# USER MANUAL

# **MODEL 2168** CopperLink Ethernet Extender







Part# 07M2168-A Doc# 058112UA Revised 6/11/02 SALES OFFICE (301) 975-1000 TECHNICAL SUPPORT (301) 975-1007

An ISO-9001Certified Company

# CONTENTS

1.0	Warranty Information	. 4
1.1	Radio and TV Interference	. 4
1.2	CE Notice	. 4
1.3	Service	. 5
2.0	General Information	. 6
2.1	Features	6
2.2	Description	. 6
3.0	Installation	. 8
3.1	Standalone unit installation	. 8
3.2	Rack card installation	. 8
3.3	Connecting the Twisted-Pair Line Interface	10
3.4	Connecting the 10/100Base-T Ethernet Interface	11
	Connecting the 10/100Base-T Ethernet Port to a Hub	12
	Connecting the 10/100Base-T Ethernet Port to a PC (DTE)	12
3.5	Connecting Power	12
4.0	Configuration	14
4.1	Configuring the hardware DIP switches	14
4.2	Configuring DIP Switch S1	16
	Switch S1-1: Ethernet Auto Sense	16
	Switches S1-2 and S1-4: Data Rate	16
5.0	Operation	18
5.1	Power Up	18
<b>F</b> 0	Front Panel LED Status Monitors	
5.Z		18
5.2 A	Specifications	18 <b>20</b>
5.2 <b>A</b> A.1	Specifications	18 <b>20</b> 20
<b>A</b> A.1 A.2	Specifications	18 <b>20</b> 20 20
5.2 A A.1 A.2 A.3	Specifications	18 20 20 20 20
5.2 A A.1 A.2 A.3 A.4	Specifications	18 20 20 20 20 20
<b>A</b> A.1 A.2 A.3 A.4 A.5	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor	18 20 20 20 20 20 20
5.2 A.1 A.2 A.3 A.4 A.5 A.6	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators	<ol> <li>18</li> <li>20</li> <li>20</li> <li>20</li> <li>20</li> <li>20</li> <li>20</li> <li>20</li> <li>20</li> </ol>
A.1 A.2 A.3 A.4 A.5 A.6 A.7	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators Power Supply	<ol> <li>18</li> <li>20</li> </ol>
A A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators Power Supply Temperature Range	<ol> <li>18</li> <li>20</li> <li>2</li></ol>
A A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators Power Supply Temperature Range	<ol> <li>18</li> <li>20</li> <li>2</li></ol>
A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9 A.10	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators Power Supply Temperature Range Humidity Dimensions	<ul> <li>18</li> <li>20</li> &lt;</ul>
A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9 A.10 B	Specifications LAN Connection Transmission Line CopperLink Line Rate CopperLink Distance CopperLink Surge Suppressor LED Status Indicators Power Supply Temperature Range Humidity Dimensions Model 2168 Series Factory	<ol> <li>18</li> <li>20</li> <li>2</li></ol>
A A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9 A.10 B	Specifications         LAN Connection         Transmission Line         CopperLink Line Rate         CopperLink Distance         CopperLink Surge Suppressor         LED Status Indicators         Power Supply         Temperature Range         Humidity         Dimensions         Model 2168 Series Factory         Replacement Parts and Accessories	<ol> <li>18</li> <li>20</li> <li>2</li></ol>
A A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9 A.10 B C	Specifications         LAN Connection         Transmission Line         CopperLink Line Rate         CopperLink Distance         CopperLink Surge Suppressor         LED Status Indicators         Power Supply         Temperature Range         Humidity         Dimensions         Model 2168 Series Factory         Replacement Parts and Accessories         Model 2168 Series Interface Pin Assignment	<ol> <li>18</li> <li>20</li> <li>2</li></ol>
A A.1 A.2 A.3 A.4 A.5 A.6 A.7 A.8 A.9 A.10 B C C.1	Specifications         LAN Connection         Transmission Line         CopperLink Line Rate         CopperLink Distance         CopperLink Surge Suppressor         LED Status Indicators         Power Supply         Temperature Range         Humidity         Dimensions         Model 2168 Series Factory         Replacement Parts and Accessories         Model 2168 Series Interface Pin Assignment         10/100Base-T Interface	<ol> <li>18</li> <li>20</li> <li>2</li></ol>

