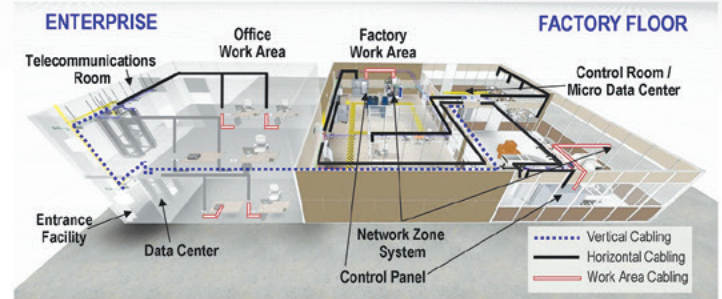


# Industrial Ethernet Physical Layer Solutions

As Ethernet increasingly drives to the plant floor, the right physical layer cabling installation is becoming even more critical to the Operational Technology (OT) community. Panduit offers comprehensive copper and fiber cabling solutions for both structured and point-to-point architectures that contribute to overall network reliability as plants become more connected. Standards based solutions are available in many performance levels and configurations offering flexibility and fast installation for a variety of demanding industrial applications.



## Key Features

## Benefits

<b>Alignment with Rockwell Automation* / Cisco** Converged Plantwide Ethernet architecture</b>	Conforms to best practices from leading network infrastructure and control equipment vendors
<b>Structured cabling</b>	Facilitates fast and easy moves, adds and changes through patching
<b>Point-to-point cabling</b>	Provides a variety of options for easy installation
<b>Field terminable copper and fiber connectors</b>	Deliver highest performance combined with rapid and reliable deployment
<b>600 V Rated, PVC, PUR, TPE and high flex cable options</b>	Ensure performance and reliability in varied, demanding industrial applications
<b>DCF and PCF fiber cables</b>	Offer reliable data transfer for distances greater than 100 meters

## Cabling Standards and References

- ANSI/TIA 568 Series — Commercial Building Telecommunications Cabling Standard and Series
- ANSI/TIA 1005-A — Telecommunications Infrastructure Standard for Industrial Premises
- ISO/IEC 11801 — Information technology - Generic cabling for customer premises and series
- ISO/IEC 24702 — Information technology - Generic cabling - Industrial premises
- IEC 60529 — Specification for classification of degrees of protection provided by enclosures
- IEC 61156-5 — Multicore and symmetrical pair/quad cables for digital communications – Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Horizontal floor wiring – Sectional specification
- IEC 61156-6 — Multicore and symmetrical pair/quad cables for digital communications – Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification
- Cenelec EN 50173-1 — Information technology. Generic cabling systems. General requirements
- Cenelec EN 50173-3 — Information technology. Generic cabling systems. Part 3: Industrial premises
- ODVA EtherNet/IP\*\*\* Specification (Chapter 8)

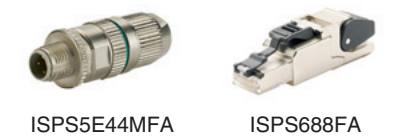
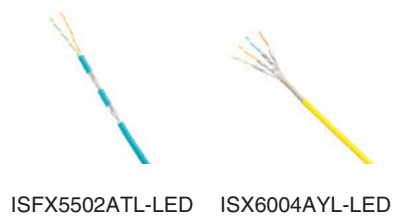
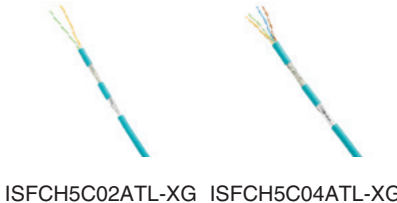
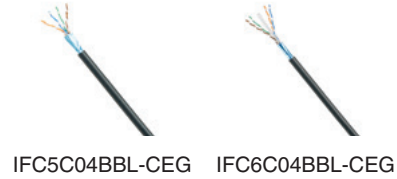
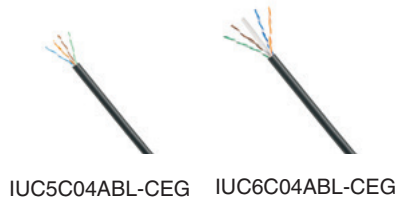
\*Rockwell Automation is registered by Rockwell Automation in the Patent and Trademark Office of the United States.

\*\*Cisco is a registered trademark of Cisco Technology Inc.

\*\*\* EtherNet/IP is a trademark of ODVA.

