Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks

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Introduction

This bulletin identifies the different types of cabling and junction boxes that may be used in twisted pair LONWORKS networks. The recommendations presented herein are intended to assist network integrators, OEMs, electrical system designers, interconnection device manufacturers, and cable manufacturers, and are provided for informational purposes only.

For specific details on the operation and cabling requirements of the FT 3120®/FT 3150® Free Topology Smart Transceivers, TP/FT-10 (FTT-10A and LPT transceivers), TP/XF-78 (TPT/XF-78 transceiver), TP/XF-1250 (TPT/XF-1250 transceiver), and TP-RS485 (TP-RS485 control module) channels please refer to the pertinent user's guides. The guides can be downloaded from Echelon's web site at `www.echelon.com`.

This document also includes specifications for twisted pair cabling for use in train braking applications compliant with the requirements of the Association of American Railroads. The AAR application uses the PL-20 channel (PLT-22 Power Line Transceiver or PL 3120 or PL 3150 Power Line Smart Transceiver) operating over a doubly terminated twisted pair power cable 3 kilometers in length. In such applications a special, non-standard coupling circuit and cable terminations are required, please contact Echelon for details.

Network Cabling

TP/FT-10 Free Topology Channel

Five cable types have been validated for the TP/FT-10 channel. These cable types are:

Cable Type	*AWG*	*Diameter*
TIA 568A Category 5 cable	24WAWG	0.5mm
Belden 8471 (PVC jacket) or equivalent cable	16AWG	1.3mm
Belden 85102 (Tefzel jacket) or equal cable	16AWG	1.3mm
Level IV cable	22AWG	0.65mm
JY (st) Y 2x2x0.8	20.4AWG	0.8mm

The distance limitations, electrical characteristics, and suppliers of these cables follow. Link power applications have unique distance limitations based on power consumption. Please refer to the pertinent LPT user's guide for details.

TP/XF-78 Bus Topology Channel

One cable type has been validated for the TP/XF-78 channel (for use with the TPT/XF-78 Bus Topology Transceiver). The only approved cable type is:

Cable Type	*AWG*	*Diameter*
Level IV cable	22AWG	0.65mm

The distance limitations, electrical characteristics, and suppliers of this cable are presented below.

TP/XF-1250 Bus Topology Channel

Two cable types have been validated for the TP/XF-1250 channel (for use with the TPT/XF-1250 Bus Topology Transceiver). These cable types are:

Cable Type	*AWG*	*Diameter*
TIA 568A Category 5 cable	24AWG	0.5mm
Level IV cable	22AWG	0.65mm

The distance limitations, electrical characteristics, and suppliers of these cables are presented below.

TP-RS485 Channel

Channels employing RS-485 transceivers should use only a shielded, twisted pair cable approved by the manufacturer for use with EIA RS-485 transceivers.

PL-20 Channel for Train Braking

One cable type has been validated for use with the PL-20 channel for long distance signaling on S-4210 cable configured in a doubly terminated bus. This cable type is as follows:

Cable Type	*AWG*	*Diameter*
AAR S-4210 twin-axial, 50 Ohm cable	8WAWG	3.3mm

Cable Specifications

TIA 568A Category 5 Cable

The specifications for Category 5 cabling are defined by the Telecommunications Industry Association standard 568A. The typical parameters of this cable are as follows:

Wire Diameter (mm/AWG)	*Resistance Rloop Ω/km*	*Capacitance nF/km*	*Velocity of Propagation Vprop % of c*
0.51mm/24	168	46	58

Echelon has qualified cabling that meets the TIA 568A standard, and any cabling – from any manufacturer - that meets this standard is acceptable.

For the TP/FT-10 channel operating in a bus topology, the maximum bus length of TIA 568A Category 5 cabling is 900 meters, with a maximum stub length of 3 meters.

For the TP/FT-10 channel operating in free topology, the maximum length of TIA 568A Category 5 cabling is 250 meters maximum node-to-node distance, and 450 meters maximum total wire length.

For the TP/XF-1250 channel operating in a bus topology, the maximum bus length of TIA 568A Category 5 cabling is 130 meters, with a maximum stub length of 0.3 meters. There are topology restrictions associated with the use of this channel – refer to Chapter 5 of the *TPT Twisted Pair Transceiver User's Guide* **before** installing any cabling for this channel.

Belden 8471 Cable

Belden 8471 16AWG (1.3mm) cable may be used only with the TP/FT-10 channel. Belden does not publish those 8471 cable parameters that affect signaling on TP/FT-10 channels, however, Echelon has measured the following important parameters:

Wire Diameter (mm/AWG)	*Resistance Rloop Ω/km*	*Capacitance nF/km*	*Velocity of Propagation Vprop % of c*
1.3mm/16	28	72	55

For the TP/FT-10 channel operating in a bus topology, the maximum bus length of Belden 8471 cabling is 2700 meters, with a maximum stub length of 3 meters.

For the TP/FT-10 channel operating in free topology, the maximum length of Belden 8471 cabling is 400 meters maximum node-to-node distance, and 500 meters maximum total wire length.

Belden 85102 Cable

Belden 85102 16AWG (1.3mm) cable may be used only with TP/FT-10 channels. Belden does not publish those 85102 cable parameters that affect signaling on TP/FT-10 channels, however, Echelon has analyzed this cable in some detail. The following specifications can be used by cable suppliers to produce an equivalent cable:

	Minimum	*Typical*	*Maximum*	*Units*	*Condition*
DC Resistance, each conductor	14.0	14.7	15.5	Ω/km	20°C per ASTM D 4566
DC Resistance Unbalance			5%		20°C per ASTM D 4566
Mutual Capacitance			55.9	nF/km	Per ASTM D 4566
Characteristic Impedance	92	100	108	Ω	64kHz to 1MHz per ASTM D 4566
Attenuation 20kHz 64kHz 78kHz 156kHz 256kHz 512kHz 772kHz 1000kHz			 1.3 1.9 2.2 3.0 4.8 8.1 11.3 13.7	 dB/km	 20°C per ASTM D 4566
Propagation Delay			5.6	nsec/m	78kHz

For the TP/FT-10 channel operating in a bus topology, the maximum bus length of Belden 85102 cabling is 2700 meters, with a maximum stub length of 3 meters.

For the TP/FT-10 channel operating in free topology, the maximum length of Belden 85102 cabling is 500 meters maximum node-to-node distance, and 500 meters maximum total wire length.