D	Distance Chart, Based on 24 AWG (0.5 mm)	23
	Terminal Block	22
	RJ-45	22
C.2	CopperLink Interface	22

# **1.0 WARRANTY INFORMATION**

**Patton Electronics** warrants all Model 2168 components to be free from defects, and will—at our option—repair or replace the product should it fail within one year from the first date of the shipment.

This warranty is limited to defects in workmanship or materials, and does not cover customer damage, abuse or unauthorized modification. If this product fails or does not performs as warranted, your sole recourse shall be repair or replacement as described above. Under no condition shall **Patton Electronics** be liable for any damages incurred by the use of this product. These damages include, but are not limited to, the following: lost profits, lost savings and incidental or consequential damages arising from the use of or inability to use this product. **Patton Electronics** specifically disclaims all other warranties, expressed or implied, and the installation or use of this product shall be deemed an acceptance of these terms by the user.

# 1.1 RADIO AND TV INTERFERENCE

The Model 2168 generates and uses radio frequency energy, and if not installed and used properly-that is, in strict accordance with the manufacturer's instructions-may cause interference to radio and television reception. The Model 2168 has been tested and found to comply with the limits for a Class A computing device in accordance with specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection from such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If the Model 2168 does cause interference to radio or television reception, which can be determined by disconnecting the unit, the user is encouraged to try to correct the interference by one or more of the following measures: moving the computing equipment away from the receiver, re-orienting the receiving antenna and/or plugging the receiving equipment and receiver are on different branches).

# **1.2 CE NOTICE**

The CE symbol on your Patton Electronics equipment indicates that it is in compliance with the Electromagnetic Compatibility (EMC) directive and the Low Voltage Directive (LVD) of the European Union (EU). A Certificate of Compliance is available by contacting Technical Support.

**Note** Conformity documents of all Patton products can be viewed online at www.patton.com under the appropriate product page.

# 1.3 SERVICE

All warranty and non-warranty repairs must be returned freight prepaid and insured to Patton Electronics. All returns must have a Return Materials Authorization number on the outside of the shipping container. This number may be obtained from Patton Electronics Technical Services at:

- Tel: +1 (301) 975-1007
- Email: support@patton.com
- URL: http://www.patton.com
  - Note Packages received without an RMA number will not be accepted.

#### 2.0 GENERAL INFORMATION

Thank you for your purchase of this Patton Electronics product. This product has been thoroughly inspected and tested and is warranted for one year for parts and labor. If any questions or problems arise during installation or use of this product, contact Patton Electronics Technical Support at +1 (301) 975-1007.

# 2.1 FEATURES

- Easy to install standalone Multi-Rate CopperLink Ethernet Extenders—*no configuration required*
- Auto-sensing full or half-duplex Ethernet
- Auto-sensing 10/100Base-T
- Extends network connections up to 6,652 ft (2.03 km) over 2-wire 24-AWG unconditioned lines
- Switch selectable line rates up to 16.67 Mbps
- 7 symmetric or asymmetric settings via DIP switch
- POTS/ISDN splitter on board
- Transparent operation
- LED indicators for Power, Ethernet Link & Activity, CopperLink & Quality of Line (QOL)
- Surge suppression up to 20 kA (8/20  $\mu s)$
- Available in rack-mount or standalone configurations
- · Made in the USA

# 2.2 DESCRIPTION

The Patton Electronics Model 2168/L and 2168/R Multi-Rate CopperLink Ethernet Extenders provide high-speed LAN connections between peered Ethernet LANs, remote PC's, or any other network enabled 10/ 100Base-T device.

