TRANSITION NETWORKS®

INDURA™ Series
Industrial Managed Switches

Install Guide

INDURA™

INDURA™

33514 Rev. G

Trademarks

All trademarks and registered trademarks are the property of their respective owners.

Copyright Notice/Restrictions

Copyright © 2011-2015 Transition Networks. All rights reserved.

No part of this work may be reproduced or used in any form or by any means (graphic, electronic or mechanical) without written permission from Transition Networks.

The information contained herein is confidential property of Transition Networks, Inc. The use, copying, transfer or disclosure of such information is prohibited except by express written agreement with Transition Networks, Inc.

Printed in the U.S.A.

INDURA™ Series Industrial Managed Switch Installation Guide 33514 Rev G

Contact Information

Transition Networks
10900 Red Circle Drive
Minnetonka, MN 55343 USA
Tel: 952- 941-7600 or 1-800-526-9267
Fax: 952-941-2322

Revision History

Rev	Date	Description
C	11/13/12	Updated for Software v **1.3**. Add IND-328x-H (100 watt DC Power Converter). Change graphics for IND-328X-H & –L. Hide FRA Power supplies for –H. Update Loop Protect port action. Added Declaration of Conformity.
D	01/10/13	Updated for Software v1.4. Add RFC2544, thermal protect trap, and add MIBs. Change SSH RSA hostkey length to 2048 bits.
E	06/12/13	Updated for Software v 1.5. Adds 2.5GB SFP ports support, MRP, Static IP Routing, Mouse Guard accessory, BWP per CoS/ EVC/ UNI options, SA enhancements, Auto-Negotiation between 2.5G port and 1G port, and adds "GB 4943.1-2011 (Safety of Information Technology Equipment)" information and UL 508 listing.
F	05/28/14	Updated for Software v 1.7. Adds DHCP option 61 client-identifier, changes S4K port LEDs, and changes SFP detect on 10G ports to not override configured speed.
G	9/9/15	Updated for Software v 2.2. Adds iCLI, Alarms, MRP, and port number scheme changes.

Cautions and Warnings

Definitions

Cautions indicate that there is the possibility of poor equipment performance or potential damage to the equipment. **Warnings** indicate that there is the possibility of injury to a person.

Cautions and Warnings appear here and may appear throughout this manual where appropriate. Failure to read and understand the information identified by this symbol could result in poor equipment performance, damage to the equipment, or injury to persons.

Cautions

Do not ship or store devices near strong electrostatic, electromagnetic, magnetic, or radioactive fields.

Caution: When handling chassis Network Devices observe electrostatic discharge precautions. This requires proper grounding (i.e., wear a wrist strap).

Caution: Copper based media ports, e.g., Twisted Pair (TP) Ethernet, USB, RS232, RS422, RS485, DS1, DS3, Video Coax, etc., are intended to be connected to intra-building *(inside plant)* link segments that are not subject to lightening transients or power faults. They are **not** to be connected to inter-building *(outside plant)* link segments that are subject to lightening.

Caution: **Do not** install the devices in areas where strong electromagnetic fields (EMF) exist. Failure to observe this caution could result in poor device performance.

Caution: Read the installation instructions before connecting the chassis to a power source. Failure to observe this caution could result in poor performance or damage to the equipment.

Caution: Only trained and qualified personnel should install or perform maintenance on the INDURA. Failure to observe this caution could result in poor performance or damage to the equipment.

Caution: Do not let optical fibers come into physical contact with any bare part of the body since they are fragile, and difficult to detect and remove from the body.

Caution: Do not bend any part of an optical fiber/cable to a diameter that is smaller than the minimum permitted according to the manufacturer's specification (usually about 65 mm or 2.5 in)!

CAUTION – "Risk of Electric Shock – More than one disconnect switch may be required to de-energize the equipment.

Warnings

Warning: Use of controls, adjustments or the performance of procedures other than those specified herein may result in hazardous radiation exposure.

Warning: Visible and invisible laser radiation when open. **Do not** look into the beam or view the beam directly with optical instruments. Failure to observe this warning could result in an eye injury or blindness.

Warning: DO NOT connect the power supply module to external power before installing it into the chassis. Failure to observe this warning could result in an electrical shock or death.

Warning: Select mounting bracket locations on the chassis that will keep the chassis balanced when mounted in the rack. Failure to observe this warning could allow the chassis to fall, resulting in equipment damage and/or possible injury to persons.

Warning: Do not work on the chassis, connect, or disconnect cables during a storm with lightning. Failure to observe this warning could result in an electrical shock or death.

Warning: Disconnect Device – Since the products are evaluated as Permanently Connected Equipment, disconnect devices shall be provided in accordance with sub clause 1.7.2.2. A readily accessible disconnect device shall be incorporated outside the equipment. These devices can be isolating switch, circuit breaker, or equivalent as specified in sub clause 3.4.2 in GB 4943.1-2011 (Safety of Information Technology Equipment). For Permanently Connected Equipment, a readily accessible disconnect device shall be incorporated external to the equipment.

See "Electrical Safety Warnings" on page 54 for Electrical Safety Warnings translated into multiple languages.

Table of Contents

Tables

Figures

1. Introduction

Transition Network's INDURA™ series of industrial, managed switches provide fully-hardened solutions designed to operate reliably in harsh environments. INDURA™ is IEC 61850-3 Substation certified, offering advanced Ethernet management, redundancy and security features coupled with rugged hardware performance for industrial or outdoor environment applications requiring high reliability and availability. Its four Gigabit SFP ports allow maximum flexibility in a wide range of fiber supported network architectures. INDURA supports IEEE 1588v2 Precision Time Protocol for real-time automation applications. IEEE 802.3ah / IEEE 802.1ag / ITU-T Y.1731 make INDURA an excellent choice for networks that need fault detection and fault isolation.