# Industrial Ethernet Physical Layer Solutions

## Copper Physical Layer Solutions



Part Number	Description
IUC5C04ABL-CEG	IndustrialNet™ Copper Cable; Category 5e, 4-pair, unshielded U/UTP; conductors are stranded, 24/7 AWG, HDPE insulation, twisted in pairs; jacket is PVC, flame retardant CM.
IUC6C04ABL-CEG	IndustrialNet™ Copper Cable; Category 6, 4-pair, unshielded U/UTP; conductors are 24/7 AWG with HDPE insulation, twisted in pairs; jacket is PVC.
IFC5C04BBL-CEG	IndustrialNet™ Copper Cable; Category 5e, 4-pair, shielded F/UTP; conductors are stranded, 26/7 AWG with HDPE insulation, twisted in pairs, surrounded by an overall metallic foil shield; jacket is PVC, flame-retardant CM.
IFC6C04BBL-CEG	IndustrialNet™ Copper Cable; Category 6, 4-pair, shielded F/UTP; conductors are 26/7 AWG with HDPE insulation, twisted in pairs, surrounded by an overall metallic foil shield; jacket is PVC, flame-retardant CM.
ISFCH5C02ATL-XG	IndustrialNet™ Copper Cable; Category 5e, 2-pair, shielded SF/UTP; conductors are stranded, 24/7 AWG with HDPE insulation, twisted in pairs, surrounded by an overall metallic foil with a braided shield; jacket is TPE, flame-retardant CM/CMX; 600 V rated, high-flex.
ISFCH5C04ATL-XG	IndustrialNet™ Copper Cable; Category 5e, 4-pair, shielded SF/UTP; conductors are 24/7 AWG with HDPE insulation, twisted in pairs, surrounded by an overall metallic foil with a braided shield; jacket is TPE, flame-retardant CM/CMX; 600 V rated, high-flex.
ISFX5502ATL-LED	IndustrialNet™ Copper Cable; Category 5e, 2-pair, shielded SF/UTP; conductors are 24/7 AWG with PE insulation, twisted in pairs, surrounded by an overall metallic foil and braided sleeve; jacket is PUR, flame-retardant, halogen-free; high-flex.
ISX6004AYL-LED	IndustrialNet™ Copper Cable; Category 6, 4-pair, shielded S/FTP; conductors are 24/7 AWG with PE insulation, twisted in pairs, surrounded by a metallic foil with a braided shield; jacket is PUR, flame-retardant, halogen-free; high-flex.
ISPS5E44MFA	IndustrialNet™ M12 D-Code Plug; 4-position; field terminable; for use with stranded 26/7 - 22/7 AWG Category 5e, unshielded UTP copper cable.
ISPS688FA	IndustrialNet™ RJ45 Plug; 8-position; field terminable; for use with solid 24/1 - 22/1 AWG and stranded 27/7 - 22/7 AWG, 1.0-1.6mm, Category 6A, unshielded UTP and shielded STP copper cable.
ISPS688FAS	IndustrialNet™ RJ45 Plug; 8-position, field terminable; for use with solid 24/1 - 22/1 AWG and stranded 27/7 - 22/7 AWG, 0.85-1.0mm, Category 6A, unshielded UTP and shielded STP copper cable.
ICAM12DRJS	IndustrialNet™ M12 D-Code to RJ45 Industrial Adapter; Category 5e, panel mount.
IAEBH5E	IndustrialNet™ Bulkhead Connector with protective cover; Category 5e, RJ45, 8-position, 8-wire.
IAEBH6	IndustrialNet™ Bulkhead Connector with protective cover; Category 6, RJ45, 8-position, 8-wire.
IAEBH5ES	IndustrialNet™ Bulkhead Connector with protective cover; Category 5e, RJ45, 8-position, 8-wire, shielded.
IAEBH6S	IndustrialNet™ Bulkhead Connector with protective cover; Category 6, RJ45, 8-position, 8-wire, shielded.
IAEBHC5E	IndustrialNet™ Bulkhead Coupler with protective cover; Category 5e, RJ45, 8-position, 8-wire.
IAEBHC6	IndustrialNet™ Bulkhead Coupler with protective cover; Category 6, RJ45, 8-position, 8-wire.
MPI588T	IndustrialNet™ TX5e™ UTP Modular Plug with Bulkhead; 8-position, 8-wire; for use with 24 AWG, Category 5e, copper cable.
MPSI588T	IndustrialNet™ TX5e™ Shielded Modular Plug with Bulkhead; 8-position, 8-wire; for use with 24 AWG, Category 5e, shielded copper cable.
IAEBHUSBAA	IndustrialNet™ Mini-Com® USB 2.0 Female A-A Coupler Module.
IUTPCH3BLY	IndustrialNet™ Copper Patch Cord constructed of industrial grade unshielded UTP Category 5e stranded cable with modular plugs. Includes dust caps.
IUTPSP3BL	IndustrialNet™ Copper Patch Cord constructed of industrial grade unshielded UTP Category 6 stranded cable with modular plugs. Includes dust caps.
ISTPCH1MBLY	IndustrialNet™ Copper Patch Cord constructed of industrial grade shielded F/UTP Category 5e stranded cable with shielded modular plugs. Includes dust caps.

