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# IP67 Industrial Ethernet Switches

**Hardware Reference Guide**

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**This document applies to the following Ethernet switch products: DRL-750, DRL-780, DRL-781 and DRL-782.**

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# Preface

## Preface Sections:

- Purpose of this Guide
- Conventions

## Purpose of this Guide

This manual explains how to install and maintain the IP-67 Industrial Ethernet Switches.

## Conventions

This guide uses special notation to help enhance your understanding.

## Special Notation

The following special notations are used throughout this guide:



### Warning

Warning messages alert the reader to situations where personal injury may result. Warnings are accompanied by the symbol shown, and precede the topic to which they refer.



### Caution

Caution messages alert the reader to situations where equipment damage may result. Cautions are accompanied by the symbol shown, and precede the topic to which they refer.



### Note

A note provides additional information, emphasizes a point, or gives a tip for easier operation. Notes are accompanied by the symbol shown, and follow the text to which they refer.

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# 1

## General Information

### Chapter Sections:

- Overview
- Part Numbering
- Operation
- Performance Specifications

## Overview

This manual will help you install and maintain the IP-67 Industrial Ethernet Switches. These switches are designed to interconnect Ethernet nodes in a harsh environment and increase network performance.

## Part Numbering

Part Number	Device
DRL-750	IP67 Fast Ethernet Unmanaged Switch Network : 5 ports M12 Power : 5 pins M12 (redundant 9 to 36 VDC)
DRL-780	IP67 Fast Ethernet Unmanaged Switch Network : 8 ports M12 Power : 5 pins Mini-Change Power in / Power out connectors (redundant 9 to 36 VDC)
DRL-781	IP67 Fast Ethernet Unmanaged Switch Network : 8 ports M12 Power : 4 pins Mini-Change Power in / Power out connectors (redundant 9 to 36 VDC)
DRL-782	IP67 Fast Ethernet Unmanaged Switch Network : 8 ports M12 Power : 5 pins M12 Power in / Power out connectors (redundant 9 to 36 VDC)

## Operation

Unlike an Ethernet hub, which broadcasts all messages received out all ports, the DRL-7xx series route Ethernet messages to the appropriate port. In other words, it prepares the network for optimal bandwidth conditions, reduces the number of collisions.

The DRL-7xx series supports 10BaseT (10 Mbps) or 100BaseT (100 Mbps) on the M-12 ports. Each port, independent of the others, will auto-negotiate the speed and duplex mode. This allows both 10 Mbps (full or half duplex) and 100Mbps (full or half duplex) devices to be connected to the same DRL-7xx series Switch.

## Performance Specifications

The performance specifications are as follows. For complete technical specifications, including switch dimensions, refer to [Appendix A](#).

Table 1: Performance Specifications

<b>Ethernet Switch Type</b>	Unmanaged
<b>Ports</b>	10BaseT/100BaseTx M12
<b>Required Voltage</b>	9-36VDC (See Appendix A for power consumption for each model)
<b>Ethernet Standards</b>	IEEE 802.3 (10BaseT), 802.3u (100BaseTX), 802.3x (Full Duplex)
<b>Ethernet Protocols</b>	All standard IEEE 802.3 protocols supported
<b>Speed Per Port</b>	10 Mbps/100Mbps
<b>Ethernet Isolation</b>	1500 Volts RMS (for 1 minute)
<b>Operating Temperature</b>	-40 to 80°C
<b>Humidity</b>	5 to 95% (non-condensing)

# 2

## LED Indicators

### Chapter Sections:

- Overview
- Power LEDs
- ACT / LNK LEDs
- 10 / 100 LEDs

## Overview

The DRL-7xx series have communication LEDs for each port and power LEDs. Refer to the sample pictures below for LED locations.