Level 4 Cable

Level 4 cable may be used with TP/FT-10, TP/XF-78, or TP/XF-1250 channels. The Level 4 cable specification used by Echelon and as originally defined by the National Electrical Manufacturers Association (NEMA) differs from the Category 4 specification proposed by the Electronic Industries Association/Telecommunication Industry Association (EIA/TIA). The following specifications can be used by cable suppliers to identify a compliant Level 4 cable – or produce an equivalent cable:

Specifications apply to shielded or unshielded 22AWG (0.65mm) cable, 24AWG (0.5mm) cable shown in brackets [ ] if different	
D-C Resistance (Ohms/1000 feet at 20°C) maximum for a single copper conductor regardless of whether it is solid or stranded and is or is not metal-coated.	18.0 [28.6]
D-C Resistance Unbalance (percent) maximum	5
Mutual Capacitance of a Pair (pF/foot) maximum	17
Pair-to-Ground Capacitance Unbalance (pF/1000 feet) maximum	1000
Characteristic Impedance (Ohms)	
772kHz	102±15%
1.0MHz	100±15%
4.0MHz	100±15%
8.0MHz	100±15%
10.0MHz	100±15%
16.0MHz	100±15%
20.0MHz	100±15%
Attenuation (dB/1000 feet at 20°C) maximum	
772kHz	4.5 [5.7]
1.0MHz	5.5 [6.5]
4.0MHz	11.0 [13.0]
8.0MHz	15.0 [19.0]
10.0MHz	17.0 [22.0]
16.0MHz	22.0 [27.0]
20.0MHz	24.0 [31.0]
Worst-Pair Near-End Crosstalk (dB) minimum. Values are shown for information only. The minimum NEXT coupling loss for any pair combination at room temperature is to be greater than the value determined using the formula NEXT (F_{MHz})>NEXT(0.772)-$15\log_{10}(F_{MHz}/0.772)$ for all frequencies in the range of 0.772MHz-20MHz for a length of 1000 feet.	
772kHz	58
1.0MHz	56
4.0MHz	47
8.0MHz	42
10.0MHz	41
16.0MHz	38
20.0MHz	36

For the TP/FT-10 channel operating in a bus topology, the maximum bus length of Level 4 22AWG (0.65mm) cabling is 1400 meters, with a maximum stub length of 3 meters.

For the TP/FT-10 channel operating in free topology, the maximum length of Level 4 22AWG (0.65mm) cabling is 400 meters maximum node-to-node distance, and 500 meters maximum total wire length.

For the TP/XF-78 channel operating in a bus topology, the maximum bus length of 4 22AWG (0.65mm) cabling is 1400 meters, with a maximum stub length of 3 meters. There are topology restrictions associated with the use of this channel – refer to Chapter 5 of the *TPT Twisted Pair Transceiver User's Guide* **before** installing any cabling for this channel.

For the TP/XF-1250 channel operating in a bus topology, the maximum bus length of 4 22AWG (0.65mm) cabling is 130 meters, with a maximum stub length of 0.3 meters. There are topology restrictions associated with the use of this channel – refer to Chapter 5 of the *TPT Twisted Pair Transceiver User's Guide* **before** installing any cabling for this channel.

JY (st) Y 2x2x0.8 Cable

JY (st) cable is available only in Europe, and may be used only with the TP/FT-10 channel. Cable parameters that affect signaling on TP/FT-10 channels are not published for this cable, however, Echelon has measured the following important parameters:

Wire Diameter (mm/AWG)	*Resistance Rloop Ω/km*	*Capacitance nF/km*	*Velocity of Propagation Vprop % of c*
0.8mm/20.4	73	98	41

For the TP/FT-10 channel operating in a bus topology, the maximum bus length of JY (st) cabling is 900 meters, with a maximum stub length of 3 meters.

For the TP/FT-10 channel operating in free topology, the maximum bus length of JY (st) cabling is 320 meters maximum node-to-node distance, and 500 meters maximum total wire length.

S-4210 Cable for Train Braking on PL-20 Channel

S-4210 cable is a two conductor, twinaxial cable for exclusive use with the PLT-22 Power Line Transceiver and PL 3120/PL 3150 Power Line Smart Transceivers. Specialized coupling and termination circuits are required for this application.

Wire Diameter (mm/AWG)	*Conductors*	*Characteristic Impedance (Ω)*	*Construction*
3.3mm/8	2	50	Twinaxial

The PL-20 channel for train braking must be operated in a doubly terminated bus topology, and will function at distances of at least 3 kilometers with 160 PLT-22-based or smart transceiver devices, and no stubs. Contact your Echelon representative for details on coupling circuits.



Untwisted wires, or cables containing flat or parallel untwisted conductors must not be used on an LONWORKS twisted pair channel. The use of thses wiers/cables may result in improper network operation and could, under certain circumstances, result in damage to nodes connected to such a channel.

Cable Suppliers

The following cable suppliers have stated that their listed cables comply with Echelon wire guidelines.

Belden Wire & Cable Company

Corporate

2200 U.S. 27 South
Richmond, Indiana 47374
Phone: +1-765-983-5200
Phone: 1-800-235-3361
Fax: +1-765-983-5294
Web: belden.com

Europe Head Office

Edisonstraat 9
5928 PG Venlo
The Netherlands
Phone: +31 (0) 77 3878555
Fax: +31 (0) 77 3878448

Asia/Pacific Head Office

100 Olympia Street
Tottenham, Victoria 3012
Australia
Phone: +61 (3) 9224 2800
Fax: +61 (3) 9314 8515

Africa/ Middle East Head Office

P.O. Box 17308
Jebel Ali
Dubai, U.A.E.
Phone: +971 4 814723
Fax: +971 4 814726

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
16AWG (1.3mm)	1	Unshielded High temperature	85102
16AWG (1.3mm)	1	Unshielded PVC jacket Non-plenum	8471
Category 5	Various	Various	Contact mfg.

BICCGeneral
(BICC Cable, Brand-Rex, General Cable, Carol Cable)

Corporate

4 Tesseneer Drive
Highland Heights, Kentucky 41076-9753
Phone: +1-606-572-8000
Phone: 1-800-424-5666
Fax: +1-606-572-8458
Web: www.biccgeneral.com

Europe Head Office

Stewarts Road
Finedon Road Industrial Estate
Wellingborough
Northants, NN8 4RJ
United Kingdom
Phone: +44(0) 1933-277700
Fax: +44(0) 1933-273696

Asia / Pacific Head Office

435 Orchard Road #17-02 Wisma Atria
Singapore 238877
Phone: +65-734 1151
Fax: +65-734 1191

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	C8601
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	C8611
Level 4 22AWG (0.65mm)	1	Unshielded Non-plenum U.L. Type CM	C8641
Level 4 22AWG (0.65mm)	1	Shielded Non-plenum U.L. Type CM	C8651
16AWG (1.3mm)	1	Unshielded Plenum U.L. Type CMP	C8621
16AWG (1.3mm)	1	Unshielded Non-plenum U.L. Type CM	C8661
Category 5	Various	Various	Contact mfg.
S-4210 8AWG (3.3mm)	1	Twin-axial, 50 Ohm	Brand-Rex T-75128