# Industrial Ethernet Physical Layer Solutions

## Copper Physical Layer Solutions (continued)



ISTPHCH1MTL



IAPNWH



CDPP8RG



IABDIN4



CADIN1IG



CWPP12WBL



IAEFP1



IAEFP2-2G

Part Number	Description
ISTPSP1MBL	IndustrialNet™ Copper Patch Cord constructed of industrial grade shielded F/UTP Category 6 stranded cable with shielded modular plugs. Includes dust caps.
ISTPHCH1MTL	IndustrialNet™ Copper Patch Cord, constructed of industrial grade shielded SF/UTP, Category 5e, 600V rated stranded cable, RJ45 plug to RJ45 plug, teal, 1 meter.
IAPNWH	IndustrialNet™ Data Access Port; provides end users a safe and secure means to maintain and monitor performance of PLCs, VFD, and industrial networks.
CDPP8RG	IndustrialNet™ 8-Port DIN Rail Mount Copper Patch Panel; includes screws to attach faceplate, Ultimate ID labels and clear covers; can also mount to other surfaces using mounting holes in latches.
IABDIN4	Industrial Automation Bracket; 4RU; for standard EIA 19" wide rack or cabinet; includes hardware. Installs DIN rail mountable equipment.
CADIN1IG	Mini-Com® DIN Rail Mount Adapter; accepts any single port Mini-Com® Module; includes a label and label cover.
CWPP12WBL	Mini-Com® 12-Port Modular Faceplate Patch Panel; includes three factory installed CFFP4 snap-in faceplates with integrated wall mount bracket.
IAEFP1	IndustrialNet™ Stainless Steel Faceplate; vertical; accepts one IndustrialNet™ Bulkhead Connector or Adapter.
IAEFP2-2G	IndustrialNet™ Stainless Steel Faceplate; double gang, vertical; accepts two IndustrialNet™ Bulkhead Connector or Adapter.