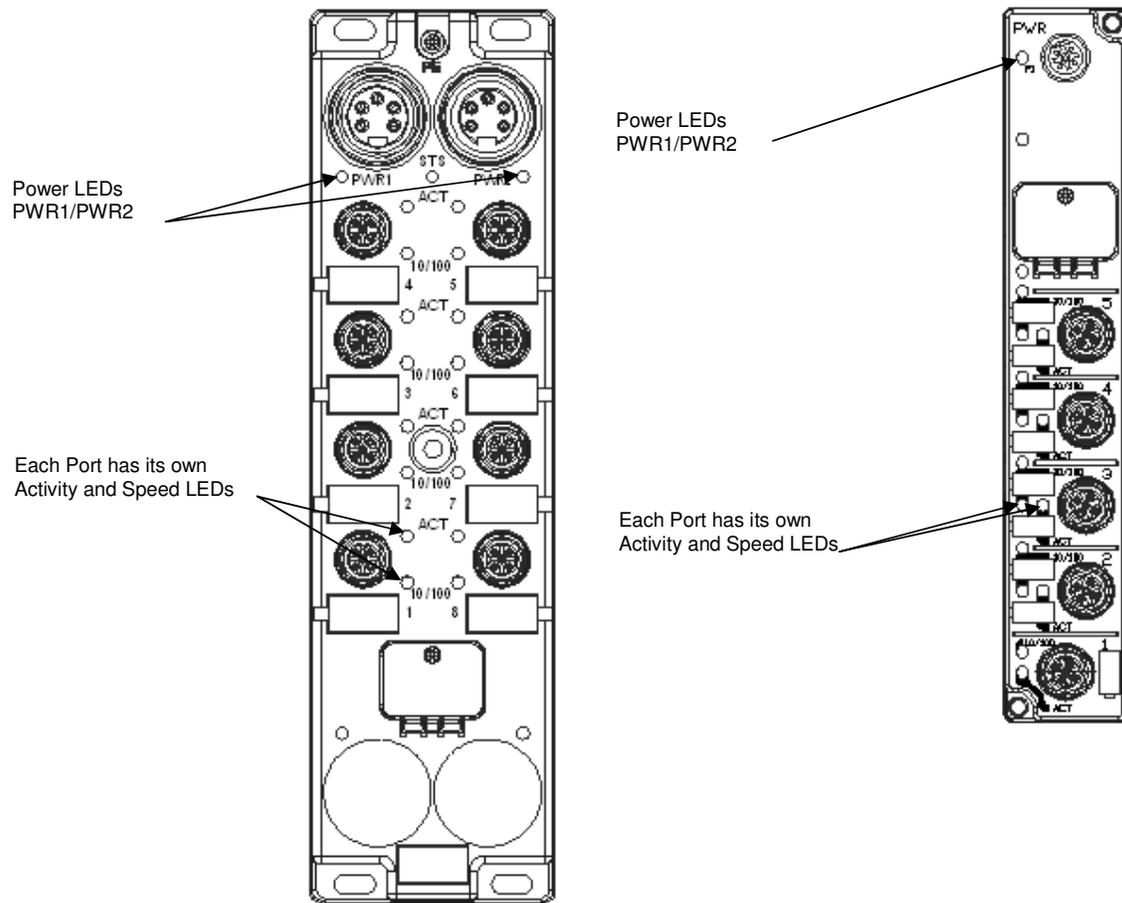


Figure 1 - LEDs on DRL-78x

Figure 2 - LEDs on DRL-750

## Power LEDs

The Power LEDs indicate the switch is correctly powered.

LED State	Meaning
Off	Device is powered Off
Green	Power is connected correctly

### DRL-780 / DRL-781 / DRL-782

There are two Power LEDs on the DRL-78x Switches. PWR1 is used for primary power, and PWR2 is used for secondary power. Both indicate if power is being applied to the respective terminal.



### Note

The DRL-780/DRL-781/DRL-782 operates while either (or both) PWR1/PWR2 LED lit.

In power redundancy mode, both PWR1 and PWR2 will be lit.

### DRL-750

The DRL-750 has only one Power LED. The LED will be lit if power is applied to one or both of the +24VDC terminals.

## ACT/LNK LEDs

The Ethernet activity (ACT) is reported through one LED. There is one of these LEDs per M12 port.

LED State	Meaning
Off	There is no activity on this port
Flashing Green	Communication activity detected.

## 10/100 LEDs

These LEDs indicate the communication speed detected on the port. There is one of these LEDs per M12 port.

LED State	Meaning
Off	There is no proper Ethernet connection (link) between the port and another Ethernet device. Make sure the cabling is correct and that all cables are plugged securely into the ports, at both ends.  For Ethernet wiring directions, refer to Section 5.
Yellow	A 10 Mbps (10BaseT) connection is detected.
Green	A 100 Mbps (100BaseTx) connection is detected.

# 3

## Installation

### Chapter Contents:

- Overview
- Procedure
- Dimensions
- Cables flow

## Overview

The IP67 Switches should be screwed directly to a flat panel or on a machine frame. Refer to the pictures below.



### Note

Mounting the Switch to a surface that is not flat can cause the circuit board inside the device to be flexed, possibly damaging it.



### Note

Allow for enough room to route the Ethernet cables.



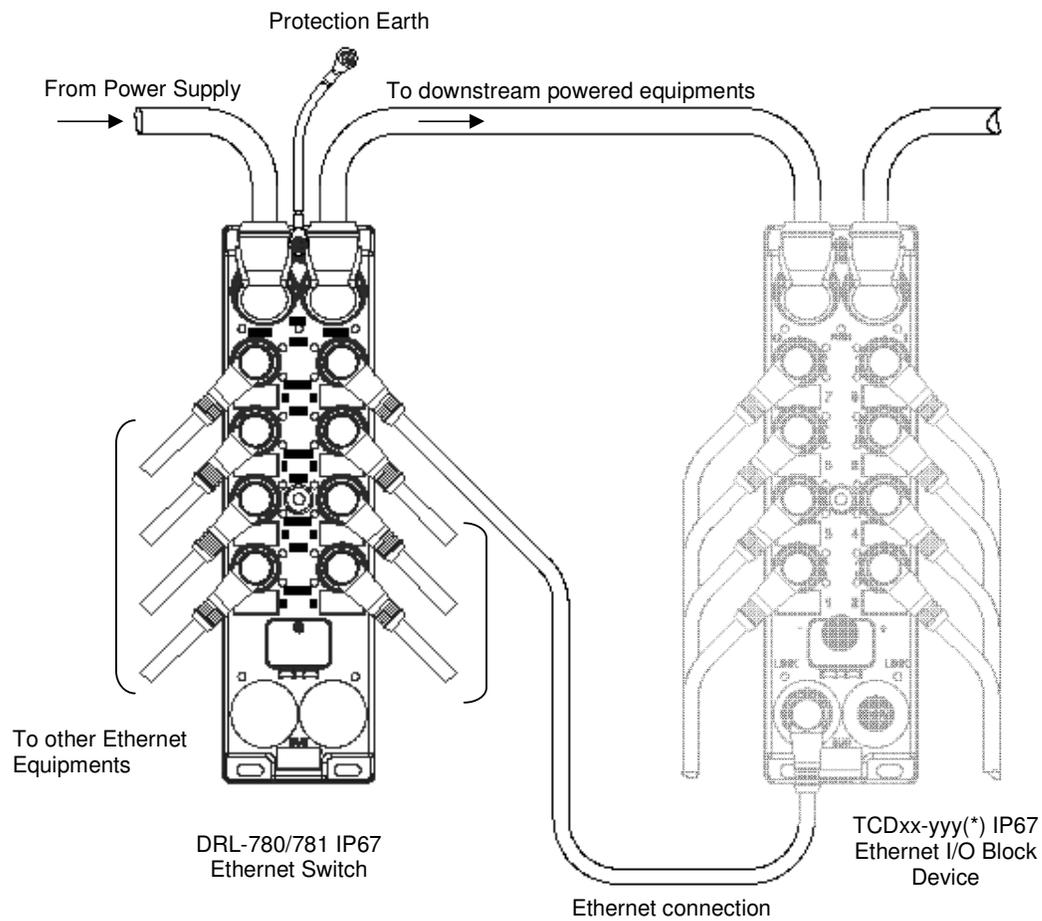
### Warning

Install the IP67 Industrial Ethernet Switch in accordance with local and national electrical codes.