The following sections detail the INDURA features, models, specification and documentation.

Features

The INDURA provides services for deploying in a carrier Ethernet network as a first point of entry into the provider network. The main services offered by the INDURA are:

- Innovative passive cooling design to maintain operating temperature of SFPs.
- IEC 61850-3 Substation Certified.
- Extended (-40°C to 75°C) operating temperature.
- Redundancy: ITU-T G.8032v2 (Ethernet Ring Protection Switching) with Recovery < 50 ms.
- STP/RSTP/MSTP support.
- Synchronization: IEEE 1588v2 PTP BC/OC/TC.
- System Alarms via Fault Output Relay / Syslog / SNMP Traps.
- Security: IEEE 802.1x User Authentication, RADIUS and TACACS+, SNMPv3.
- IPv4 and IPv6 support.
- Link Aggregation (LACP).
- OAM Support: LOAM IEEE 802.3ah, SOAM IEEE 802.1ag, and ITU-T Y.1731.
- Jumbo Frame Support (9.6K).
- Quality of Service (802.1p) for real-time traffic prioritization.
- LAN (802.1Q) with double tagging.
- IGMP v2/v3.
- Management via CLI, Telnet, SSH, SSL, and SNMPv1, v2c & v3.
- EEE Power Saving option
- MRP per IEC 62439-2 Ed. 1.0 b:2010.

All of the INDURA features closely follow standard recommendations (IEEE, ITU, and IETF).

- 2.5GB SFP ports support
- MRP (Media Redundancy Protocol)
- Static IP Routing (SIR)
- BWP per CoS/per EVC/per UNI option

Specifications

Data Rate	*Copper*: 10/100/1000 Mbps *SFP*: 100/1000 Mbps
Status LEDs	Power, Fault Relay Alarm. Port Activity, Duplex
Dimensions	*Width*: 5.05" [128.27mm] *Depth*: 5.64" [143.256mm] *Height*: 6.80" [178.72mm]
Ingress Protection	IP30 (IEC529 (BSEN60529:1991) (Ingress Protection)
Input Power	18 - 57 VDC; redundant inputs (IND-328x-L only) 125-300 VDC, 100-250 VAC; dual-input power (-H model)
Fault Relay	1A at 60 VDC capacity
Management Console	one RJ45 serial Management Console port
Power Consumption	36 Watts max. (14 Watts Max in datasheet)
Power Measurements (all ports active)	
Power required (*typical*) IND-3284-L:	20VDC, 700mA, 13.8W 57VDC, 230mA, 13.1W
Power required (*typical*) IND-3280-L:	20VDC, 595mA, 11.7W 57VDC, 210mA, 11.4W **Note 1**: USB port can draw up to an additional 2.5W (Maximum per USB specification).
Power required (*typical*) IND-328x-H:	127-300 VDC, 100-250 VAC, 30W (0.3A Max.) 60V, 1A max - Alarm Relay (60W max).
Environment	Operating temp: -40°C to +75°C (-40°F to +167 °F) Operating Humidity: 5% to 95% non-condensing Storage temp: -40°C to +85°C (-40°F to +185 °F)
Shipping Weight	6.75 lbs (3.06 Kg.)
Mounting Options	DIN Rail, Desktop, Panel mount *(in datasheet)*
Maximum frame size	9,600 bytes
Max. MAC addresses	8K
Shared buffer memory	4 Mb
Switch fabric	Fully non-blocking wire-speed switching performance for all frame sizes.
Safety	UL508 certified for Industrial Control Equipment.
Certifications	IEC 61850-3, EN 60079-15:2005, IEEE 1613 (*pending) *(just IEC 61850-3 in datasheet)*
Warranty	Lifetime

Applications

The INDURA multi-port switch primarily targets the industrial market space surrounding Smart Grid initiatives that also require an IEEE 1613 substation rating. Suitable INDURA applications include:

- ☐ Power Generation, Transmission, & Distribution
- ☐ Electrical Substation, Smart Grid
- ☐ Oil & Gas, Petrochemical
- ☐ Mining
- ☐ Water/Wastewater Treatment Plants
- ☐ Shipyards / Airports
- ☐ Outdoor IP Video Surveillance
- ☐ Intelligent Transportation Systems
- ☐ Process and Factory Automation requiring Precision Time Protocol (PTP)
- ☐ High Availability Fiber-based Network Ring Architectures
- ☐ Cellular backhaul

Standards Compliance

The INDURA complies with the following industry standards.

Table 1: Standards Compliance

Standard	Title
IEEE 802.1AB	Station and Media Access Control Connectivity Discovery
IEEE 802.1D	Media Access Control (MAC) Bridges
IEEE 802.1s	Multiple Spanning Trees
IEEE 802.1w	Media Access Control (MAC) Bridges - Amendment 2 Rapid Reconfiguration
IEEE 802.1x	Port Based Network Access Control
IEEE 802.1Q	Virtual Bridged Local Area Networks
IEEE 802.1ad	Amendment 4 Provider Bridges
IEEE 802.1ag	Connectivity Fault Management. (SOAM)
IEEE 802.1ak	Amendment 7 Multiple Registration Protocol
IEEE 802.3	CSMACD Access Method and Physical Layer
IEEE 802.3af	Amendment DTE Power via the Media Dependent Interface (MDI) Enhancements
IEEE 802.3at	Amendment 3 DTE Power via the Media Dependent Interface (MDI) Enhancements
IEEE 802.3az	Amendment 5 Media Access Control Parameters, Physical Layers, and Management Parameters for Energy-Efficient Ethernet
IEEE 1588v2	Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
ITU Y.1731	Ethernet OAM
ITU G.8031	Ethernet Protection Switching
ITU G.8032v2	Ethernet Ring Protection
ITU G.8264	Distribution of timing information through packet networks
IETF	
RFC 768	User Datagram Protocol
RFC 791	Internet Protocol
RFC 792	Internet Control Message Protocol

