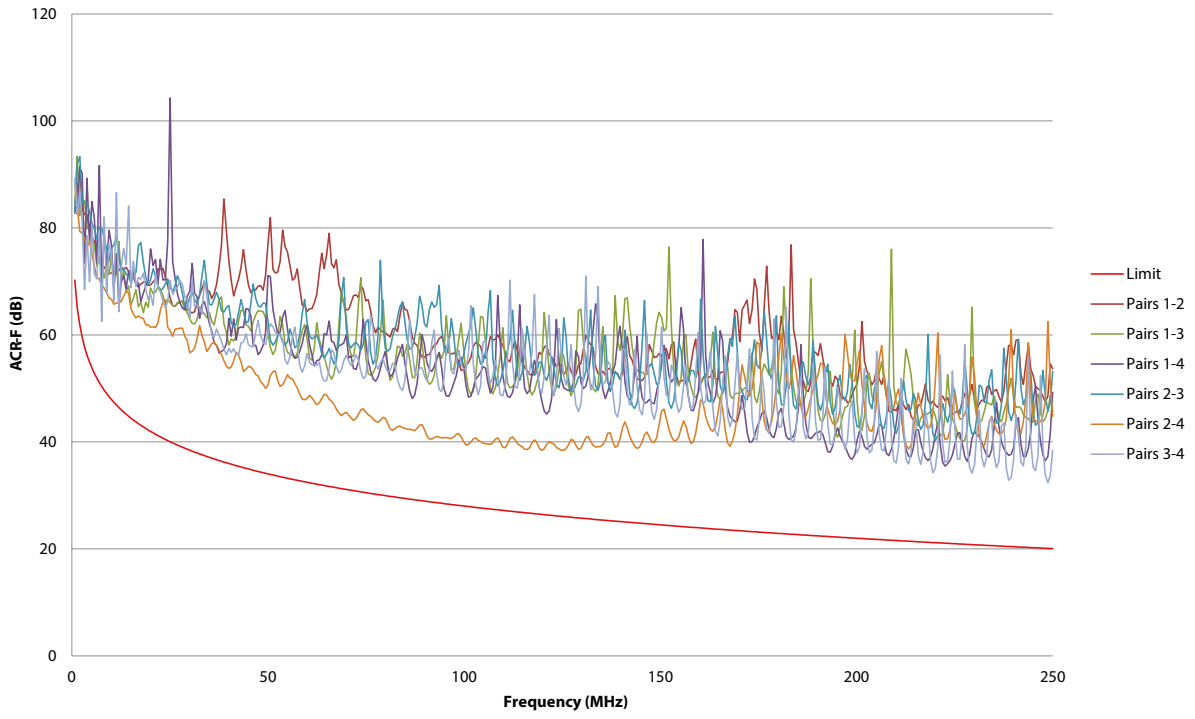




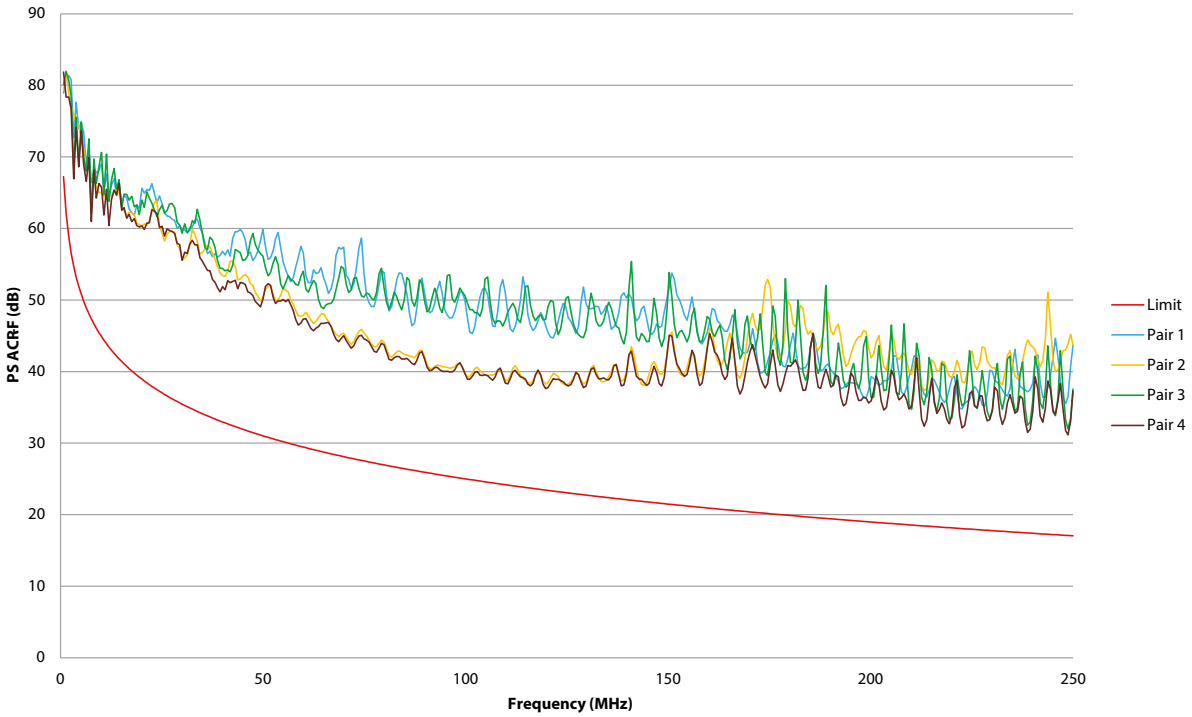
Power Sum NEXT



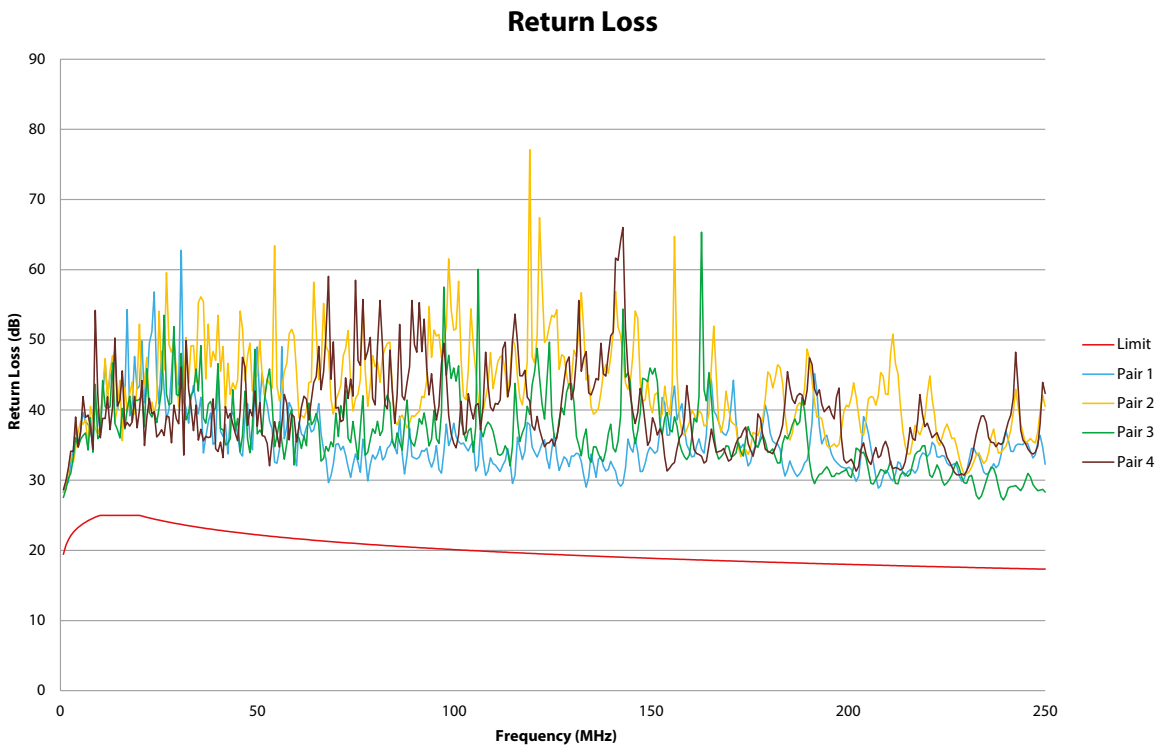
ACR-F



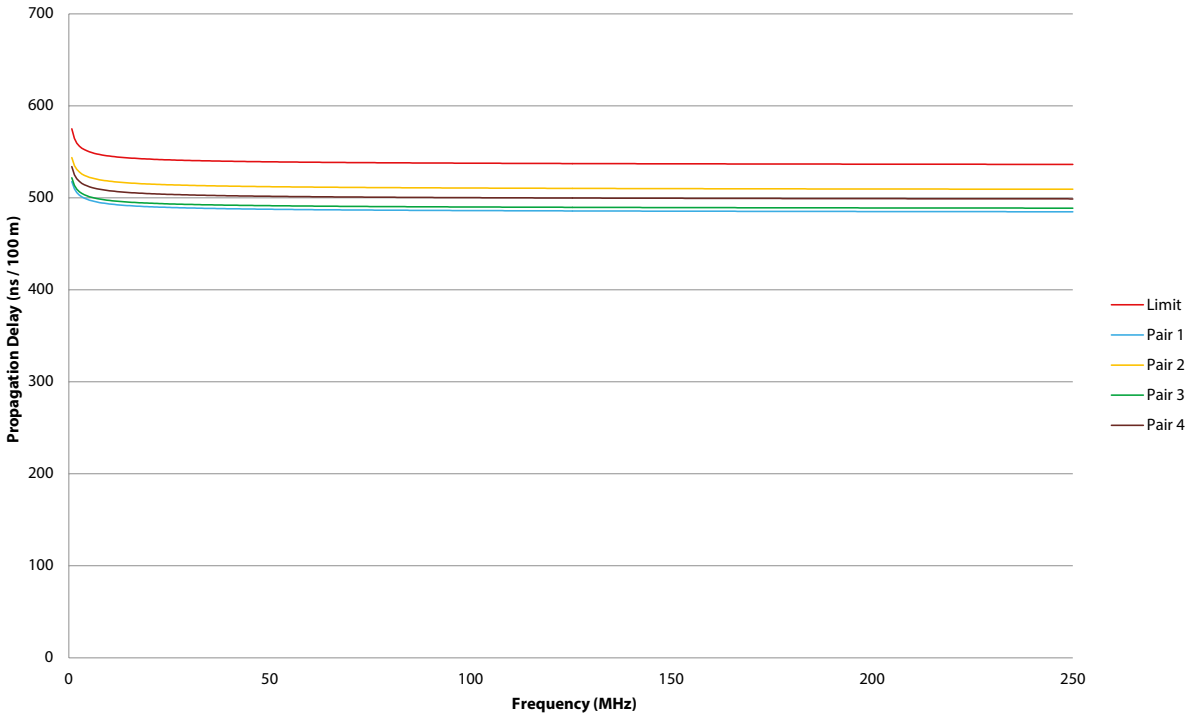
Power Sum ACRF



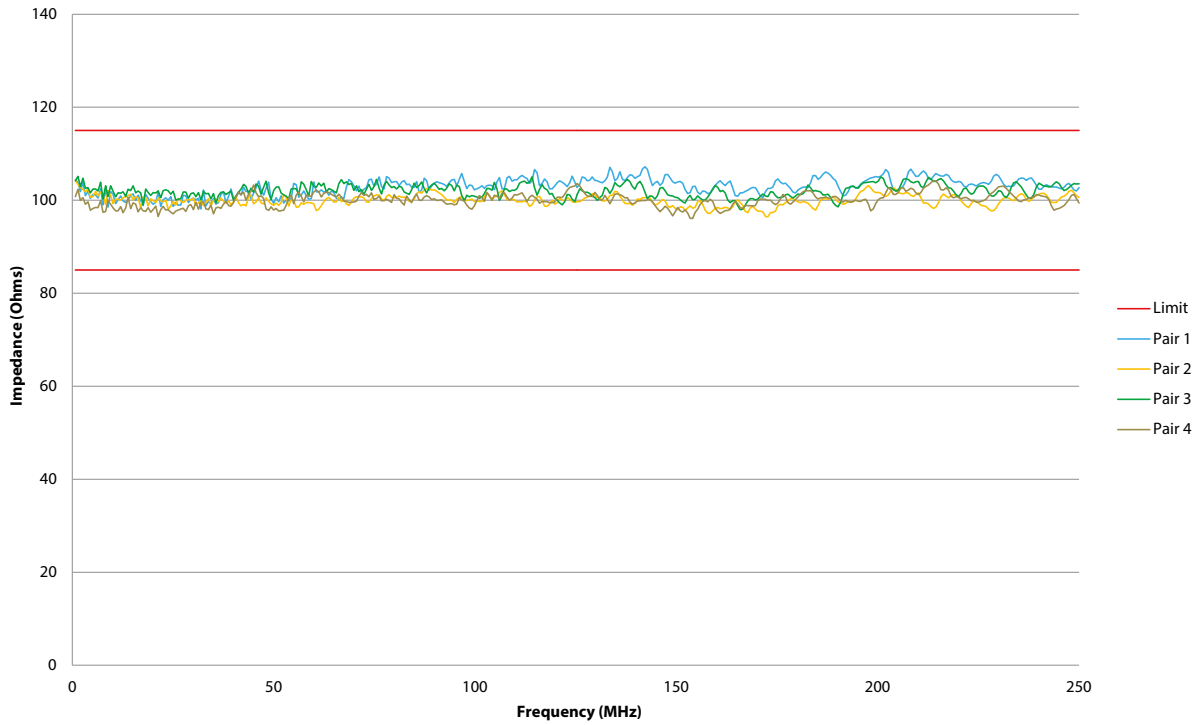
Return Loss



Propagation Delay



Impedance



UPDATED for V5

S8

Excel Modular Panel - Product Selector

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

Modules		Patch Panels		
		Excel 16 Port Unloaded Keystone Patch Panel Frame - Black	Excel 24 Port Unloaded Keystone Patch Panel Frame - Black	Excel 16 Port Unloaded Keystone Patch Panel Frame - Chrome