## Procedure

- Connect Protective Earth to the Ground Nut.
- Connect Ethernet ports.
- Connect the Power Supply to the power terminals. This will start the switch operation.

## Typical Cabling



**Figure 3 - Typical Switch Cabling**

<sup>(\*)</sup> See P/N references in IP67 HarshIO product catalog

# 4

## Power Wiring

### Chapter Contents:

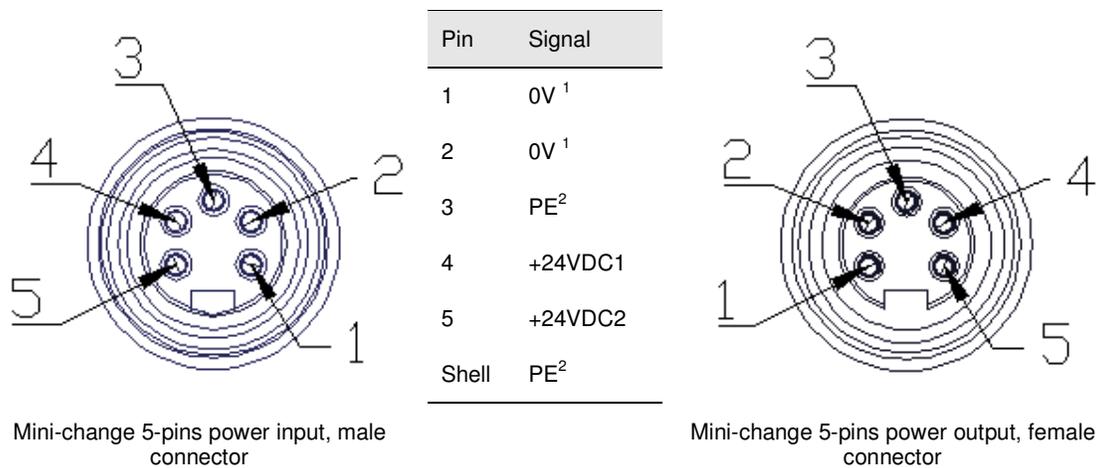
- Overview
- Power Supply Redundancy
- Daisy-Chaining Module's Power-supply

## Overview

IP67 Switches can be powered from the same DC source that is used to power your I/O devices. 9 to 36 VDC needs to be applied across the +24VDC1 and Common (0v) terminals.

The third terminal (PE) should be tied to panel or chassis ground, first making sure the possible grounding point is free of electrical noise.

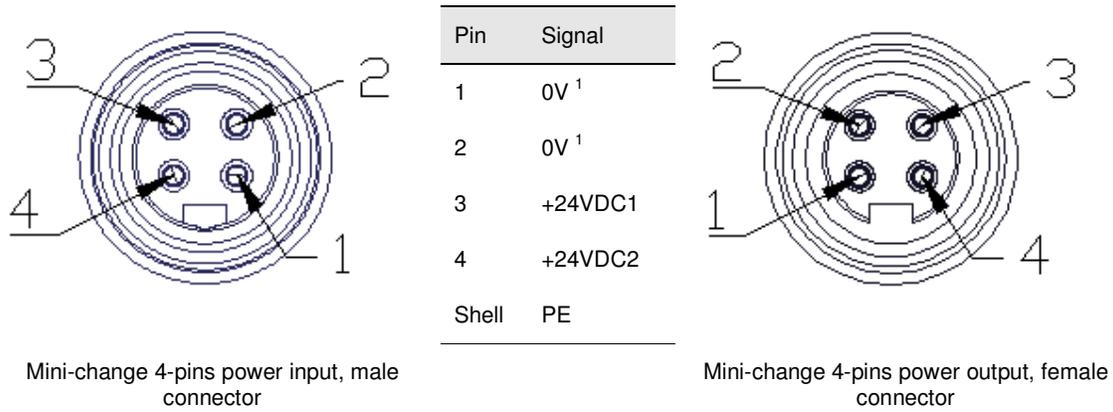
To reduce downtime resulting from power loss, the switch can be powered redundantly by connecting a second power supply to the +24VDC2 terminal and the Common terminal (0v).



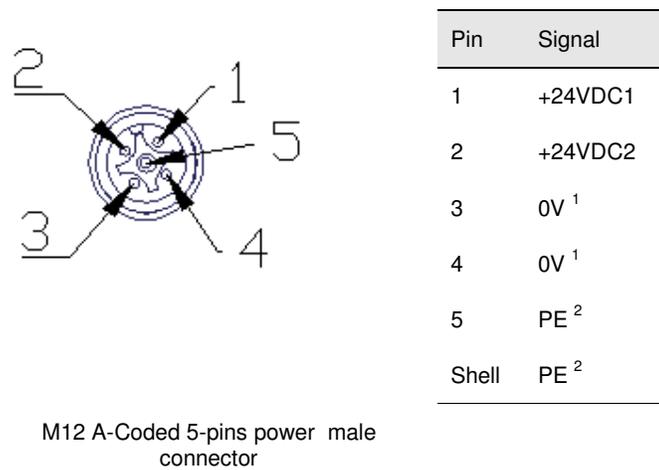
**Figure 4 - 5 Pins Mini-Change Power Connector Pinout**

<sup>1</sup> Both 0V terminals are connected internally

<sup>2</sup> Both PE terminals are connected internally



**Figure 5 - 4 Pins Mini-Change Power connector Pinout**



**Figure 6 - 5 Pins M12 Power connector Pinout**



**Note**

Connecting the power supply will start device operation.