Standard	Title
RFC 793	Transmission Control Protocol
RFC 826	Address Resolution Protocol
RFC 854	Telnet
RFC 1112	Internet Group Management Protocol, version 1
RFC 1157	Simple Network Management Protocol
RFC 1213	MIB-II
RFC 1350	Trivial File Transfer Protocol
RFC 2030	Simple Network Time Protocol
RFC 2131	Dynamic Host Configuration Protocol
RFC 2236	Internet Group Management Protocol, version 2
RFC 2460	Internet Protocol, Version 6
RFC2544	Performance Tests
RFC 2674	VLAN Bridge MIB
RFC 2818	HTTP over TLS
RFC 2819	RMON MIB
RFC 2863	Interfaces Group MIB
RFC 2933	IGMP MIB
RFC 3046	DHCP Relay Agent Information Option
RFC 3376	Internet Group Management Protocol, version 3
RFC 3411	An Architecture for Describing SNMP Management Frameworks
RFC 3414	User-based Security Model MIB
RFC 3415	View-based Access Control Model MIB
RFC 3416	Simple Network Management Protocol, version 2
RFC 3635	Ethernet-Like MIB
RFC 3636	IEEE 802.3 Medium Attachment Unit MIB
RFC 4133	Entity MIB
RFC 4188	Bridge MIB
RFC 4668	RADIUS Authentication Client MIB
RFC 4670	RADIUS Accounting Client MIB

Models

Transition Networks' INDURA Series Industrial Switch models are described below.

Table 2: Model Numbers

Model	Description
IND-3280-L	(4) 10/100/1000 Mbps RJ45 ports (4) 100/1000 Mbps SFP ports L = 18-57 VDC dual-input power
IND-3284-L	(7) or (8) 10/100/1000Mbps RJ45 ports (3) or (4) 100/1000 Mbps SFP ports L = 18-57 VDC dual-input power
IND-3280-H	(4) 10/100/1000 Mbps RJ45 ports (4) 100/1000 Mbps SFP ports H = Power Converter 100 watt DC
IND-3284-H	(7) or (8) 10/100/1000Mbps RJ45 ports (3) or (4) 100/1000 Mbps SFP ports H = Power Converter 100 watt DC
IND-3280-MG	Hooded Vent (Mouse Guard)

The INDURA models are shown below.

Model IND-3280-x   Model IND-3284-x

Figure 1: INDURA Models IND-3280-x and IND-3284-x

Document Overview

This installation guide provides instructions on how to install, set up, and login to the INDURA Series Industrial Managed Switches. The purpose of this manual is to provide the information needed to install the INDURA to the point of operation.

This manual documents all of the INDURA models, and notes differences where they apply. This manual includes three chapters, three appendixes, a table of contents, and Index.

A printed Product Documentation postcard is shipped with each INDURA device. A substantial set of technical documents, white papers, case studies, etc. are available on the Transition Networks web site at www.transition.com. Note that this manual may provide links to third party web sites for which Transition Networks, Inc. is not responsible.

Related Manuals and Online Help

This manual is one of several INDURA manuals which include:

- Product Documentation Postcard, 33504
- INDURA™ Install Guide, 33514 (this manual)
- INDURA™ Web User Guide, 33508
- INDURA™ CLI Reference, 33510
- IND-3280-MG Vent Hood (Mouse Guard) Accessory Install Guide, 33553
- Converge™ EMS Admin Guide 33533, Install Guide 33543, Admin Procedures 33544
- Release Notes (version specific)

Context-sensitive Help screens are built into the Web interface (click) and the CLI (type **?** or **Help**).

Check the TN web site at http://www.transition.com/ for additional white papers, application notes, etc.

Check the INDURA landing page at http://www.transition.com/TransitionNetworks/Landing/indura/indura.aspx for Product Information, Application Notes, etc.

Check the INDURA product page at http://www.transition.com/TransitionNetworks/Products2/Family.aspx?Name=Indura for access to the latest INDURA datasheet, Features, Applications, Specs, SKUS, etc.

When the procedures in this manual are successfully completed, refer to the INDURA Web Interface User Guide or the *INDURA CLI Reference Guide* for configuration, monitoring, diagnostics, and maintenance information.

2. Installation

This section describes how to install the INDURA hardware and software, and the procedures to access and initially set up the INDURA through either a local serial interface (USB) or a remote Ethernet connection (Telnet session or Web interface).

Safety

Before installing the INDURA, read the "Safety Cautions and Warnings" on pages 3-4 of this manual and ensure that the requirements noted are met. During installation and maintenance, avoid direct exposure to laser beams. Specifically, do not look into laser ports. Ensure that each SFP port at which laser beams are (or will be) present is occupied by an SFP that is locked in position. See the related SFP manual for details. See "Electrical Safety Warnings" on page 54 for Electrical Safety Warnings translated into multiple languages.