Operating in pairs, a Model 2168/L (local) located at one end of the LAN extension and a Model 2168/R (remote) at the other end, these units can automatically forward LAN broadcasts, multicasts, and frames across a 2-wire voice-grade twisted-pair link. The data is passed transparently (unmodified) through the 2168s. The 2168s automatically add and delete

MAC addresses, only passing packets across the CopperLink that are meant for the remote peered LAN.



Figure 1. Ethernet Extender allows copper instead of fiber for vertical Ethernet spans

Multi-rate Ethernet Extenders are ideal for bridging Ethernet spans inside buildings that are beyond the 328-foot (100-meter) distance limit of Ethernet.

As shown in Figure 1, connecting workgroups located on different floors in a building no longer requires expensive switches or the installation of low capacitance cable.

#### 3.0 INSTALLATION

Because the Model 2168 requires no configuration, it can be installed quickly. If you are installing a standalone unit, refer to section 3.1 "Standal-one unit installation". Otherwise, refer to section 3.2 "Rack card installation".

**Note** If asymmetric transmission or line rates other than 12.5 Mbps are required, refer to section 4.0, "Configuration" on page 14.

#### 3.1 STANDALONE UNIT INSTALLATION

Do the following:

1. Connect the line interface between the units (refer to section 3.3, "Connecting the Twisted-Pair Line Interface" on page 10)

**Note** See Figure 2 for the standalone unit's rear panel arrangements.

- 2. Connect the Ethernet interface (refer to section 3.4, "Connecting the 10/100Base-T Ethernet Interface" on page 11).
- 3. Connect the power plug (refer to section 3.5, "Connecting Power" on page 12).



Figure 2. Model 2168 standalone rear panel

#### 3.2 RACK CARD INSTALLATION

The Model 2168 rack card version comprises a front card and a rear card. Do the following to install the cards into the rack chassis:

1. Slide the rear card into the back of the chassis along the metal rails.

- 2. Secure the rear card using the supplied metal screws.
- 3. Slide the front card into the chassis until you feel resistance as the front card engages the rear card. When that happens, *gently* push the front card forward until it is fully seated in the card-edge receptacle of the rear card (it should *click* into place).
- 4. Secure the front card using the captive fasteners.
  - **Note** The Model 1001R14 chassis supports "hot swapping" of cards, so it is not necessary to power down the rack when you install or remove a Model 2168 rack card.



Figure 3. Model 2168 rack cards

5. Connect the line interface between the units (refer to section 3.3, "Connecting the Twisted-Pair Line Interface" on page 10)

**Note** See Figure 3 for the rack card's panel arrangements.

6. Connect the Ethernet interface (refer to section 3.4, "Connecting the 10/100Base-T Ethernet Interface" on page 11).

# 3.3 CONNECTING THE TWISTED-PAIR LINE INTERFACE

The Model 2168 supports communication between two peer Ethernet LAN sites over a distance of up to 6,652 ft (2.03 km) over 24 AWG (0.5 mm) twisted-pair wire.

**Note** Actual distance and link performance may vary depending on the environment and type/gauge of wire used.

Follow the steps below to connect the Model 2168 CopperLink Interfaces.

- Note The Model 2168 units work in pairs. One of the units must be a Model 2168/L (Local), and the other unit must be a Model 2168/R (Remote). It does not matter which end is the 2168/L and which is the 2168/R. The link is always initiated by the 2168/R. As long as the 2168/L is powered on, the 2168/R can establish a link by being powered on or by having its power reset.
- To function properly, the two Model 2168s must be connected together using twisted-pair, unconditioned, dry, metal wire, between 19 (0.9mm) and 26 AWG (0.4mm). Leased circuits that run through signal equalization equipment are not acceptable.
- 2. The Model 2168 is equipped with two interface jacks that can be used on the CopperLink interface, an RJ-45 or a terminal block. These CopperLink interfaces are a two-wire interface. Observe the signal/pin relationships on the Model 2168's CopperLink interface jacks.