<sup>1</sup> Both 0V terminals are connected internally

<sup>2</sup> Both PE terminals are connected internally



## Warning

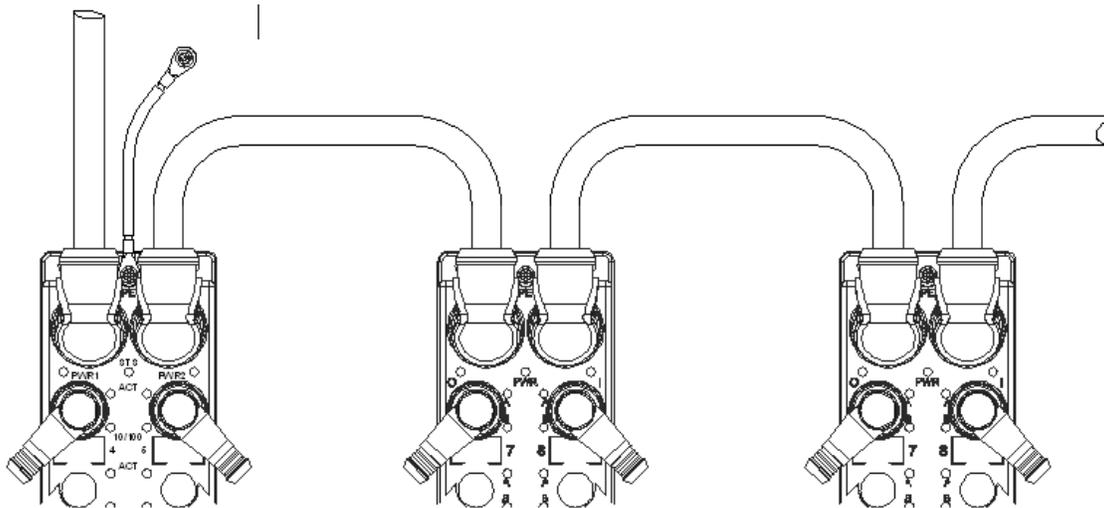
Equipment should be installed in accordance with local and national country wiring codes.

## Power-supply Redundancy

IP67 switches can operate from either +24VDC1 or +24VDC2. When using power supply redundancy, two different power supplies shall be used. If one of these power supplies would fail, the DRL-7xx Industrial Switch will continue to operate transparently.

## Daisy-Chaining Module's Power-supply

The DRL-78x has 2 power ports to allow daisy chaining power from one device to another. This feature could be used to power additional I/O blocks or switches without power tees or taps.



## Warning

While daisy-chaining power between modules, the total current (amps) needs to be calculated for the whole chain and that value must not exceed **8 A** (DRL-780, DRL-781) or **4 A** (DRL-782) per power-supply pin, either +24VDC or 0V terminal. The power requirements of the DRL-78x also need to be considered in power budgeting (refers to Fig. 10).

# 5

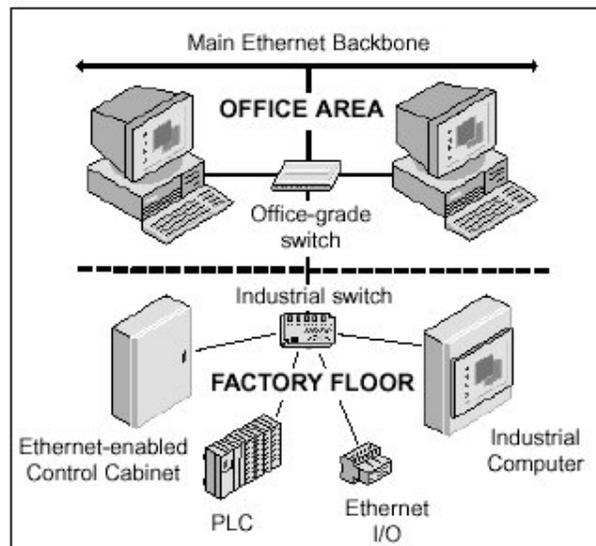
## Communication Ports Wiring

### Chapter Contents:

- Overview
- M12 Ethernet Wiring
- Ethernet Connector Pinout
- Ethernet Cable Length
- Duplex Operation
- Verifying Connectivity

## Overview

Switches provide connections to standard Ethernet devices, such as PLCs, Ethernet I/O and industrial computers. These devices are connected to the switch using standard M12 communication ports.



**Figure 7 - Switch Connections**

## M12 Ethernet Wiring

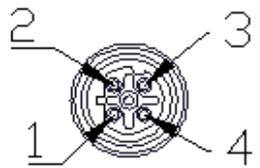
Use data-quality (not voice-quality) twisted pair cable, rated category 5 (or better), with M12 D-Coded connectors. For best performance, use shielded cable. Straight through or crossover M12 cable can be used, regardless of the device the switch is to be connected to, as all the DRL-700 Series Switches are capable of auto-mdi/mdix-crossover detection.

The M12 Ethernet port connector bodies are metallic and are connected to the PE connection point (either terminal or screw). Therefore, shielded cables may be used to provide further protection.

To prevent ground loops, the cable shield should be tied to the metal connector body at one end of the cable only. For increased reliability, electrical isolation is also provided on the Ethernet ports.

## Ethernet Connector Pinout

Table 6: Ethernet Connector Pinouts



Pin	Signal
1	TX+
2	RX+
3	TX-
4	RX-

Figure 8 - M12 Ethernet D-Coded Connector

## Ethernet Cable Length

The maximum cable length for 10BaseT / 100BaseTx is typically 100 meters (328 ft.).

## Duplex Operation

All Ethernet ports will auto-sense for Full or Half duplex operation.