Lifting

Even though the INDURA Industrial Switch weights less than 6 pounds, use proper lifting to move the Industrial Switch about. Keep your back straight and lift with your legs, not your back. If you need to bend down to lift the box, bend at the knees, not at the waist to reduce potential for straining your lower-back muscles. See Figure 1 below.
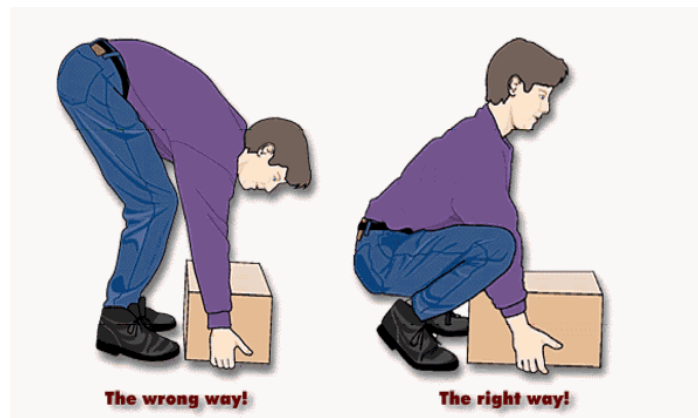

Figure 2: Proper Lifting Technique

Unpacking

1. Carefully unpack all INDURA contents. Use proper lifting technique as discussed above.

2. Verify receipt of all INDURA components; see "Ship Kit Contents" on page 14.

3. Place the INDURA and related materials in the desired install location (e.g., Rack-mount, Table top, or Wall mount). See "Installing INDURA Hardware" on page 24.

Figure 3: INDURA Unpacking

4. Save the INDURA shipping carton and packing materials for future use.

Package Contents

The INDURA is shipped with some standard and some optional components. Make sure you have received the following standard items:

- One INDURA Switch
- One printed Product Documentation postcard
- Four rubber feet

The INDURA is shipped with Dust Caps for protecting the connectors from intrusions. A Dust Cap is usually made from flexible plastic. When placing a Dust Cap over a connector, avoid pressing it against the fiber ferula surface in the connector so as to prevent contamination. Leave the Dust Cap(s) in place until making the actual fiber connection. Save the Dust caps for future use (reconfiguration, equipment moves, spares, returns, etc.).

Other / Optional Items

Additional items used during installation may include one or more SFPs, SGMII device(s), a USB cable, Ethernet CAT 5 cable(s) and/or Fiber cable(s), and wall mount brackets or rack mount brackets.

Optional Power Supply: External AC/DC Power Supply (25080 48~53 VDC 120W or 25105 48~55 VDC 120W (sold separately).

Tools Required

Installation may require a #4 Phillips screwdriver.

Additional tools and equipment required for cleaning connectors may include dust caps, isopropyl alcohol (solvent for contaminants), and tissues (soft multi-layered fabric made from non-recycled cellulose).

Use industry standard procedures for cleaning connectors. If applicable, follow your organizations process and procedure for copper and fiber cable cleaning and maintenance.

Hardware Overview

The INDURA switch hardware is described below in terms of its ports, access, security, IEEE 1613 industrial services support, dimensions, and LEDs.

Ports

The INDURA switch comes equipped with the following data access port types:

- **RJ-45** 10/100/1000Base-T Fast Ethernet (data) ports
- **SFP** (mini-GBIC) ports
- **RJ-45 Console** Port

RJ-45 data ports: The switch uses auto-negotiation to automatically sense transmission speeds of 10, 100, or 1000 Mbps along with duplex modes on any port. The RJ-45 interface provides automatic cable detection (AutoCross) on the TX ports for adjusting to straight through or crossover cables during installation; so a crossover cable is not required. All Ethernet ports have memory buffers that support the store-and-forward mechanism, which ensures that data transmits properly.

Console port: The switch has an RJ-45 console port that allows root access to its CLI (command line interface) via a computer, regardless of the state of the switch (unless it is completely dead). By connecting to the console port, out-of-band remote access to the CLI of the switch is possible. This creates a secondary path to the switch outside the bandwidth of the network, which needs to be secured without relying on the primary network.

SFP ports: The SFP fiber slots provide flexibility when planning and implementing a network. The SFP slots accept any SFP-type fiber module with data transmission capabilities of 550m (multi-mode), and 10km, 30km, 50km, 70km or 110km (single-mode). The slots also support SFP modules for Wavelength-Division Multiplexed (WDM) single-fiber transmission. This means that you can easily change the transmission mode and distance of the switch by simply pulling out the SFP module and plugging in a different module. The SFP modules are hot swappable and plug-and-play. See the TN SFP page.

Shared port: on the IND-3284-xx, port 12 (the last TP interface) and port 4 (last SFP interface) become a shared port. Only one can be active at a time.
The "Active Hunt" mode will cycle between each interface once per second until a linked condition is detected. Note that the SFP port takes priority.
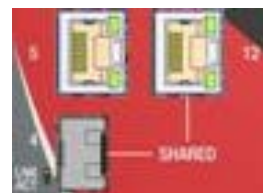
Access: The INDURA Switch design makes it suitable to operate in harsh environmental conditions, providing a solid foundation for highly fault-tolerant and easily managed networks. It can be remotely configurable via Telnet, a Web browser, or through the console port, which allows managing the switch using the CLI. Use Simple Network Management Protocol (SNMP) and Remote Monitoring (RMON) to manage the switch.

Security: The INDURA offers different levels of security:
- Management interface features user authentication locally and through RADIUS/TACACS plus (Remote Authentication Dial In User Service/Terminal Access Controller Access-Control System Plus).
- Set access control via different user accounts and privilege levels
- SSH (Secure Shell), SSL (Security Socket Layer) features secure management access.
- Use Access Management Configuration to specify IP address ranges for valid management access.
- SNMPv3 offers secure access channel.
- Set port-level access to limit the number of MAC addresses per port; also, action such as a trap, shutdown, or both can be configured.
- Management VLAN provides a safe tunnel for the provider and makes sure that no intruder can get access the device.
- Intrusion detection is possible using DMI on fiber interfaces and through cable test on copper to prevent sabotage.
- Perform MAC layer security using 802.1X port authentication.
- ACLs (Access Control Lists) provide a very strong set of features for discarding traffic, rate limiting, or mirroring for inspection. The deep-packet inspection of the device can scan through L2-L4 packet headers to provide network security.
- DHCP (dynamic host configuration protocol) snooping, ARP (Address Resolution Protocol) inspection and IP source guard add more security.