The RJ-45 connector on the Model 2168's twisted pair interface is polarity insensitive and is wired for a two-wire interface. The signal/pin relationship is shown in Figure 4.



Figure 4. Model 2168 (RJ-45) twisted pair line interface.

The terminal block connector on the Model 2168's twisted pair interface is polarity insensitive and is wired for a two-wire interface. The signal/pin relationships is shown in Figure 5.



Figure 5. Model 2168 (Terminal Block) twisted pair line interface.

# 3.4 CONNECTING THE 10/100BASE-T ETHERNET INTERFACE

The shielded RJ-45 port labeled *Ethernet* is the 10/100Base-T interface. This port is designed to connect directly to a 10/100Base-T network. Figure 6 shows the signal/pin relationships on this interface. You may connect this port to another Ethernet device via a Type 4 or Type 5 cable that is up to 328 ft long.



Figure 6. Model 2168 10/100Base-T RJ-45 Connector Pinout.

### Connecting the 10/100Base-T Ethernet Port to a Hub

The Model 2168 10/100Base-T interface is configured as DTE (Data Terminal Equipment), just like a 10/100Base-T network interface card in a PC. Therefore, it "expects" to connect to a 10/100Base-T Hub using a straight-through RJ-45 cable. Figure 7 diagrams the cable wiring for connecting the Model 2168 to a 10/100Base-T hub.

10/100Base-T Hub RJ-45 Pin No.	
1 (RX+)	
2 (RX-)	
3 (TX+)	
6 (TX-)	

Figure 7. Wiring diagram for connecting the Model 2168 to a 10/100Base-T hub

#### Connecting the 10/100Base-T Ethernet Port to a PC (DTE)

The Model 2168 10/100Base-T interface is configured as DTE (Data Terminal Equipment). If you wish to connect the 2168 to another DTE devices such as 10/100Base-T network interface card in a PC (or 2168s in a back-to-back arrangement), you must construct a 10/100Base-T crossover cable as shown in Figure 8.



Figure 8. 10/100Base-T crossover cable

# 3.5 CONNECTING POWER

An external AC or DC power supply is available separately. This connection is made via the barrel jack on the rear panel of the Model 2168. No configuration is necessary for the power supply (See Appendix B for domestic and international power supply and cord options).

DC power (supplied via the power supply jack to the 2168) must meet the following requirements; DC power supplied must be regulated +5VDC  $\pm5$ %, 1.0A minimum. Center pin is +5V. The barrel type plug has a 2.5/5.5/10mm I.D./O.D./Shaft Length dimensions.

The Model 2168 does not have a power switch, so it powers up as soon as it is plugged in.

#### 4.0 CONFIGURATION

The Model 2168 has four DIP switches for configuring the unit for a wide variety of applications. This section describes switch locations and explains the different configurations.

#### 4.1 CONFIGURING THE HARDWARE DIP SWITCHES

Using a small flat-tip screwdriver, remove the protective cover located on the underside of the Model 2168 (see Figure 9).



Figure 9. Removing protective cover

Figure 10 and Figure 11 on page 15 show the orientation of the DIP switches in the On and Off positions.



Figure 11. Rack card DIP switch orientation

# 4.2 CONFIGURING DIP SWITCH S1

DIP switch S1 is where you configure the CopperLink line rate, symmetric or asymmetric, Ethernet full auto sense capability (100BaseT full or half duplex, 10BaseT full or half duplex) or limited auto sense (only 100BaseT half duplex, 10BaseT full or half duplex). Table 1 summarizes default positions of DIP switches S1-1 through S1-4. Detailed descriptions of each switch follow the table.