The Cable Company

498 Bonnie Lane
Elk Grove, Illinois 60007
U.S.A
Phone: 1-847-437-5267
Fax: +1-847-437-8820
Web: www.thecableco.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Non-plenum U.L. Type CMR	0612ECH
Level 4 22AWG (0.65mm)	2	Unshielded Non-plenum U.L. Type CMR	0614ECH
Level 4 22AWG (0.65mm)	1	Shielded Non-plenum U.L. Type CMR	0732ECH
Level 4 22AWG (0.65mm)	2	Shielded Non-plenum U.L. Type CMR	0734ECH
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	5012ECH
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	5014ECH
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	5202ECH
Level 4 22AWG (0.65mm)	2	Shielded Plenum U.L. Type CMP	5204ECH
16AWG (1.3mm)	1	Unshielded Non-plenum U.L. Type CMR	0652ECH
16AWG (1.3mm)	1	Unshielded Plenum U.L. Type CMP	5052ECH

Calvert Wire and Cable Corporation

5091 West 164th Street
Brook Park, OH. 44142
USA
Phone: +1-216-433-7600
Fax: +1-216-433-7614
Web: www.calvert-wire.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1 Stranded	Unshielded Non-plenum U.L. Type CMR	RD3001-LON
Level 4 22AWG (0.65mm)	2 Stranded	Unshielded Non-plenum U.L. Type CMR	RD2P3001-LON
Level 4 22AWG (0.65mm)	1 Stranded	Shielded Non-plenum U.L. Type CMR	RD3011-LON
Level 4 22AWG (0.65mm)	2 Stranded	Shielded Non-plenum U.L. Type CMR	RD2P3011-LON
Level 4 22AWG (0.65mm)	1 Stranded	Unshielded Plenum U.L. Type CMP	MDC3001-LON
Level 4 22AWG (0.65mm)	2 Stranded	Unshielded Plenum U.L. Type CMP	DMC2P3001-LON
Level 4 22AWG (0.65mm)	1 Stranded	Shielded Plenum UL CMP	DMC3011-LON
Level 4 22AWG (0.65mm)	2 Stranded	Shielded Plenum U.L. Type CMP	DMC2P3011-LON
Level 4 24AWG (0.5mm)	1 Stranded	Shielded Plenum U.L. Type CMP	402-241PFSB
Level 4 24AWG (0.5mm)	2 Stranded	Shielded Plenum U.L. Type CMP	402-242PFSO
Level 4 24AWG (0.5mm)	1 Stranded	Shielded Non-plenum U.L. Type CMR	401-241PFSBW

Communication Supply Corporation (CSC)

Low Voltage Division Headquarters

5950 Office Boulevard, N.E.
Albuquerque, NM 87108
USA
Phone: 1-505-344-3400, 1-800-334-2150
Fax: +1-505-345-3862
Web: www.gocsc.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1 Stranded	Unshielded Non-plenum U.L. Type CM	CSC 588547
Level 4 22AWG (0.65mm)	2 Stranded	Unshielded Non-plenum U.L. Type CM	CSC 588548
Level 4 22AWG (0.65mm)	1 Stranded	Shielded Non-plenum U.L. Type CM	CSC 588549
Level 4 22AWG (0.65mm)	2 Stranded	Shielded Non-plenum U.L. Type CM	CSC 588550
Level 4 22AWG (0.65mm)	1 Stranded	Unshielded Plenum U.L. Type CMP	CSC 583783
Level 4 22AWG (0.65mm)	2 Stranded	Unshielded Plenum U.L. Type CMP	CSC 588544
Level 4 22AWG (0.65mm)	1 Stranded	Shielded Plenum U.L. Type CMP	CSC 588545
Level 4 22AWG (0.65mm)	2 Stranded	Shielded Plenum U.L. Type CMP	CSC 588546

ConnectAir International

4240 B Street N.W.
Auburn, Washington 98001
Phone: +1-253-813-5599
Phone: 1-800-247-1978
Fax: +1-253-813-5699
Web: www.connect-air.com

Direct burial and aerial messenger cables also available.

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	W221P-2001
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	W222P-2003
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	W221P-2002
Level 4 22AWG (0.65mm)	2	Shielded Plenum U.L. Type CMP	W222P-2004
Level 4 22AWG (0.65mm)	1	Unshielded Non-plenum U.L. Type CM	W221P-1002
Level 4 22AWG (0.65mm)	2	Unshielded Non-plenum U.L. Type CM	W222P-1004
Level 4 22AWG (0.65mm)	1	Shielded Non-plenum U.L. Type CM	P221P-1003
Level 4 22AWG (0.65mm)	2	Shielded Non-plenum U.L. Type CM	P222P-1005
Category 5	Various	Various	Contact mfg.
Composite Level 4 22 AWG (0.65mm) 16 AWG (1.3mm)	 1 1	 Unshielded Unshielded Non-plenum Standard U.L. Type CM	W22162P-1820

Eastman Wire & Cable

International Sales Office

1085 Thomas Busch Highway
Pennsauken, New Jersey 08110
Phone: +1-609-488-8800
Phone: 1-800-257-7940
Fax: +1-609-488-8899
Web: www.eastmanwire.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum	LEV4221P725
Level 4 22AWG (0.65mm)	2	Unshielded Plenum	LEV4222P725
Level 4 22AWG (0.65mm)	1	Shielded Plenum	LEV4221PSJ725
Level 4 22AWG (0.65mm)	2	Shielded Plenum	LEV4222PSJ725
Level 4 22AWG (0.65mm)	1	Unshielded PVC jacket Non-plenum	LEV4221P
Level 4 22AWG (0.65mm)	2	Unshielded PVC jacket Non-plenum	LEV4222P
Level 4 22AWG (0.65mm)	1	Shielded PVC jacket Non-plenum	LEV4221PSJ
Level 4 22AWG (0.65mm)	2	Shielded PVC jacket Non-plenum	LEV4222PSJ
16AWG (1.3mm)	1	Unshielded Plenum	725-5705
16AWG (1.3mm)	1	Unshielded Plenum High temperature Radiation resistant	725-5705SP
16AWG (1.3mm)	1	Unshielded PVC jacket Non-plenum	5705
Category 5 24AWG (0.5mm)	4	Unshielded Plenum	800-244CAT5 EZM
Category 5 24AWG (0.5mm)	4	Unshielded Non-plenum	244CAT5 BL EZM
Category 5	Various	Various	Contact mfg.