IEEE 1613 services for industrial environments: The INDURA provides IEEE 1613 compliant services for deploying in an industrial Ethernet environment. The main service offerings include:

- Various Ethernet physical media supports copper and fiber at various speeds, which will help in deployment in most networks.

- Supports several management interfaces such as CLI via Serial port/Telnet, WEB, SNMP.

- Provides protection on any pair of ports, meaning the operation will be switched transparently to the customer and providers using G.8031/G.8032 standards.

- Use multiple ports to provide a high-speed pipe, using link aggregation.

- Spanning tree protocols STP, RSTP, MSTP, and loop protection help avoid loops in the network.

- Provides a rich set of VLAN management as per IEEE 802.1Q.

- True provider bridging as per IEEE802.1ad to support transparent handling of subscriber traffic over the carrier Ethernet network.

- Supports Ethernet OAM protocols such as Link OAM and Service OAM to enrich fault monitoring and isolation capability in the provider's network.

- RMON counters and other performance monitoring as per Y.1731.

- Supports remote backup of configuration and firmware upgrades.

- Offers a rich set of QoS, traffic management and bandwidth profiling aids in maintaining service level agreements and hence suited for deployment in a carrier network.

All features follow and are compliant with these standards: IEEE, ITU, and IETF.

Additional Key features

- Full bandwidth 1000Mbps switching, non-blocking.
- 4-Triple speed SFP interfaces with DMI support (100FX, 1000X, SGMII).
- Optional four additional 10/100/1000Base-T TP interfaces by an expansion board.
- Dual leaky bucket policing per queue and per port.
- Eight priorities and eight queues per port.
- Dry contact relay for fault indication: supports both normally closed and open contacts.
- Last or dying gasp - ports (power remote units).
- IEEE 1588 Precision Time Protocol support.

**DC Power features / option (IND-328x-L)**

- 18-57VDC
- 2100VDC isolation input to prevent ground loops.
- Dual redundant inputs using a standard screw down terminal block.
- Automatic detection of primary failure and switchover to secondary: "Hitless switchover" in either direction.
- Voltage, current, and active source from each power input can be monitored through software.

DC Power features / option (IND-328x-H)

- 127-300 VDC
- 100-250 VAC
- 30W (0.3A Max.)
- 2100VDC isolation input to prevent ground loops.

Vent Hood (Mouse Guard) Accessory
- In order to be deployed in areas where rodents may be present, an alternate way of venting the cooling air from the INDURA is provided with an optional accessory to allow alternate venting and yet be unaffected by nesting rodents on top of the unit.
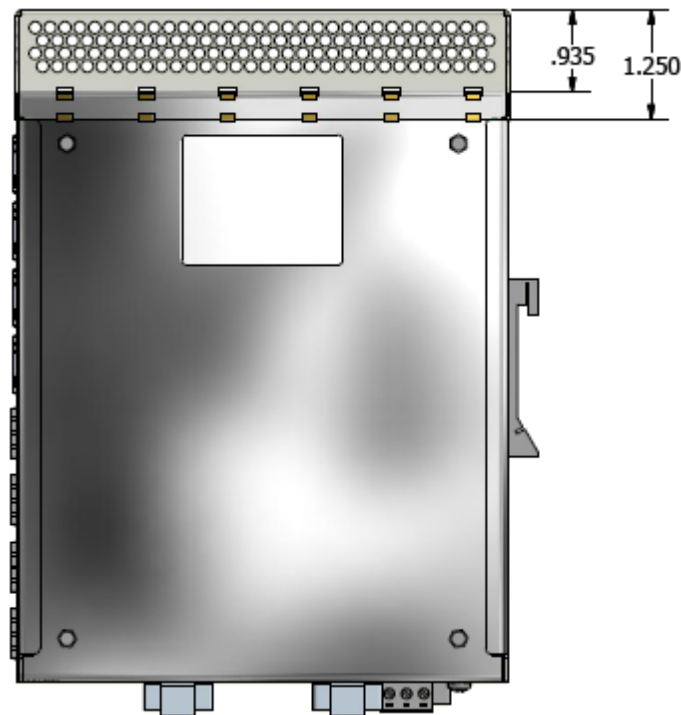
Hardware Description

This section discusses INDURA dimensions, front panel, LEDs, ports, and cable considerations.

