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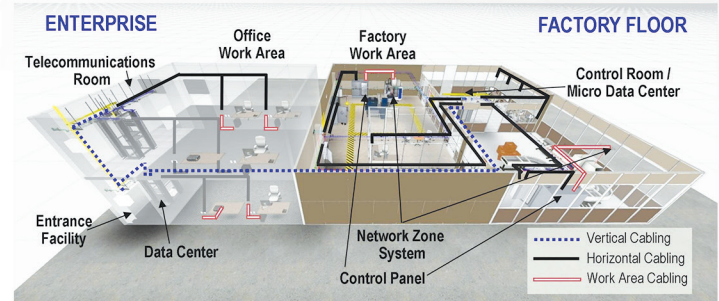
| Key Features | Benefits |
| --- | --- |
| Alignment with Rockwell Automation* / Cisco** Converged Plantwide Ethernet architecture | Conforms to best practices from leading network infrastructure and control equipment vendors |
| Structured cabling | Facilitates fast and easy moves, adds and changes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

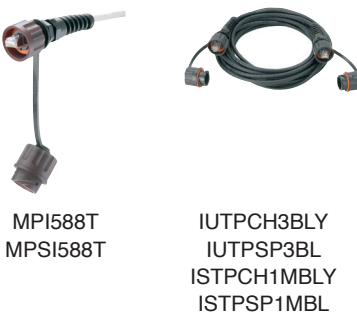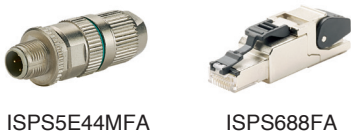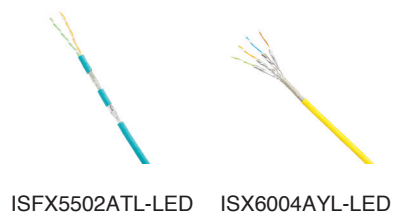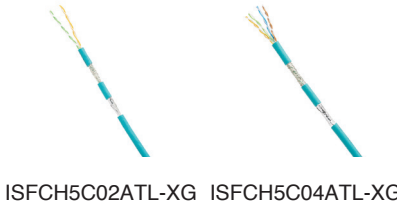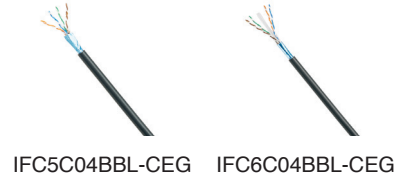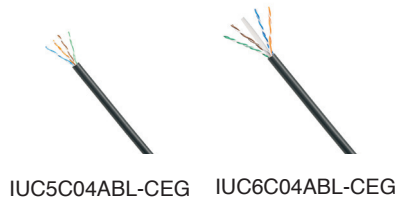ODVA EtherNet/IP*** Specification (Chapter 8)

*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.

## Copper Physical Layer Solutions

IUC5C04ABL-CEG    IUC6C04ABL-CEG

IFC5C04BBL-CEG    IFC6C04BBL-CEG

ISFCH5C02ATL-XG   ISFCH5C04ATL-XG

ISFX5502ATL-LED   ISX6004AYL-LED

ISPS5E44MFA    ISPS688FA

ICAM12DRJS     IAEBHxx

MPI588T        IUTPCH3BLY
MPSI588T       IUTPSP3BL
               ISTPCH1MBLY
               ISTPSP1MBL

| 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. |

## Copper Physical Layer Solutions (continued)

ISTPHCH1MTL

IAPNWH

CDPP8RG

IABDIN4

CADIN1IG

CWPP12WBL

IAEFP1

IAEFP2-2G

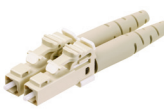| Part Number | Description |
|---|---|
| ISTPSP1MBL | IndustrialNet™ Copper Patch Cord constructed of industrial grade shielded F/UTP Category 6 stranded cable with shielded modular plugs. Includes dust caps. |
| ISTPHCH1MTL | IndustrialNet™ Copper Patch Cord, constructed of industrial grade shielded 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