General Wire Products

International Sales Office

425 Shrewsbury Street
Worcester, Massachusetts 01604
Phone: +1-508-752-8260
Fax: +1-508-753-2173
Web: www.generalwireproducts.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Solid Plenum	030-21890
Level 4 22AWG (0.65mm)	2	Unshielded Solid Plenum	030-42102
Level 4 22AWG (0.65mm)	1	Shielded Solid Plenum	030-42701
Level 4 22AWG (0.65mm)	2	Shielded Stranded Plenum	030-21891
Level 4 22AWG (0.65mm)	1	Unshielded Stranded Plenum	030-21851
Level 4 22AWG (0.65mm)	2	Unshielded Stranded Plenum	030-52902-S
Level 4 22AWG (0.65mm)	1	Shielded Stranded Plenum	030-21892
Level 4 22AWG (0.65mm)	2	Shielded Solid Plenum	030-42702
16AWG (1.3mm)	1	Unshielded Stranded High temperature Harsh environment	030-84952
16AWG (1.3mm)	1	Unshielded Stranded PVC jacket Non-plenum	030-8321

Great Lakes Wire and Cable, Incorportated

International & Domestic Sales Office

32400 Howard Street
Madison Heights, MI 48071
Phone: +1-248-616-0022
Phone: 1-888-833-4592
Fax: +1-248-616-9118
Web: www.greatwire.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1 solid	Unshielded plenum, U.L. Type CMP	70002
Level 4 22AWG (0.65mm)	2 solid	Unshielded plenum, U.L. Type CMP	70003
Level 4 22AWG (0.65mm)	1 solid	Shielded plenum, U.L. Type CMP	70004
Level 4 22AWG (0.65mm)	2 solid	Shielded plenum, U.L. Type CMP	70005
Level 4 22AWG (0.65mm)	1 stranded	Unshielded plenum, U.L. Type CMP	70006
Level 4 22AWG (0.65mm)	2 stranded	Unshielded plenum, U.L. Type CMP	70007
Level 4 22AWG (0.65mm)	1 stranded	Shielded plenum, U.L. Type CMP	70008
Level 4 22AWG (0.65mm)	2 stranded	Shielded plenum, U.L. Type CMP	70009
16AWG (1.3mm)	1 stranded	Unshielded plenum, U.L. Type CMP	70010
16AWG (1.3mm)	1 stranded	Unshielded Non-plenum, U.L. Type CMP	70011
16AWG (1.3mm)	1 stranded	Unshielded Plenum, U.L. Type CMP Harsh Environment High Temperature Radiation Resistant	70012
Category 5	Various	Various	Contact mfg.

Keystone Electric Wire and Cable Company, Ltd.

Head Office

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Kwan Tri North Village
Fanling, N.T.
Hong Kong

Phone: +852-2691 7183
Fax: +852-2695 9738
Web: www.keystonecable.com

China Factory

Ye Sha Management District
Shatin, Dongguan City
Guangdong, P.R. China
Postal Code: 523998

Phone: +86-769-886 7234
Fax: +86-769-886 1696
Web: www.dgkeystone.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded PVC jacket	H4-22Ax1
Level 4 22AWG (0.65mm)	2	Unshielded PVC jacket	H4-22Ax2
16AWG (1.3mm)	1	Unshielded PVC jacket	H4-16Ax1
Category 5, 24AWG	2	UTP, CM	H5-24Ax2
Category 5e, 24AWG	4	UTP, CM, CMX, CMR	H5-24Ax4
Category 5, 24AWG	12	UTP, CM, CMR	H5-24Ax12
Category 5, 24AWG	20	UTP, CM, CMR	H5-24Ax20
Category 5, 24AWG	25	UTP, CM, CMR	H5-24Ax25

Lake Cable, LLC

2020 North Austin Avenue
Chicago, IL. 60639
USA
Phone: +1-773-385-8700
Fax: +1-773-385-8770

Web: www.lakecable.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	PF222C-ECH
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	PF222PRC-ECH
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	PF222C1-ECH
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	F222PRC1-ECH
Level 4 22AWG (0.65mm)	2	Shielded Plenum U.L. Type CMP	PFF222PRCS-ECH
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	PFF222CS-ECH
Level 4 22AWG (0.65mm)	1	Shielded Non-plenum U.L. Type CM	222CSFPP-ECH

Lucent Technologies

Americas

2333 Ponce de Leon Boulevard
Coral Gables, Florida 33134
Phone: +1-305-569-3600
Web: www.lucent.com/netsys/systimax

Europe

1945 Chaussee de Wavre
1160 Brussels
Belgium
Phone: +322-676-3598

Asia/Pacific

30/F Shell Tower
Times Square
1 Matheson Street
Hong Kong
Phone: +852-2506-5368

Lucent Technologies has qualified Echelon's FTT-10A Free Topology Transceiver for use on Lucent's SYSTIMAX Structured Cabling Systems.

Request document 461-110-042 *SYSTIMAX® Intelligent Building System LONWORKS® Design Guidelines* or see the following Lucent web site: www.lucent.com/netsys/systimax, then select Documentation, then select Application Guides, and finally select the document number listed above.

Cable Type	Number of Pairs	Details	Catalog Number
Category 5 - Systimax	4	Non-plenum	1061
Category 5 - Systimax	4	Plenum	2061
Category 5 - Systimax	Various	Various	Contact mfg.

Magnum Cable Corporation

International Sales Office

5250 Naiman Parkway
Solon, Ohio 44139 USA
Phone: +1-440-519-3333
Fax: +1-440-519-3334
Web: www.magnumcable.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum	A3001LON
Level 4 22AWG (0.65mm)	2	Unshielded Plenum	A3004LON
Level 4 22AWG (0.65mm)	1	Shielded Plenum	A30016LON
Level 4 22AWG (0.65mm)	2	Shielded Plenum	A30018LON
Level 4 22AWG (0.65mm)	1	Unshielded PVC jacket Non-plenum	A20001LON
Level 4 22AWG (0.65mm)	2	Unshielded PVC jacket Non-plenum	A20003LON
Level 4 22AWG (0.65mm)	1	Shielded PVC jacket Non-plenum	A20050LON
Level 4 22AWG (0.65mm)	2	Shielded PVC jacket Non-plenum	A20052LON
16AWG (1.3mm)	1	Unshielded Plenum	A30013LON
16AWG (1.3mm)	1	Unshielded Plenum High Temperature Radiation Resistant	KA30013LON
16AWG (1.3mm)	1	Unshielded PVC jacket Non-plenum	A20032LON
Category 5 24AWG (0.5mm)	4	Unshielded Plenum	A50588LON
Category 5 24AWG (0.5mm)	4	Unshielded Non-plenum	A50069LON
Category 5	Various	Various	Contact mfg.

Metro Wire and Cable Corporation

36625 Metro Court
Sterling Heights, MI 48321 USA
Phone: +1-586-264-3050

Fax: +1-586-264-7390
E-mail: metrowire@Earthlink.net

1275-A Oakbrook Drive
Norcross, GA 30093 USA
Phone: +1-770-449-6327
Phone: +1-800-633-1432
Fax: +1-770-263-6504
E-mail: mwcatl@att.net

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	MWC-1000
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	MWC-1001
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	MWC-1002
Level 4 22AWG (0.65mm)	2	Shielded Plenum U.L. Type CMP	MWC-1003
Category 5, 24AWG	4	Unshielded Plenum	MWC-5456
Category 5, 24AWG	4	Unshielded Non-plenum	MWC-1728

Paige Electric

1160 Springfield Road
P.O. Box 368
Union, New Jersey 07083-0368 USA
Phone: +1-908-687-7820
Phone: +1-800-327-2443
Fax: +1-908-687-8860
Web: www.paigewire.com

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Stranded Plenum U.L. Type CMP	AK3791BL
Level 4 22AWG (0.65mm)	2	Unshielded Stranded Plenum U.L. Type CMP	AK3792BL