Dimensions
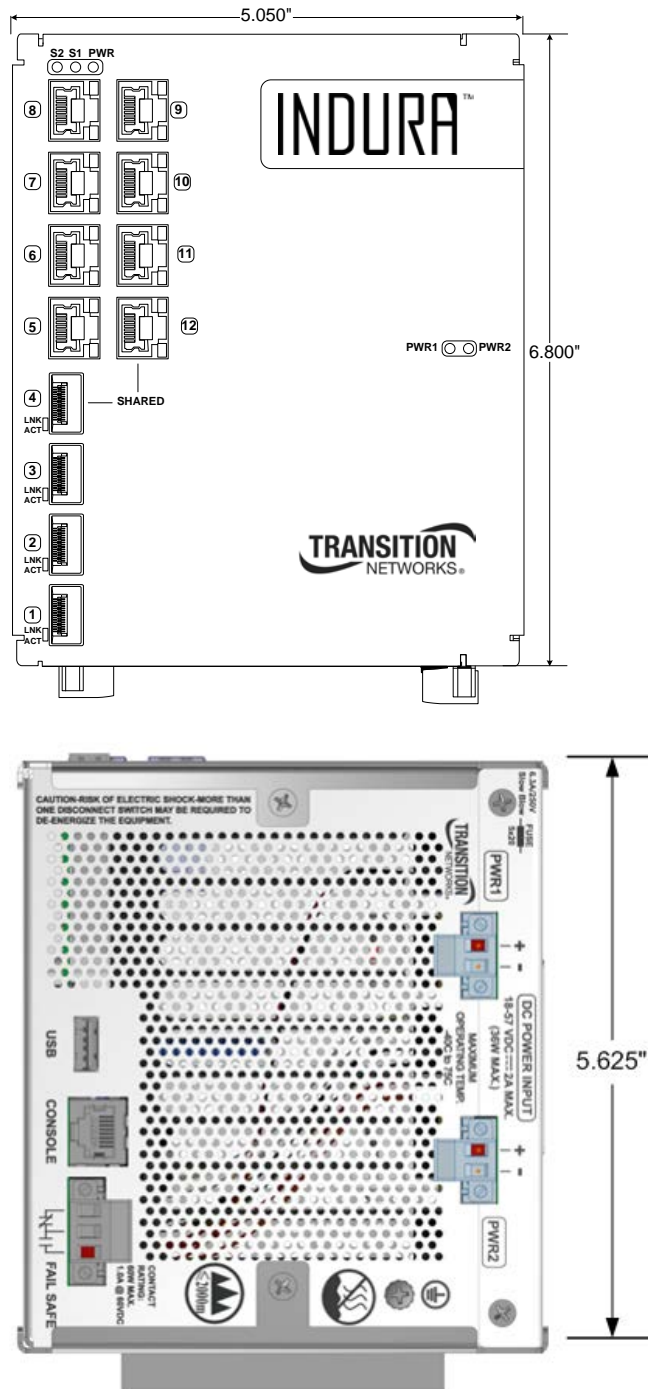Figure 4 below shows the physical dimensions (in inches) of the Indura switch.

Figure 4: INDURA Physical Dimensions

Physical Port layout

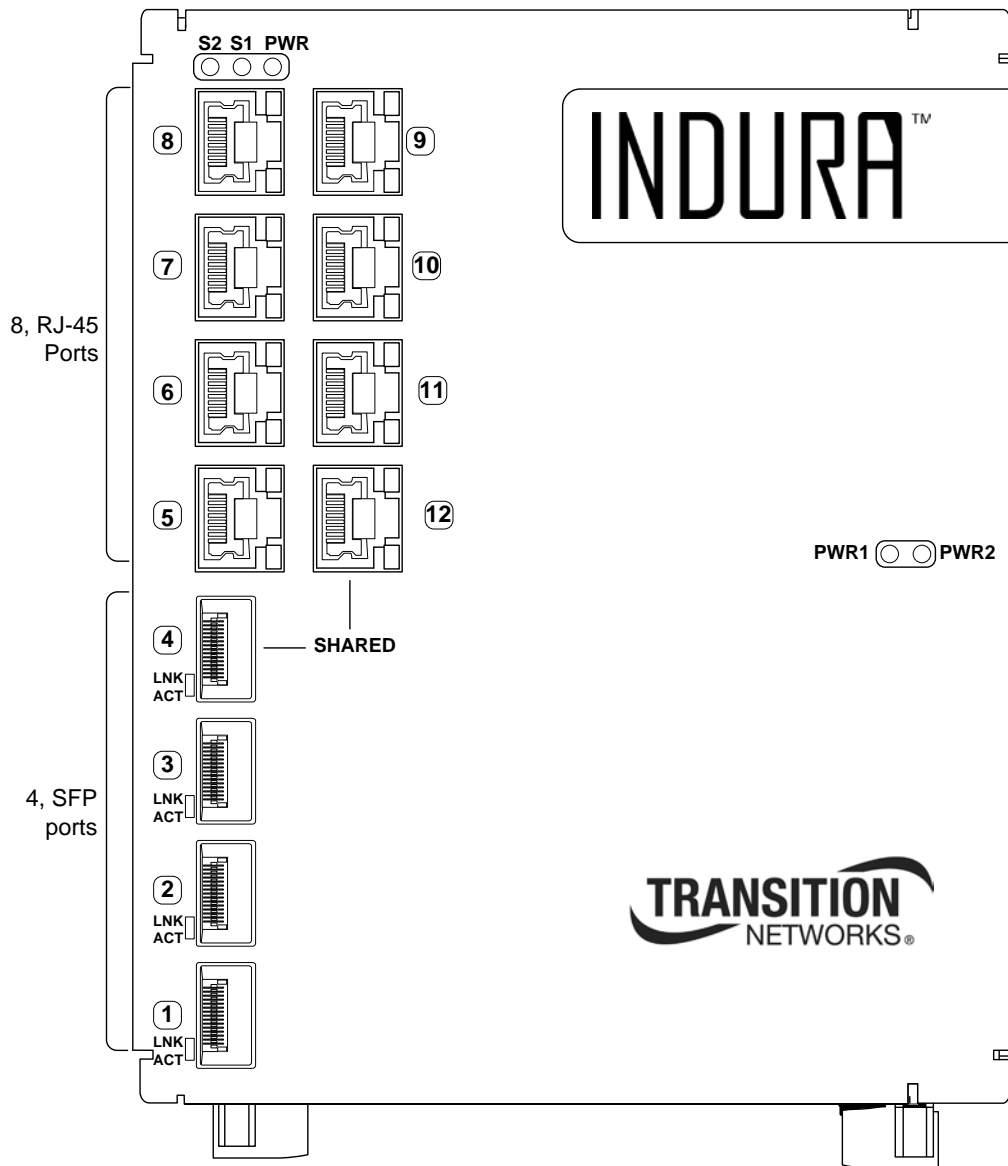Figure 5 below shows the INDURA port arrangement.