## Fiber Physical Layer Solutions



FLCSHMIG



FIID102



FI2D202



FSPD512



FCCSR10BL



FSLP512



FLCDMEIY



FLCDMC5BLY



FDME8RG



CBXF6BL-AY



ACG24K



FX2ELLNLNSNM002

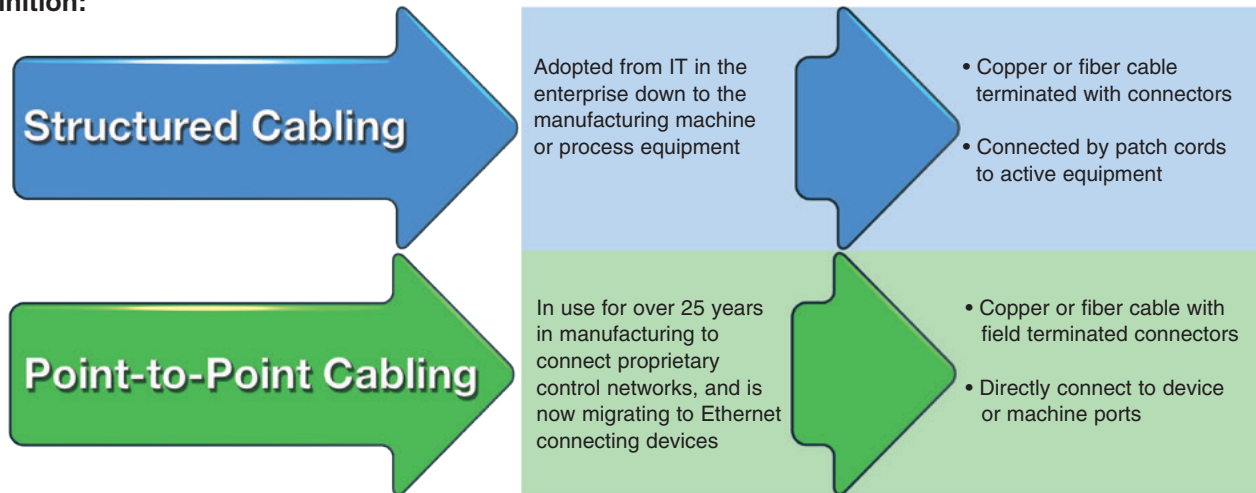
Part Number	Description
FLCSHMIG	LC simplex crimp and cleave fiber optic connector for use with IndustrialNet™ Graded Index (OM1 and OM2) PCF (polymer coated fiber) Multimode Cable in interconnect and breakout cable configurations.
FIID102	Opti-Core® Polymer Coated Fiber (PCF) Cable; 2-fiber; OM1 multimode duplex; LSZH – riser rated interconnect cable. Larger fiber cross-section promotes ease of field installation.
FI2D202	Opti-Core® Polymer Coated Fiber (PCF) Cable; 2-fiber; OM2 multimode; LSZH – riser rated; indoor breakout cable. Larger fiber cross-section promotes ease of field installation.
FSPD512	Opti-Core® Dielectric Conduited Fiber (DCF) Cable; 12-fiber; OM2 multimode; LSZH – riser rated; indoor distribution cable for use in horizontal installations and backbones; no grounding or bonding is required; offers six times the crush resistance of unarmored cable.
FCCSR10BL	DCF fiber strain relief; used with Dielectric Conduited Fiber (DCF) cable; controls the bend radius at the transition of fiber distribution or breakout cables where they exit an armored conduit.
FSLP512	Opti-Core® Fiber Optic Indoor/Outdoor Armored Cable with tight buffered fibers; 12-fiber; OM2 multimode; OFNP (plenum) rated.
FLCDMEIY	LC Fiber Optic Connector for 1.6mm – 2.0mm jacketed cable; OM1 multimode duplex.
FLCDMC5BLY	OptiCam® LC OM2 Multimode Duplex Connector for 900µm tight-buffered fiber installation.
FDME8RG	IndustrialNet™ 8-port DIN Rail Fiber Optic Enclosure; provides enclosed fiber protection for terminated distribution style cabling; includes a PG21 or 3/4 NPT cable cord grip to secure fiber cable(s) exiting the enclosure.
CBXF6BL-AY	Mini-Com® Surface Mount Box accepts up to six Mini-Com® Modules; includes built-in fiber spool that stores up to 24 meters of buffered fiber optic cable; icon slots available for optional icons; dimensions: 0.98"H x 4.70"W x 6.66"L (25.0mm x 119.4mm x 169.2mm).
ACG24K	StructuredGround™ Grounding Jumper for armored cable; #6 AWG diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end.
FX2ELLNLNSNM002	Opti-Core® Fiber Optic Patch Cord; 2-fiber; OM3 multimode; LC duplex to LC duplex; LSZH – riser rated; 1.6mm jacket patch cord; Std. IL – straight through connection type.

# Industrial Ethernet Physical Layer Solutions

## Structured vs. Point-to-Point Cabling

When assessing the cabling network topology to determine whether to use structured cabling or point-to-point cabling, the primary considerations are the design specs, network longevity, maintainability, and installation. These considerations will help choose the best cabling option for the Ethernet industrial automation application.

### Definition:



### Pros and Cons:

Primary Considerations	Structured Cabling	Point-to-Point Cabling
<b>Meet Design Specifications</b>	<ul style="list-style-type: none"> <li>High cable density – many cables from panel to panel</li> <li>Testability at the panel can provide assurance for commissioning new ports and may yield potentially longer warranty terms</li> </ul>	<ul style="list-style-type: none"> <li>Low cable density – few cables from panel to machine</li> <li>Ring or linear topology using copper cabling where distance between connections is &lt; 100 meters</li> <li>PCF for long reach or noise mitigation</li> </ul>
<b>Network Longevity (Future Proof)</b>	<ul style="list-style-type: none"> <li>Designed in spare ports (no need to re-pull new cables for 'adds')</li> <li>Fiber backbones with higher grade fiber such as OM3 or OM4</li> </ul>	<ul style="list-style-type: none"> <li>Impractical to have spare cable runs laying loose and/ or unprotected</li> <li>Higher performance with fewer connectors</li> </ul>
<b>Maintainability (Moves, Adds, and Changes)</b>	<ul style="list-style-type: none"> <li>Environments with multiple changes occurring</li> <li>Cable slack is required</li> </ul>	<ul style="list-style-type: none"> <li>Environments with minimal changes occurring</li> <li>Slack cabling is undesired and precise cable lengths are required</li> </ul>
<b>Installation</b>	<ul style="list-style-type: none"> <li>Multiple points of connectivity</li> <li>Backbone and horizontal cabling is largely untouched</li> </ul>	<ul style="list-style-type: none"> <li>Quick installation</li> <li>Use where tight bends or moderate flexing is required</li> <li>Use in areas where it is impractical or impossible to mount a patch panel or other cable connector interface</li> </ul>

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