Showa Electric Wire and Cable Co. Ltd. (Japan)

No. 26 Chuo Building
29-5, Nishi-Shinbashi 2-chome
Minato-ku
Tokyo
Phone: +81-03-3437-7301
Fax: +81-03-3437-7323
Web: www.asiansources.com/showa.co or www.swcc.co.jp

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Level 4 22AWG (0.65mm)	1	Unshielded Non-plenum	LW221
Level 4 22AWG (0.65mm)	2	Unshielded Non-plenum	LW222
16AWG (1.3mm)	1	Unshielded Non-plenum	LW161

The Siemon Company

Asia/Pacific

Room B1512
Vantone New World Plaza
No. 2 Fu Cheng Men Wai Avenue
Xicheng District, Beijing
100037 China
Phone: +86-10-6858-7358
Fax: +86-10-6858-7361
Web: www.siemon.com/tbic

The Siemon Company has qualified Echelon's FTT-10A Free Topology Transceiver for use on Siemon's TBIC Total Building Integration Cabling system. At the time of publication of this document, TBIC is available only in the Asia/Pacific market. Please contact Siemon or check `www.siemon.com/tbic` for the availability of TBIC in other markets.

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Category 5 - TBIC	Various	Various	Contact mfg.

Wieland Electric Ltd.

Europe Office

Riverside Business Center
Walnut Tree Close
Guildford
Surrey GUI 4UG
Phone: +44 (0) 1483-531213
Fax: +44 (0) 1483-505029
Web: www.wieland.co.uk/buslynx

Cable Type	*Number of Pairs*	*Details*	*Catalog Number*
Composite 16AWG (1.3mm) 16AWG (1.3mm)	2 2	Two unshielded 16AWG (1.3mm) twisted pairs for network signaling. Two unshielded 16AWG (1.3mm) twisted pairs for low voltage, low current power distribution.	BusLynx

Wieland cables employing paralle (non-twisted) high voltage power conductors may not be used with LONWORKS networks due to the potential for noise coupling.

Windy City Wire

4250 Madison Street
Hillside, Illinois 60162
Phone: +1-708-493-1191
Phone: 1-800-379-1191
Fax: +1-708-493-1390
Web: www.smartwire.com

Cable Type	Number of Pairs	Details	Catalog Number
Level 4 22AWG (0.65mm)	1	Unshielded Plenum U.L. Type CMP	105500 – Blue jacket 105530 – Yellow jacket 105540 – Orange jacket 105550 – Purple jacket 105580 – Pink jacket
Level 4 22AWG (0.65mm)	2	Unshielded Plenum U.L. Type CMP	105600 – Blue jacket
Level 4 22AWG (0.65mm)	1	Shielded Plenum U.L. Type CMP	106500- Blue jacket 106502 – Orange jacket 106503 – Yellow jacket 106540 – Purple jacket
Level 4 22AWG (0.65mm)	2	Shielded Plenum U.L. Type CMP	106600 – Blue jacket
Level 4 22AWG (0.65mm)	1	Unshielded Non-plenum U.L. Type CM	107500 – Blue jacket
Level 4 22AWG (0.65mm)	1	Shielded Non-plenum U.L. Type CM	108500 – Blue jacket
Level 4 22AWG (0.65mm)	2	Shielded Non-plenum U.L. Type CM	108600 – Blue jacket
16AWG (1.3mm)	1	Unshielded Plenum U.L. Type CMP	104500 – White jacket 104560 – Green jacket 105580 – Pink jacket
16AWG (1.3mm)	1	Unshielded Non-plenum U.L. Types CMR or CL2R	103500 – Gray jacket
Category 5	Various	Various	Contact mfg.

Junction Boxes

A junction box provides an interface between the twisted pair cable and one or more LONWORKS application nodes. The twisted pair cabling used between junction boxes will depend on the type of transceiver being installed. For free topology twisted pair systems, including the FT 3120/FT 3150 Free Topology Smart Transceiver, FTT-10A Free Topology Transceiver, LPT-11 Link Power Transceiver (figure 1), the PLT-22 Power Line Transceiver, and the PL 3150/PL 3120 Power Line Smart Transceiver, the wiring is typically specified separately for each transceiver. For systems using TP/XF-78, TP/XF-1250, TP-RS485, TPT/XF-78, or TPT/XF-1250 modules the bus wiring is 22AWG (0.65mm), while either 22 or 24AWG (0.5mm) cabling may be used on the stub between the junction box and the LONWORKS application node (figure 2).

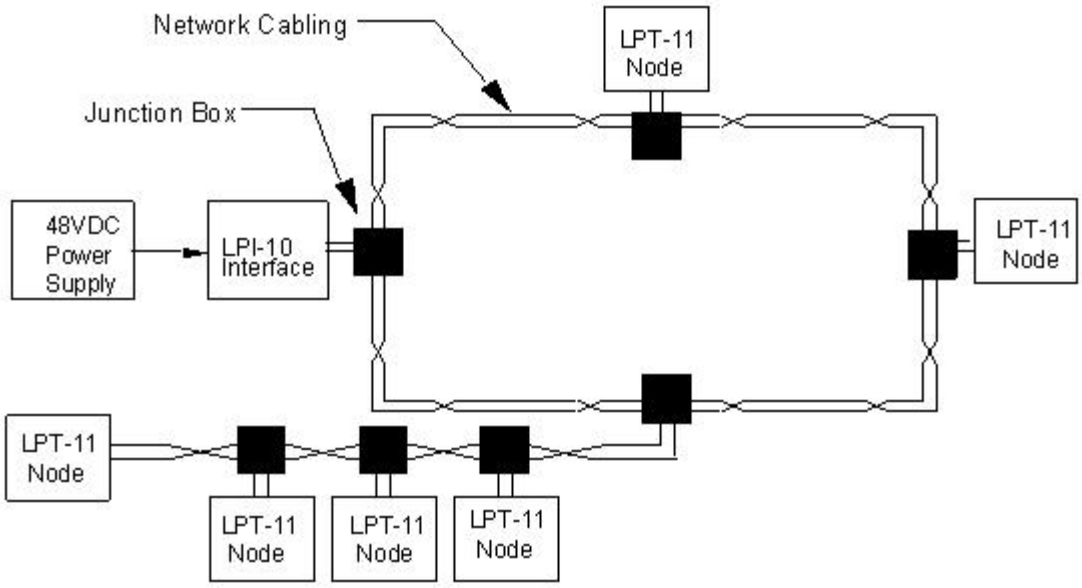


Figure 1 Typical Network Topology for Free Topology Networks
(LPT-11 Link Power Transceiver shown)