		P/N 100-025	P/N 100-026	P/N 100-027
				
Excel Angled Butterfly Keystone Jack - Toolless				
P/N 100-185 Chrome - Screened - Category 6_A				
P/N 100-213 Black - Unscreened - Category 6				
Excel Butterfly Keystone Jack - Toolless				
P/N 100-801 Chrome Screened - Category 8		✓	✓	✓
P/N 100-181 Chrome Low Profile Screened - Category 6_A		✓	✓	✓
P/N 100-183 Chrome Low Profile Screened - Category 6_A*		✓	✓	✓
P/N 100-184 Chrome Shuttered Low Profile Screened - Category 6_A		✓	✓	✓
P/N 100-182-WT White Low Profile Unscreened - Category 6_A		✓	✓	✓
P/N 100-182-BK Black Low Profile Unscreened - Category 6_A		✓	✓	✓
P/N 100-180 Screened Keystone Jack, Toolless - Category 6_A		✓	✓	✓
P/N 100-210 Chrome Screened, Toolless - Category 6		✓	✓	✓
P/N 100-215-WT White Low Profile Unscreened - Category 6		✓	✓	✓
P/N 100-215-BK Black Low Profile Unscreened - Category 6*		✓	✓	✓
P/N 100-208-WT White Low Profile Unscreened - Category 6*		✓	✓	✓
P/N 100-208-BK Black Low Profile Unscreened - Category 6		✓	✓	✓
P/N 100-906 Chrome Screened - Category 5e		✓	✓	✓
P/N 100-202-WT White Low Profile Unscreened - Category 5e		✓	✓	✓
P/N 100-202-BK Black Low Profile Unscreened - Category 5e		✓	✓	✓
Excel Unscreened Keystone Jack IDC				
P/N 100-156 White Unscreened - Category 6_A		✓	✓	✓
P/N 100-156-BK Black Unscreened - Category 6_A		✓	✓	✓
P/N 100-011 White Unscreened - Category 6		✓	✓	✓
P/N 100-011-BK Black Unscreened - Category 6		✓	✓	✓
P/N 100-010 White Unscreened - Category 5e		✓	✓	✓
P/N 100-010-BK Black Unscreened - Category 5e		✓	✓	✓
Excel Screened Through Couplers				
P/N 100-107 Chrome Screened - Category 6_A		✓	✓	✓
P/N 100-106 Chrome Screened - Category 6		✓	✓	✓
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		✓	✓	✓