Figure 5: INDURA Ports (IND-3280-x shown)

Bottom Panel

The INDURA bottom panel is equipped with one grounding screw, one dry contact relay terminal block, and one or two Power Inputs. See Figures 6a and 6b below.
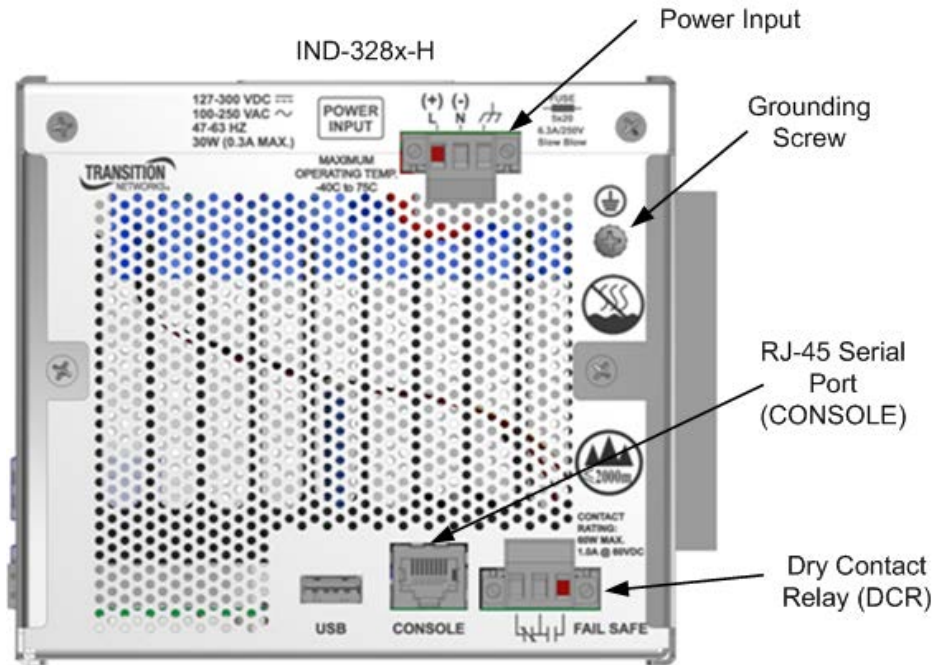

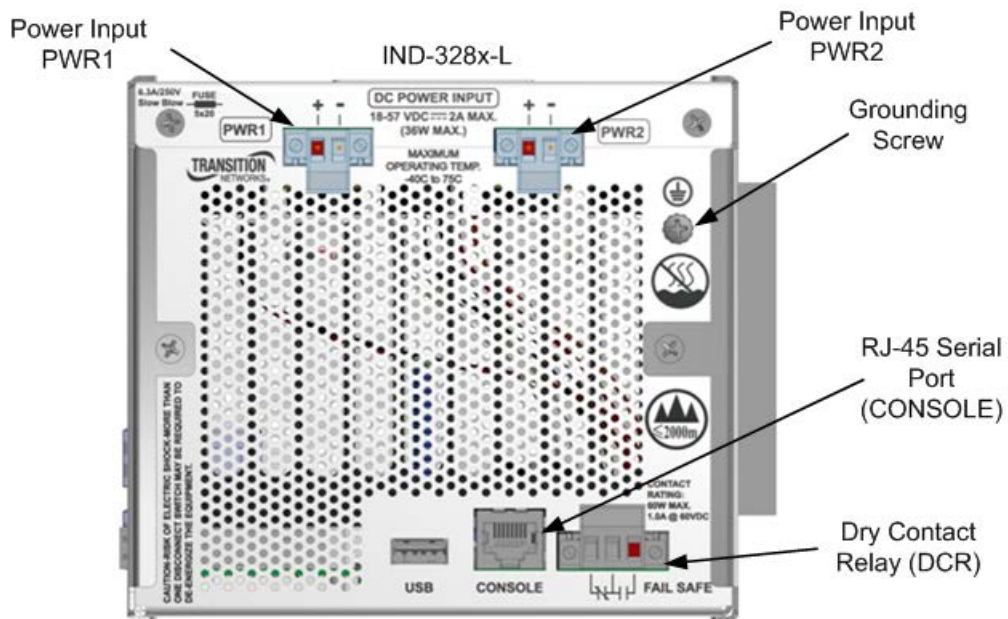**Figure 6a: INDURA Bottom View (IND-328x-H)**

Figure 6b: INDURA Bottom View (IND-328x-L)