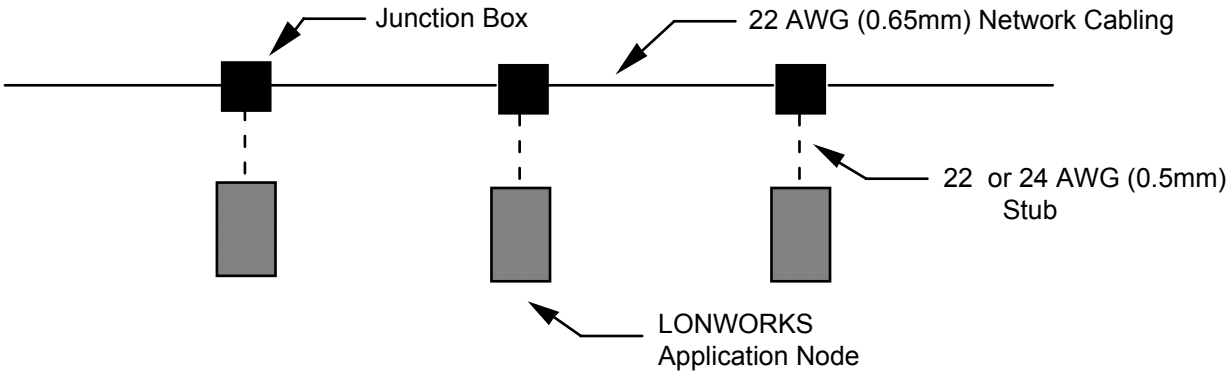


Figure 2 Typical Network Topology for Bus-Topology Networks

A Pass-Thru Junction Box is intended to be a splice point only and does not include interconnections for a local node. A Stub Junction Box provides both a stub for a local node and a convenient splice point for cables passing to the previous and next junction boxes. A Local Loop Terminal Junction Box provides terminals for a local loop and a splice point for cables passing to the previous and next junction boxes. These two junction boxes are intended to be used when the distance between the junction box and the local node exceeds the allowed stub length, or when a loop-style architecture is desirable.

The connector that will be used to connect the twisted wire pair to the application node is typically defined by the industry application.

For the purposes of the discussion about junction box design that follows, we need to establish a common definition of terms. These terms, and their definitions, are presented below.

Color Code	The color of the LONWORKS network cable conductors. In systems using a single twisted wire pair (two wire), the colors will be white/blue (W/B) and blue (B). In systems using a dual twisted wire pair (four wire), the colors will be white/blue (W/B), blue (B), white/orange (W/O)), and orange (O). A shield drain wire (S) may be provided in either single or dual twisted wire pair networks, and will be clearly designated by color coding or other markings as being a shield or drain wire.
IN	Wiring that originates at the previous node.
Insulation Displacement Terminal	A connector arrangement in which wiring is affixed to insulation displacement terminals. Multiple wires can be attached to a single connector bus either

	by permitting two conductors to be inserted in the same displacement terminal or by providing two or more displacement terminals on a common bus.
Local Loop	A loop of bus cable that exits from a junction box, interconnects with a node, and returns to the junction box.
Local Power	A power source that provides operating power to a locally powered node.
OUT	Wiring that originates at the current node.
Pass-Thru	A junction box at which wires are spliced, and to which no nodes are connected.
Screw Terminal	A connector arrangement in which wiring is affixed to screw terminals. Washers are provided to separate multiple conductors attached to a single screw.
Stub	A T-tap from a bus cable that originates at a junction box and terminates at a node.
2-Wire Link Power	2-wire link power permits the transmission of both node power and LonTalk® network data on a common pair of wires. Link power nodes may or may not require local power depending on the system topology and local power consumption levels.

Pass-Thru Junction Box

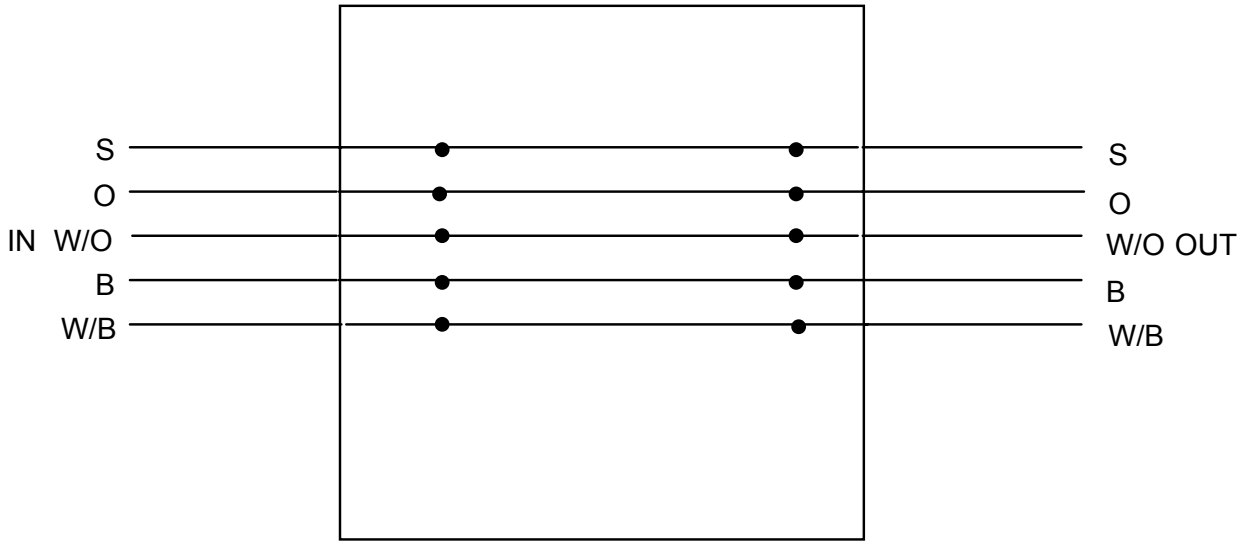
A pass-thru junction box provides a convenient point at which to splice two cables. No nodes or connectors are provided at a pass-thru junction box. There are three primary methods of implementing a splice at a pass-thru junction box:

1. Screw Terminals: IN and OUT wires are stripped and wrapped around screw terminals, which are tightened to retain the wires and make a secure electrical contact. Each screw is supplied with two or more washers. The washers separate conductors where multiple wires are landed at one screw, thereby preventing wires from being ejected as the screw is tightened. IN terminals 1-5 are connected directly by buses, circuit card traces, or wire jumpers, to OUT terminals 1-5, respectively. These connections provide the "pass-thru" function by routing the incoming signals to the outgoing terminals.

2. Insulation Displacement Terminals: IN and OUT wires are punched down on barrel or telco insulation displacement terminals. IN terminals 1-5 are connected directly by buses, circuit card traces, or wire jumpers, to OUT terminals 1-5, respectively. These connections provide the "pass-thru" function by routing the incoming signals to the outgoing terminals.

3. Crimp Connectors: IN and OUT wires are spliced together using crimp connectors. The connectors are then fitted inside the junction box, which itself contains no terminals.