*Designed for the Nordic Market - speak to our sales team for more information

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

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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 48-port Keystone Patch Panel Frame, 1U	Excel 48-port Keystone UTP Patch Panel Frame, 1U	Excel 24 Port Unloaded Key-stone Patch Panel Frame - Screened, 1U - Black
P/N 100-028	P/N 100-023	P/N 100-024	P/N 100-040	P/N 100-041	P/N 100-042	P/N 100-050	P/N 100-755
							
	✓ ✓	✓ ✓					
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓			✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
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✓ ✓ ✓ ✓			✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓

UPDATED for V5

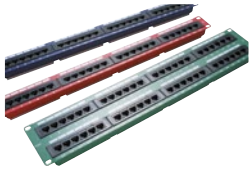
S8

Excel Patch Panel - Product Selector

ZERO Plastic Packaging

Excel patch panels are supplied in 100% plastic free packaging

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 Force Technology certificates, where applicable, please visit the downloads area of **www.excel-networking.com**

Excel Mounting Hardware - Product Selector Modules - 6c

UPDATED for V5

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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 Force Technology certificates, where applicable, please visit the Excel website **www.excel-networking.com**

UPDATED for V5

S8

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		✓	✓	✓	✓	✓			✓	✓

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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,		✓	✓	✓	✓			✓	✓
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		✓	✓	✓	✓	✓	✓	✓	✓

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Excel Mounting Hardware - Product Selector

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

Keystone		Shutter		
		45mm x 45mm	50mm x 50mm	45mm x 45mm
		Excel Curved Keystone Shutters	Excel Angled 2 Port Keystone Faceplate	Excel Flat Keystone Shutters
		P/N 100-281 & 100-282	P/N 100-283 & 100-284	P/N 100-289 & 100-290
				
Excel Category 6_A Screened Keystone Toolless Jack P/N 100-180 - Chrome		✓	✓	✓
Excel Category 6_A Low Profile Screened Keystone Toolless Jack P/N 100-181 - Chrome		✓	✓	✓
Excel Category 6_A Low Profile Screened Keystone Toolless Jack P/N 100-183 - Chrome*		✓	✓	✓
Excel Category 6_A Low Profile Unscreened Keystone Toolless Jack P/N 100-182-WT - White P/N 100-182-BK - Black		✓	✓	✓
Excel Category 6_A Unscreened Keystone Toolless Jack P/N 100-156 - White P/N 100-156-BK - Black		✓	✓	✓
Excel Category 6 Screened Keystone Toolless Jack P/N 100-210 - Chrome		✓	✓	✓
Excel Category 6 Unscreened Keystone Jack P/N 100-011 - White P/N 100-011-BK - Black		✓	✓	✓
Excel Category 6 Low Profile Unscreened Keystone Toolless Jack P/N 100-215-WT - White P/N 100-215-BK - Black		✓	✓	✓
Excel Category 6 Low Profile Unscreened Keystone Toolless Jack P/N 100-208-WT - White* P/N 100-208-BK - Black*		✓	✓	✓
Excel Category 5e Screened Keystone Toolless Jack P/N 100-906 - Chrome		✓	✓	✓
Excel Category 5e Low Profile Unscreened Keystone Toolless Jack P/N 100-202-WT - White P/N 100-202-BK - Black		✓	✓	✓
Excel Category 5e Unscreened Keystone Jack P/N 100-010 - White P/N 100-010-BK - Black		✓	✓	✓
Excel Category 6_A Screened Keystone Through Coupler P/N 100-107 - Chrome		✓	✓	✓
Excel Category 6 Screened Keystone Through Coupler P/N 100-106 - Chrome		✓	✓	✓

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*Designed for the Nordic Market - speak to our sales team for more information