Position	Function	Factory Default	
S1-1	Ethernet Auto Sense	OFF	Full Auto Sense capability
S1-2	Line Rate	ON	
S1-3	Line Rate	OFF	12.5Mbps Symmetric
S1-4	Line Rate	OFF	

#### Switch S1-1: Ethernet Auto Sense

Use switch S1-1 to configure the unit for full auto sense capability or limited auto sense capability. Full Auto sense capability consists of standard Ethernet Auto sensing (100BaseT full duplex, 100BaseT half duplex, 10BaseT full duplex, and 10BaseT half duplex). Limited Auto sensing capability consists on only auto sensing for 100BaseT half duplex, 10BaseT full duplex, and 10BaseT half duplex. The limited auto sensing feature is used when an Ethernet device does not comply with IEEE 802.3x (back pressure flow control) at 100M full duplex.

S1-1	Setting
OFF	Full Auto Sensing (100 Mbps, Full or Half Dupley)
	(10 Mbps, Full or Half Duplex)
ON	Limited Auto Sensing
	(100 Mbps Half Duplex)
	10 Mbps Full or Half Duplex)

Table 2: Ethernet Auto Sense Selection Chart

#### Switches S1-2 and S1-4: Data Rate

Use switches S1-2 and S1-4 to configure the CopperLink line rates.

Table 3: Symmetric CopperLink Line Rates Selection Chart

S1-2	S1-3	S1-4	Symmetric Line Rate
ON	ON	ON	6.25 Mbps
ON	ON	OFF	9.38 Mbps

Table 3: Symmetric CopperLink Line Rates Selection Chart

S1-2	S1-3	S1-4	Symmetric Line Rate
ON	OFF	OFF	12.5 Mbps
ON	OFF	ON	16.67 Mbps

Table 4: Asymmetric CopperLink Line Rates Selection Chart

S1-2	S1-3	S1-4	Asymmetric Line Rates DS/US
OFF	OFF	ON	4.17 Mbps/1.56 Mbps
OFF	ON	ON	9.38 Mbps/1.56 Mbps
OFF	ON	OFF	16.67 Mbps/2.34 Mbps

#### 5.0 OPERATION

Once the Model 2168s are properly installed, they should operate transparently. No user settings required. This section describes reading the LED status monitors.

#### 5.1 POWER UP

Before applying power to the Model 2168, please review section 3.5, "Connecting Power" on page 12 to verify that the unit is connected to the appropriate power source.

# 5.2 FRONT PANEL LED STATUS MONITORS

The Model 2168 features five front panel LEDs that monitor power, the Ethernet signals, and the CopperLink connection. Figure 12 (standalone version) and Figure 13 on page 19 (rack card version) show the front panel location of each LED. Table 5 on page 19 describes the LED functions.

![](_page_17_Figure_6.jpeg)

Figure 12. Model 2168 standalone unit front panel

![](_page_18_Figure_0.jpeg)

Figure 13. Model 2168 rack card front panel

Table 5: Front panel LED description

LED	Description	
Power	Solid GREEN to indicate the unit is powered on.	
CopperLink Link	(Active Green) Solid green (ON) to indicate that the end-to-end CopperLink between the Model 2168s is established. The CopperLink LED is OFF when the link is down.	
CopperLink QOL	(Active Yellow) Flashes YELLOW to indicate the pro- cessor is correcting an error in the data thus prevent- ing the transmission of corrupted data to the Ethernet port. The more error corrections, the more often the LED blinks. If the light remains lit continuously, it means that the CopperLink line is noisy—although the data at the Ethernet port remains uncorrupted. Further impairment of the line however, risks having the line fail, as indicated by the green CopperLink Link LED extinguishing.	
Ethernet Link	(Active Green) Solid Green indicates that 10/ 100Base-T Ethernet link has been established.	
Ethernet Activity	(Active Yellow) Flashes yellow to indicate Ethernet activity on the Model 2168's 10/100Base-T Ethernet port.	

# **APPENDIX A**

#### SPECIFICATIONS

#### A.1 LAN CONNECTION

- Shielded RJ-45, 10/100Base-T, IEEE 802.3 Ethernet
- CopperLink Connection: RJ-45 and Terminal Block

#### **A.2 TRANSMISSION LINE**

Two-wire unconditioned twisted pair.