Pass-Thru Terminal Junction Box



Terminal Legend

Terminal	Wire Color	Function
1	White/Blue	Data comm. or + for 2-wire link power
2	Blue	Data comm. or - for 2-wire link power
3	White/Orange	Power + if locally powered
4	Orange	Power GND if locally powered
5	S - Shield	Cable shield if used

Stub Junction Box

A stub junction box provides a convenient point at which to splice two cables and provide a stub for servicing a local node. There are two primary methods of implementing a stub connector junction box:

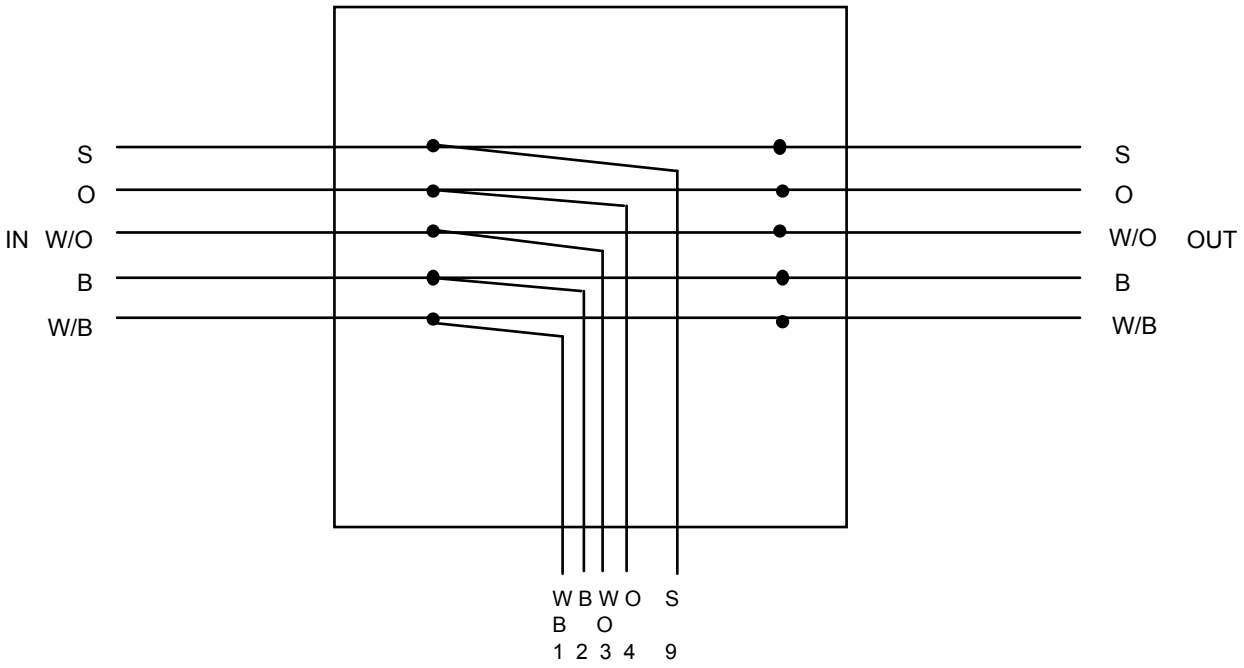
1. Screw Terminal 10 Wire Pin Connector: IN and OUT wires are stripped and wrapped around screw terminals, which are tightened to retain the wires and make a secure electrical contact. Each screw is supplied with two or more washers. The washers separate conductors where multiple wires are landed at one screw, thereby preventing wires from being ejected as the screw is tightened.

2. Insulation Displacement 10 Wire Pin Connector: IN and OUT wires are punched down on barrel or telco insulation displacement terminals. Both stranded and solid conductor wires are supported.

The following section applies to both versions of a stub connector junction box.

IN terminals 1-5 are connected directly by buses, circuit card traces, or wire jumpers, to OUT terminals 1-5, respectively. These connections provide the "pass-thru" function by routing the incoming signals to the outgoing terminals.

Stub Junction Box



Terminal Legend

Terminal	Wire Color	Function
1	White/Blue	Data comm. or + for 2-wire link power
2	Blue	Data comm. or - for 2-wire link power
3	White/Orange	Power + if locally powered
4	Orange	Power GND if locally powered
5	S - Shield	Cable shield if used

Tap Legend

Terminal	Wire Color	Function
1	White/Blue	IN Data comm. or + for 2-wire link power
2	Blue	IN Data comm. or - for 2-wire link power
3	White/Orange	IN Power + if locally powered
4	Orange	IN Power GND if locally powered
5 -8	Not used	
9	S - Shield	IN Cable shield
10	Not used	

Local Loop Terminal Junction Box

A local loop terminal junction box provides a convenient point at which to terminate two cables and provide a wiring loop for servicing a local node. There are two primary methods of implementing a local loop terminal junction box:

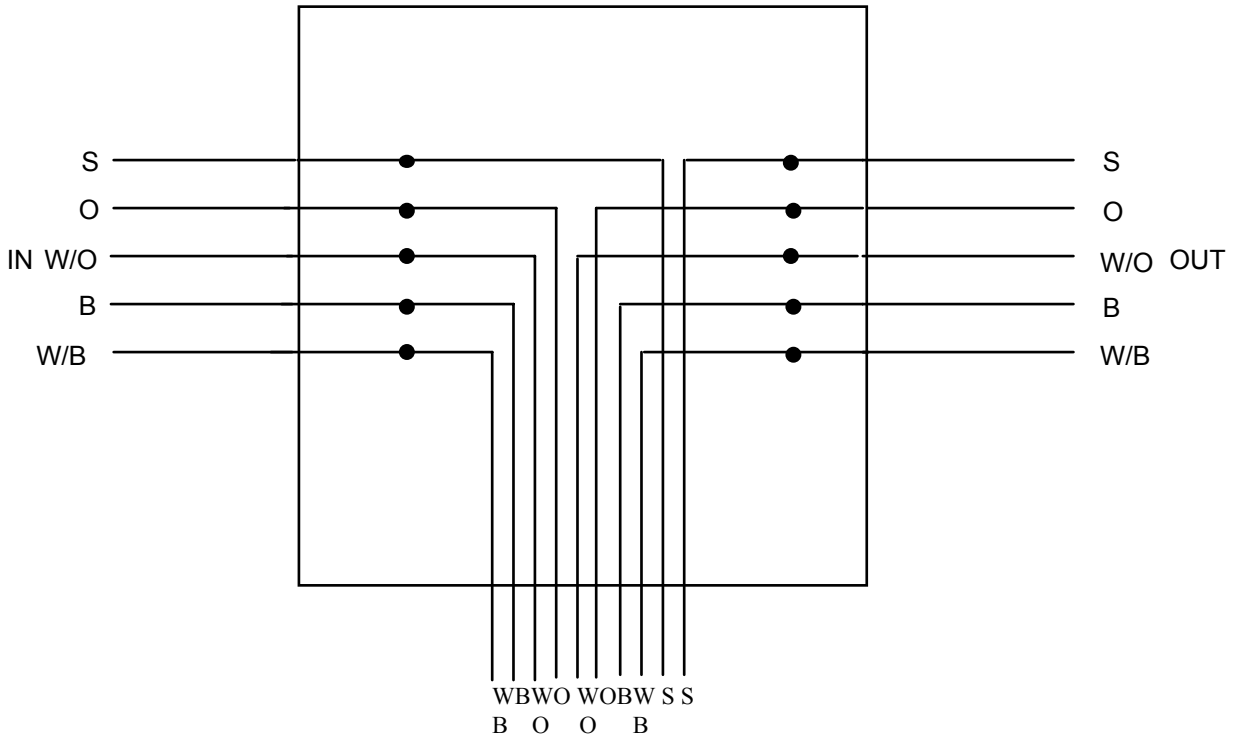
1. Screw Terminal 10 Wire: IN and OUT wires are stripped and wrapped around screw terminals, which are tightened to retain the wires and make a secure electrical contact. Each screw is supplied with two or more washers. The washers separate conductors where multiple wires are landed at one screw, thereby preventing wires from being ejected as the screw is tightened. The local node is wired directly to the In and OUT terminals.