## Verifying Connectivity

When all Ethernet connections have been made, check the LEDs corresponding to the ports with devices connected. Each port that is in use, the LED should be ON or blinking. If a port LED is off, check for connectivity problems between that port and the network device connected to it. In addition, the LED color should indicate the speed your device is connected at (for more details, refer to Chapter 2, [LED Indicators](#)).

# 6

## Switch Features

### Chapter Contents:

- Switch Features

## Switch Features

Below is a brief description of the features of the IP67 Industrial Ethernet Switches DRL-7xx series.

### 10BaseT and 100BaseTx Auto-Negotiation

Standard Ethernet (10BaseT) has a maximum speed of 10 Mbps. Fast Ethernet (100BaseTx) has a maximum speed of 100 Mbps. The M12 ports on the switches automatically select the appropriate speed.

### 1K / 8K MAC Addresses with Automatic Learning, Aging and Migration

Each Ethernet device inserts its unique “MAC” address into each message it sends out. The port on the switch used for a given MAC address is automatically learned when a frame is received from that address. Once an address is learned, the switch will route messages to the appropriate port only, instead of broadcasting messages out all ports, like a hub. A timestamp is also placed in memory when a new address is learned. This timestamp is used with the aging feature, which will remove unused MAC addresses from the table after 300 seconds. If a device moves, the associated port on the switch will be changed (migrated) as needed. Up to 1,024 MAC addresses can be stored and monitored at any time on the DRL-750 and 8,192 on the DRL-78x.

### Auto-Crossover (Auto-MDI/MDI-X)

The switch ports will automatically detect the cable type (straight-thru vs. cross-over) and re-configure accordingly.

### Auto-Sensing or Auto-Negotiating Speed

The switch ports will auto-negotiate with the connected device to determine the optimal speed (10 Mbps vs. 100 Mbps).

### Backoff Operation

The switches will drop a packet after 16 consecutive retransmit attempts.

## Back Pressure for Half-Duplex

The switches will apply “back pressure” when necessary with half-duplex operation. This will reduce congestion on busy networks.

## Buffering

SRAM is used for buffering the messages. The DRL-750 has an internal 512 Kbit SRAM for buffering, and the DRL-78x have 1 Mbit.

## Unmanaged Operation

The switches require no supervisory processor to operate properly.

## Flow Control

The switches automatically support flow control frames on both transmit and receive sides.

## Forwarding

The switches support store and forward mode. They forward messages with known addresses out the appropriate port only. Messages with unknown addresses, broadcast messages, and multicast messages get forwarded out all ports, except the source port. The switches will not forward error packets, 802.3x pause frames, or “local” packets.

## Full/half-Duplex Operation

The switches’ ports support both full and half duplex flow control.

## Illegal Frames

Illegal frames, as defined by IEEE 802.3, will be dropped. This includes short frames, long frames and FCS error frames.

## **IEEE 802.3 Compliant**

The switches abide to the IEEE 802.3 standard for 10BaseT and 100BaseTX Ethernet communications.

## **Late Collision**

If a packet experiences collisions after 512 bit times of transmission, it will be dropped.

## **Latency**

The typical latency of a message is 5 microseconds or faster. The latency is the time it takes a message to be routed internally to a switch from one port to another.

## **Plug and Play**

This means that most of the switches' functions or features are automatic and that no optional parameters need to be set. Just plug in your Ethernet cables, apply power, and the unit will immediately begin to operate.

## **Protocol Independent**

The switches simultaneously support all popular Ethernet protocols and networks, such as TCP/IP and NetBEUI that run over standard Ethernet (IEEE 802.3).

# 7

## Technical Specifications

### Appendix Contents:

- Technical Specifications
- Dimensions
- Cable flow

## Technical Specifications

The hardware technical specifications for the Unmanaged Switches are as follows.

<b>10/100BaseT Ports</b>	Shielded M12
<b>Protocols supported</b>	All standard IEEE 802.3
<b>Ethernet compliancy</b>	IEEE 802.3, 802.3u, 802.3x
<b>Auto-crossover</b>	Yes, allows you to use straight or cross wired cables
<b>Auto-sensing operation</b>	Full and half duplex
<b>Auto-negotiating</b>	10BaseT and 100BaseTx
<b>Auto-polarity</b>	Yes, on the TD and RD pair
<b>Flow control</b>	Automatic
<b>Ethernet isolation</b>	1500 VRMS 1 minute
<b>Plug and play</b>	Yes
<b>Cable requirements</b>	Twisted pair (Cat. 5 or better) (shielded recommended)
<b>Max. cable distance</b>	100 meters

**Figure 9 - Copper Ports: (10BaseT or 100BaseTx)**

	<b>DRL-75x</b>	<b>DRL-78x</b>
<b>Ethernet switch type</b>		Unmanaged
<b>Ethernet ports</b>	5 x M12 Fast Ethernet	8 x M12 Fast Ethernet
<b>Switching technology</b>		Store and forward
<b>Latency for 10Mbps ports</b>		16us + frame time (typical)
<b>Latency for 100Mbps ports</b>		5us + frame time (typical)
<b>Duplex operation</b>		Full or half
<b>Mounting</b>		Direct panel mounting
<b>Power in connector</b>	M12 Male A-Coded 5 pins	Mini Change Male 5 pins (DRL-780) Mini Change Male 4 pins (DRL-781) M12 Male A-Coded 5 pins (DRL-782)
<b>Power out connector (daisy-chain)</b>	N/A	Mini Change Female 5 pins (DRL-780) Mini Change Female 4 pins (DRL-781) M12 Female A-Coded 5 pins (DRL-782)
<b>Power input</b>		Redundant Input Terminals
<b>Input power (max)</b> (all ports active at 100Mbps)	2.0 W	2.4 W
<b>Input voltage (all models)</b>		9-36VDC (continuous)
<b>Ethernet isolation</b>		1500 VRMS 1 minute
<b>Operating temperature range</b>		-40 to +80°C
<b>Storage temperature range</b>		-40 to +90°C
<b>Humidity (non-condensing)</b>		5 to 95% RH
<b>Vibration</b>		7g (IEC68-2-6)
<b>Shock</b>		50g (IEC68-2-29)
<b>Electrical safety</b>		EN61010-1
<b>EMI emissions</b>	EN55022 class B	EN55022 class A
<b>EMC immunity</b>	EN61000-4-3 10V/m radiated EN61000-4-6 10V conducted EN61000-4-4 EN61000-4-5 EN61000-4-2 8Kv contact / 16Kv air	EN61000-4-3 10V/m radiated EN61000-4-6 10V conducted EN61000-4-4 EN61000-4-5 EN61000-4-2 4Kv contact / 8Kv air
<b>Packaging</b>		IP67 protection
<b>Dimensions</b>	220 x 60 x 37 mm See figure 11 for details.	176 x 30 x 34 mm See figure 12 & 13 for details.
<b>Weight</b>	230 g	580g