#### A.3 COPPERLINK LINE RATE

16.67 Mbps, symmetric upstream/downstream. Additional symmetric and asymmetric rates are available via DIP switch settings.

#### A.4 COPPERLINK DISTANCE

6,000 ft (1.83 km) at 1.56 Mbps upstream/4.17 Mbps downstream

Note Distances depend on selected line rate.

#### A.5 COPPERLINK SURGE SUPPRESSOR

Gas tube with maximum current surge: 20 kA (8120 µs).

# A.6 LED STATUS INDICATORS

- Power (Green)
- CopperLink: Link (Green) & QOL (Red)
- Ethernet: Link (Green) & Activity (Yellow)

#### A.7 POWER SUPPLY

External AC and DC options:

- AC: 120 VAC, 220 VAC, and UI (120-240 VAC)
- DC: 12 VDC, 24 VDC and 48 VDC
- Power consumption: 450 mA at 5 VDC

#### A.8 TEMPERATURE RANGE

0–50°C

# A.9 HUMIDITY

Up to 90% non-condensing.

#### A.10 DIMENSIONS

1.58H x 4.16W x 3.75D in. (10.6H x 4.1W x 8.8D cm)

# **APPENDIX B**

#### MODEL 2168 SERIES FACTORY REPLACEMENT PARTS AND ACCESSORIES

Patton Model #	Description	
Base Models		
2168RC/L	Local Multi-Rate CopperLink Ethernet Extender, Rack Card	
2168RC/R	Remote Multi-Rate CopperLink Ethernet Extender, Rack Card	
2168/L	Local Multi-Rate CopperLink Ethernet Extender, Standalone	
2168/R	Remote Multi-Rate CopperLink Ethernet Extender, Standalone	
2168-2PK	Multi-Rate CopperLink Ethernet Extender Kit: includes one local (L) and one remote (R) Model 2168	
07M2168-A	User Manual	
Power Supplies		
08055DCUI	100-240VAC (+5V reg. DC/2A) Universal Input Adapter.	
08055-120-5-1	120 VAC (+5V reg. DC/1A) Input Adapter	
12V-PSM	12 VDC Input Adapter	
24V-PSM	24 VDC Input Adapter	
48V-PSM	48 VDC Input Adapter	
Power Cords*		
0805US	American Power Cord	
0805EUR	European Power Cord CEE 7	
0805UK	United Kingdom Power Cord	
0805AUS	Australian Power Cord	
0805DEN	Denmark Power Cord	
0805FR	France/Belgium Power Cord	
0805IN	India Power Cord	
0805IS	Israel Power Cord	
0805JAP	Japan Power Cord	
0805SW	Switzerland Power Cord	

\*Only required with optional UI power supply (08055DCUI)

# **APPENDIX C**

MODEL 2168 SERIES INTERFACE PIN ASSIGNMENT

#### C.1 10/100BASE-T INTERFACE

#### RJ-45

- Pin 1: TX+
- Pin 2: TX-
- Pin 3: RX+
- Pin 6: RX-
- Pins 4, 5, 7, 8: no connection

# C.2 COPPERLINK INTERFACE

#### RJ-45

- Pin 4: RING
- Pin 5: TIP
- Pins 1, 2, 3, 6, 7, 8: no connection

# **Terminal Block**

See Figure 5 on page 11.

# APPENDIX D

DISTANCE CHART, BASED ON 24 AWG (0.5 MM)

Symm Line Rate (DS/US)	Distance in feet (km)
6.25 Mbps	4,500 (1.37)
9.38 Mbps	4,150 (1.26)
12.5 Mbps	4,000 (1.22)
16.67 Mbps	3,300 (1.00)

Asymm Line Rate (DS/US)	Distance in feet (km)
4.17 Mbps/1.56 Mbps (Mode 0)	6,000 (1.83)
9.38 Mbps/1.56 Mbps	5,500 (1.68)
16.67 Mbps/2.34 Mbps	5,000 (1.52)

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