FIID102

FI2D202

FSPD512

FCCSR10BL

FSLP512

FLCDMEIY

FLCDMC5BLY

FDME8RG
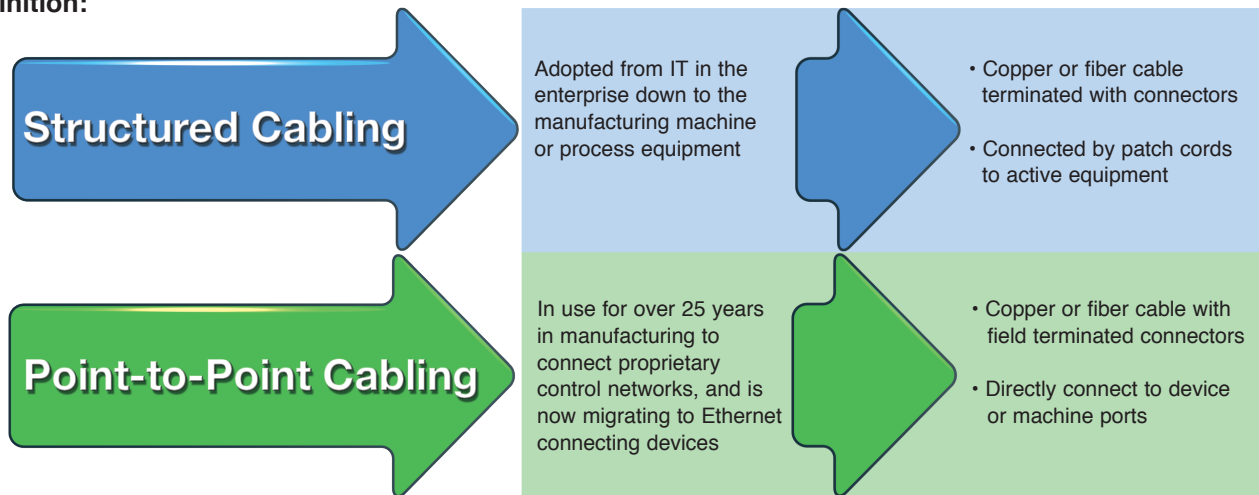
CBXF6BL-AY

ACG24K

FX2ELLNLNSNM002

| Part Number | Description |
|---|---|
| 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. |

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## 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:**

**Structured Cabling**

Adopted from IT in the enterprise down to the manufacturing machine or process equipment

- Copper or fiber cable terminated with connectors
- Connected by patch cords to active equipment

**Point-to-Point Cabling**

In use for over 25 years in manufacturing to connect proprietary control networks, and is now migrating to Ethernet connecting devices

- Copper or fiber cable with field terminated connectors
- Directly connect to device or machine ports

**Pros and Cons:**

| Primary Considerations | Structured Cabling | Point-to-Point Cabling |
|---|---|---|
| **Meet Design Specifications** | • High cable density – many cables from panel to panel<br><br>• Testability at the panel can provide assurance for commissioning new ports and may yield potentially longer warranty terms | • Low cable density – few cables from panel to machine<br><br>• Ring or linear topology using copper cabling where distance between connections is < 100 meters<br><br>• PCF for long reach or noise mitigation |
| **Network Longevity** (Future Proof) | • Designed in spare ports (no need to re-pull new cables for 'adds')<br><br>• Fiber backbones with higher grade fiber such as OM3 or OM4 | • Impractical to have spare cable runs laying loose and/or unprotected<br><br>• Higher performance with fewer connectors |
| **Maintainability** (Moves, Adds, and Changes) | • Environments with multiple changes occurring<br><br>• Cable slack is required | • Environments with minimal changes occurring<br><br>• Slack cabling is undesired and precise cable lengths are required |
| **Installation** | • Multiple points of connectivity<br><br>• Backbone and horizontal cabling is largely untouched | • Quick installation<br><br>• Use where tight bends or moderate flexing is required<br><br>• Use in areas where it is impractical or impossible to mount a patch panel or other cable connector interface |

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