**Figure 10 - General Specifications**

## Dimensions

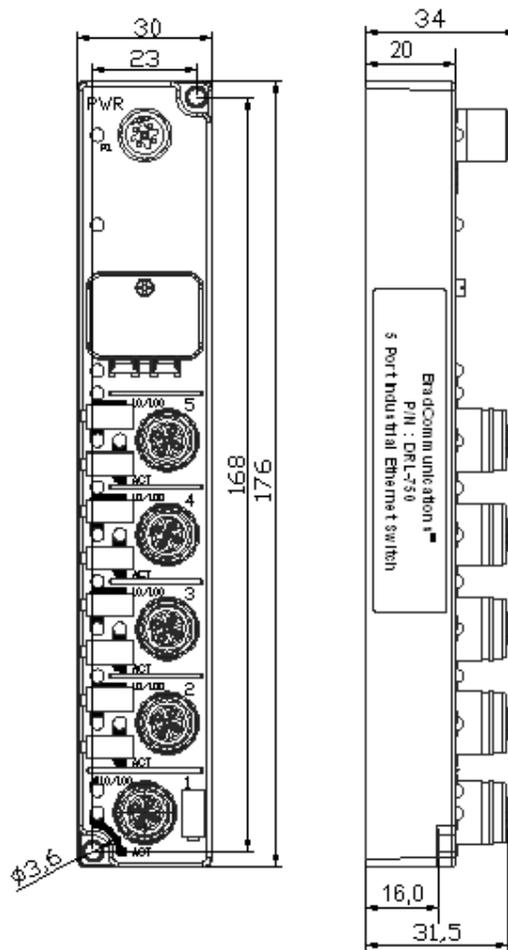


Figure 11 - DRL-750 Dimensions

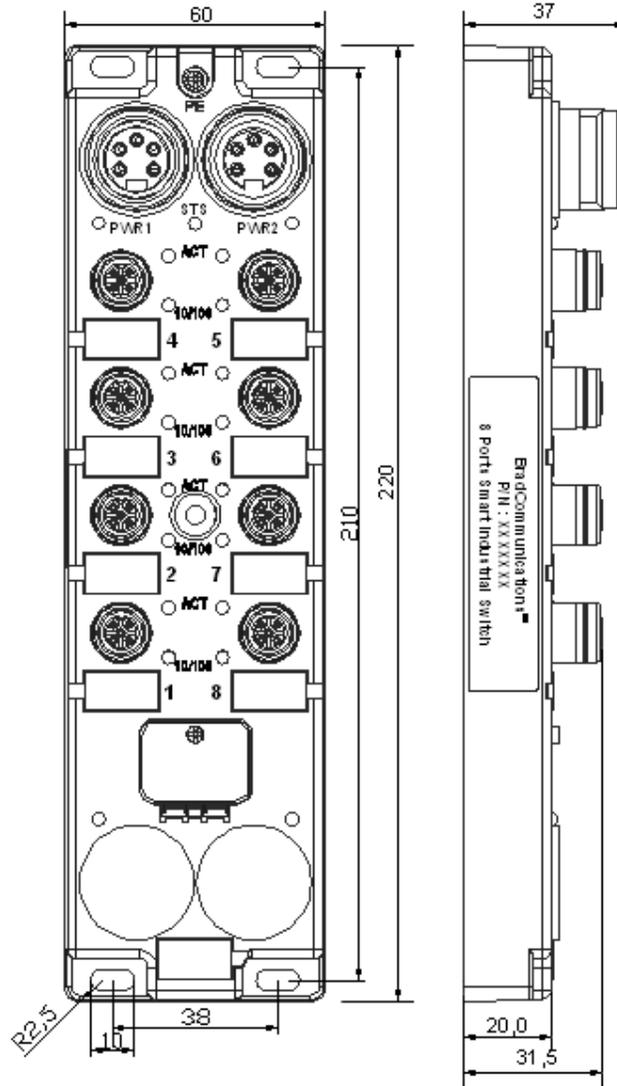


Figure 12 - DRL-780, DRL-781 Dimensions

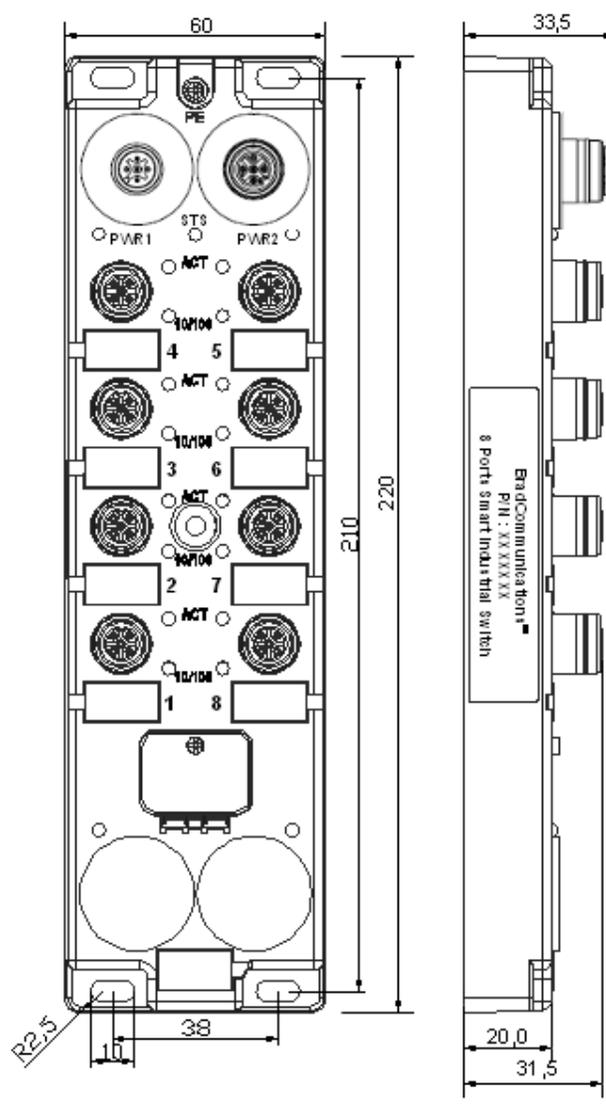


Figure 13 - DRL-782 Dimensions

## Cable Flow

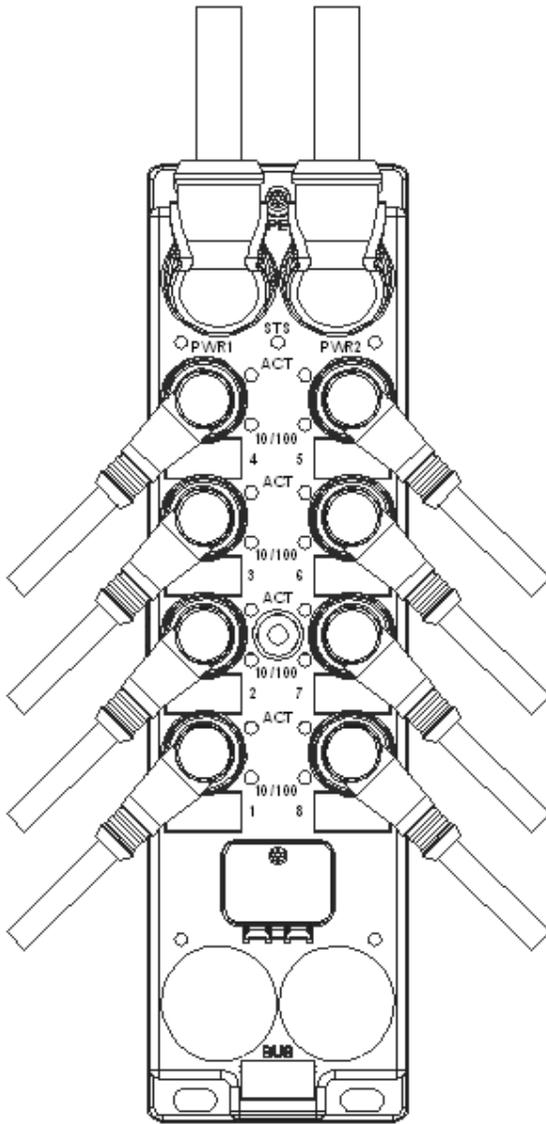


Figure 14 - Cable flow on DRL-78x

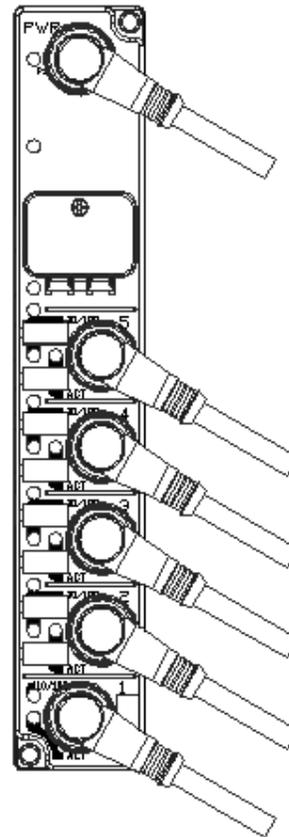


Figure 13 - Cable flow on DRL-750

# 8

## Cabling Guidelines

### Appendix Sections

- Overview
- Cable Categories
- Cable Routing
- Bonding and Grounding
- Data Cable Shielding
- Conforming to IP67
- Planning your Installation

## Overview

The following chapter highlights some basic cabling rules that must be implemented to achieve reliable operation of your network. Industrial networks must be robust enough to avoid costly process downtime. Every part of the design should be carefully selected to perform in a harsh environment over its lifetime. Specifically Devices, Connectors and Cables should be chosen based on their behavior regarding:

- Vibrations
- Climatic stresses
- Electric noise
- Chemical aggression

## Cable Categories

IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources (IEEE Std 518-1982) defines 4 cables categories. When planning the network, every cable shall be assigned a category to help routing.