2. Insulation Displacement 10 Wire: IN and OUT wires are punched down on barrel or telco insulation displacement terminals. The local node is wired directly to the In and OUT terminals.

The following section applies to both versions of a local loop connector junction box.

IN terminals and OUT terminals are isolated from each other: this junction box does not perform a "pass-thru" function.

Local Loop Terminal Junction Box



Terminal Legend

Terminal	Wire Color	Function
1	White/Blue	Data comm. or + for 2-wire link power
2	Blue	Data comm. or - for 2-wire link power
3	White/Orange	Power + if locally powered
4	Orange	Power GND if locally powered
5	S - Shield	Cable shield if used

Local Loop Legend

Terminal	Wire Color	Function
1	White/Blue	IN Data comm. or + for 2-wire link power
2	Blue	IN Data comm. or - for 2-wire link power
3	White/Orange	IN Power + if locally powered
4	Orange	IN Power GND if locally powered
5	White/Orange	OUT Power + if locally powered
6	Orange	OUT Power GND if locally powered
7	Blue	OUT Data comm. or - for 2-wire link power
8	White/Blue	OUT Data comm. or + for 2-wire link power
9	S - Shield	IN Cable shield
10	S - Shield	OUT Cable shield

Appendix A
Application for Cable Approval

This Appendix is intended for use by vendors who manufacture electrical cables and would like those cables approved by Echelon for use on one or more LONWORKS channels. Echelon approves cables based on information supplied by the cable vendor: the vendors self-certify that their products comply with Echelon's published specifications, and the responsibility to meet and adhere to these specifications reside solely and exclusively with the cable vendors. Echelon will not test any cables or validate the electrical characteristics of the submitted cables. Echelon relies exclusively on the veracity of the information provided by the cable vendors.

To submit a cable for approval, please complete the vendor information for each geographic area in which your products are sold.

For each cable being submitted for approval, please complete the pertinent cable type form. You must include entries for every blank space in the table. Failure to fill out the form completely will result in the rejection of your application. One form must be completed for each cable submitted for your approval. For reference purposes, the mandated specifications are shown in italicized type in each table.

Send or fax your completed application to:

Echelon
550 Meridian Avenue
San Jose, CA 95126 USA
Attn: Echelon Support

Fax number: +1-408-790-3801 (attention Echelon Support)

Vendor Information

Vendor Information – **Americas**

Company Name	
Address (including country and postal code)	
Phone Number	
Facsimile Number	
E-Mail Address	
Web Site URL	

Vendor Information – **Asia/Pacific**

Company Name	
Address (including country and postal code)	
Phone Number	
Facsimile Number	
E-Mail Address	
Web Site URL	

Vendor Information – **Europe, Middle East, Africa**

Company Name	
Address (including country and postal code)	
Phone Number	
Facsimile Number	
E-Mail Address	
Web Site URL	

Cable Type Forms

Belden 8471 Equivalent Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*	

Wire Diameter (mm/AWG)	*Resistance Rloop Ω/km*	*Capacitance nF/km*	*Velocity of Propagation Vprop % of c*

Belden 85102 Equivalent Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*	

	Minimum	*Typical*	*Maximum*	*Units*	*Condition*
DC Resistance, each conductor				*Ω/km*	*20°C per ASTM D 4566*
DC Resistance Unbalance				*%*	*20°C per ASTM D 4566*
Mutual Capacitance				*nF/km*	*Per ASTM D 4566*
Characteristic Impedance				*Ω*	*64kHz to 1MHz per ASTM D 4566*
Attenuation *20kHz* *64kHz* *78kHz* *156kHz* *256kHz* *512kHz* *772kHz* *1000kHz*				*dB/km*	*20°C per ASTM D 4566*
Propagation Delay				*nsec/m*	*78kHz*

Level 4 Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*	
Specifications apply to shielded or unshielded 22AWG (0.65mm) cable, 24AWG (0.5mm) cable shown in brackets [ ] if different	
D-C Resistance *(Ohms/1000 feet at 20°C) maximum for a single copper conductor regardless of whether it is solid or stranded and is or is not metal-coated.*	
D-C Resistance Unbalance *(percent) maximum*	
Mutual Capacitance of a Pair *(pF/foot) maximum*	
Pair-to-Ground Capacitance Unbalance *(pF/1000 feet) maximum*	
Characteristic Impedance (Ohms)	
772kHz	
1.0MHz	
4.0MHz	
8.0MHz	
10.0MHz	
16.0MHz	
20.0MHz	
Attenuation (dB/1000 feet at 20°C) maximum	
772kHz	
1.0MHz	
4.0MHz	
8.0MHz	
10.0MHz	
16.0MHz	
20.0MHz	
Worst-Pair Near-End Crosstalk *(dB) minimum. Values are shown for information only. The minimum NEXT coupling loss for any pair combination at room temperature is to be greater than the value determined using the formula* $NEXT\ (F_{MHz}) > NEXT(0.772) - 15_{log10}(F_{MHz}/0.772)$ *for all frequencies in the range of 0.772MHz-20MHz for a length of 1000 feet.*	
772kHz	
1.0MHz	
4.0MHz	
8.0MHz	
10.0MHz	
16.0MHz	
20.0MHz	

JY (st) 2x2x0.8 Equivalent Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*			
Wire Diameter (mm/AWG)	*Resistance Rloop Ω/km*	*Capacitance nF/km*	*Velocity of Propagation Vprop % of c*

S-4210 Equivalent Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*			
Wire Diameter (mm/AWG)	*Conductors*	*Characteristic Impedance (Ω)*	*Construction*

Category 5 Cable

Cable model number *Number of pairs* *Plenum/Non-plenum* *Special features, i.e., aerial or direct burial*	

Disclaimer

Echelon Corporation assumes no responsibility for any errors contained herein. Echelon makes no representation and offers no warranty of any kind regarding any of the third-party components mentioned in this document. These components are suggested only as examples of usable devices. The use of these components or other alternatives is at the customer's sole discretion. Echelon also does not guarantee the designs shown in this document. No part of this document may be reproduced, translated, or transmitted in any form without permission from Echelon.

Part Number 005-0023-01 Rev. 1

Echelon Corporation
www.echelon.com

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