Cable Category	Cable Type
Aggressors	<ul style="list-style-type: none"> <li>● High-power AC lines</li> <li>● DC I/O lines connecting solenoids, relays or switches</li> </ul> <p>These conductors correspond to IEEE levels 3 (low susceptibility) &amp; 4 (power)</p>
Victims	<ul style="list-style-type: none"> <li>● Low-power analog or digital lines</li> <li>● Communication lines</li> </ul> <p>These conductors correspond to IEEE levels 1 (high susceptibility) &amp; 2 (medium susceptibility)</p>

## Cable Routing

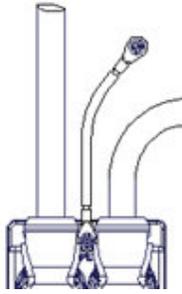
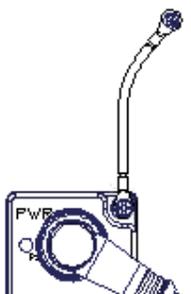
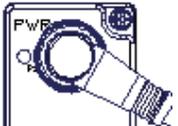
As a general guide:

- Cables of the same category shall be routed together and never cross each other.
- If crossing cables is necessary it should be done at right angles to reduce any negative impact. This is especially important when crossing communication and power wires.
- When running disturbing cables (class 1 and 2) parallel they should be kept apart from Data cables with a minimum separation of 0.30m to limit capacitive and radiated coupling.
- All cables should be routed in metal cableways.

## Bonding and Grounding

Proper bonding and grounding of your equipments is a key point to meet safety regulations. It will also help in reducing EMI and ground noise effects.

The PE on power connector needs to be connected only when no earth connection is available. In order to avoid ground loops, it is recommended that the one of the Protected Earth connection points (PE in Power connector OR FE screw to the chassis) be grounded.

<p>Connecting the DRL-78x to earth requires a bonding lead with an M3 ring terminals. See picture below for details.</p>	<p>The DRL_750 can be grounded through its top right or bottom left holes using either a bonding lead with an M3 ring terminal or directly to an earthed chassis with M3 screws.</p>	
		

## Data Cable Shielding

The IP67 Industrial Ethernet Switches are designed for mounting directly on machine frames. This kind of environment, subject to high electrical noise, requires usage of suitable cable type. Shielded Cables (STP) shall be selected for this type of application, as they provide good noise immunity to the whole system.

## Conforming to IP67

To ensure the device is IP67 rated, all connectors (Power supply, Ethernet ports) need to be connected to an IP67 cable, or terminated with the appropriate caps.

## Planning your installation

Always use cables/connectors suitable for your application. It's important to go with cables/connectors designed for an industrial environment.



### Caution

A DC power source that complies with the Safety Extra Low Voltage (SELV) requirements of UL 1950, CSA C22.2 No. 950-95, EN 60950, and IEC 60950 must be used when powering the DRL-700 Series of IP67 Industrial Ethernet Switches.

# A

## Standards and Safety

### Appendix Sections

- CE Statement
- General Warnings

The applicable standards and certifications are:



## CE Mark

Electrical safety - EN61010-1 (IEC61010)  
EMI emissions - EN55011  
EMC immunity – EN61326

## General Warnings



### Caution

This equipment is neither designed for, nor intended for operation in installations where it is subject to hazardous voltages and hazardous currents.



### Note

To maintain compliance with the limits and requirements of the EMC Directive, it is required to use quality interfacing cables and connectors when connecting to this device.



### Note

The supply voltage for this equipment must be delivered as Separated Extra Low Voltage (SELV).

# B

## Warranty and Support

### Appendix Sections:

- Statement of Limited Warranty
- Technical Support

## Statement of Limited Warranty

Brad™ from Molex, manufacturer of **DRL-7xx** products, warrants to Buyer that products, except software, manufactured by Brad™ will be free from defects in material and workmanship. Brad™ obligation under this warranty will be limited to repairing or replacing the defective parts within one year of the date of installation. Products may be returned by Buyer only after permission has been obtained from Brad™. Buyer will prepay all freight charges to return any products to the repair facility designated by Brad™.

Brad™ further warrants that any software supplied as part of a product sale, except obsolete products, will be free from non-conformances with Brad™ published specifications for a period of 90 days from the time of delivery. While Brad™ endeavors to improve the features and performance of its products, no effort on the part of Brad™ to investigate, improve or modify **DRL-7xx** modules at the request of a customer will obligate Brad™ in any way.

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# Technical Support

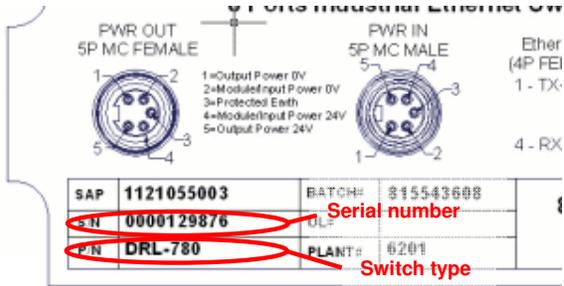
Please ensure that you have the following information readily available before calling for technical support:

- Switch type and serial number
- Details of the problem you are experiencing: switch type and version, target network, and circumstances that may have caused the problem

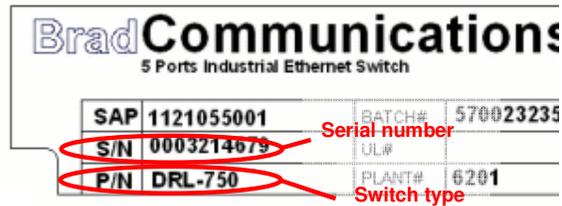


## Note

Your switch identification is located on the backside of the device.



Locate required support information on back label (DRL-78x)



Locate required support information on back label (DRL-75x)

## Getting Help

Technical support is available during regular business hours by email or telephone.

To get more information, please go to our [Brad® Automation products Support Center](#) where you can find:

- **Support Request** - For technical inquiries and product support, you can initiate a support ticket and a member of our team will respond.
- **Download Center** - Download software, demo software, user manuals, quick-start guides, and technical notes. The Download Center can be searched by part number, protocol or keyword.
- **Knowledge Base** - Connects you to technical documentation, what's new!, and the latest patches.

**Worldwide Technical Support Contacts** - Our Worldwide Technical Support covers Europe, Middle East, Africa, North America, South America, and Asia. Our Support Teams have extensive knowledge in the commissioning, diagnostics, and configuration of our automation products portfolio. They will be glad to assist you with any further questions you might have.