LED Indicators

Status LEDs are located on the INDURA front panel. See Figure 5 and Table 3 below for LED descriptions.
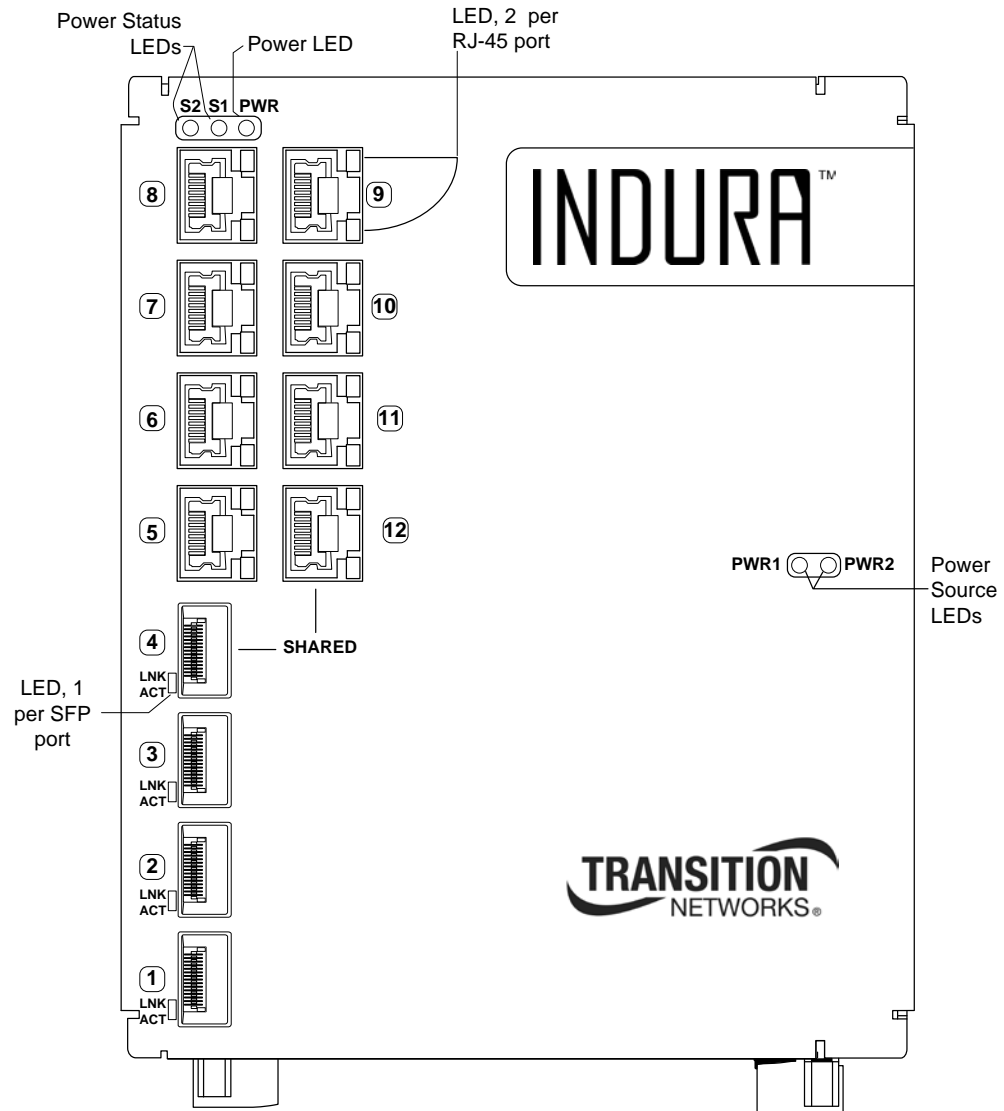
Figure 7: Indura LEDs (IND-328x-L shown)

LEDs

The table below describes the INDURA LEDs.

Table 3: LEDs

LED	Description	Status
Left TP RJ-45 LED, left per port	Half duplex, link/activity Full duplex, link/activity	ON Yellow (*link*); Blinking means activity. ON Green (*link*); Blinking means activity.
Left TP RJ-45 LED, left per port	10Mbps 100Mbps 1000Mbps	OFF Yellow Green
Fiber SFP port LED	Half duplex, link/activity Full duplex, link/activity	ON Yellow (*link*); Blinking means activity. ON Green (*link*); Blinking means activity.
Power LED (**PWR**)	Power applied to the board	ON Green
System LED	**S1** (Sytem Status)	Amber during normal boot up. Green when fully booted. Flashes Green during firmware upgrade. Flashes Amber when a fatal condition is logged.
System LED	**S2** (Fault indicator)	Off: Fault indicator not configured. Green: Fault indicator configured. Amber: Fault indicator triggered.
Power source	Primary (**PWR1**) Secondary (**PWR2**)	ON Green: power good. ON Green: power good.

Installation Overview

A summary of the overall INDURA install process is given below.

1. ☐ Review the "Safety" and "Lifting" sections on page 13.

2. ☐ Perform the "Unpacking" procedure on page 14.

3. ☐ Review the "Hardware Overview" on page 15 and the "Hardware Description" on page 18.

4. ☐ Review the "Installation Overview" on page 23 and "Install cautions and warning" on page 24.

5. ☐ Ground the INDURA (see "Grounding the INDURA" on page 25).

6. ☐ Power the INDURA (see "Powering the INDURA" on page 26).

7. ☐ Perform the "Installing SFP modules and fiber cables" on page 32).

8. ☐ Install copper cables (see "Installing copper cables" on page 35).

9. ☐ Mount the INDURA (see "Mounting considerations" on page 37).

10. ☐ Review the ""Fiber and copper cable connectivity" descriptions on page 39.

11. ☐ When steps 1-10 above are successfully completed, go to the INDURA manual for your specific operating environment (GUI or CLI):

   • INDURA CLI Reference for CLI operation

   • INDURA Web User Guide for Web GUI operation

   If the install was unsuccessful, see "3. Messages and Troubleshooting" on page 39.

► Start the installation process with the "Installing INDURA Hardware" procedure below.

Installing INDURA Hardware

This section discusses INDURA Industrial Switch installation methods, powering the unit, and data cables.

Installation considerations

Installation location

Deciding where to install the INDURA can greatly affect its performance. When selecting an installation location, consider the following:

- Install the INDURA in a fairly cool and dry place. See Technical Specifications section and cautions below for the acceptable temperature and humidity ranges.
- Install the INDURA where it will not be exposed to liquid.
- Install the INDURA in a location free from strong electromagnetic field generators *(such as motors)*.
- Do not expose or subject the INDURA to excessive vibration, dust, or direct exposure to sunlight.
- Leave at least 5cm *(1.97 in)* of space around the unit for ventilation purposes.

Install cautions and warning

Observe the following cautions and warning when installing the INDURA.

⚠ **WARNING**

Disconnect power before installing the INDURA. Failure to observe this warning could result in an electrical shock. Safety

⚠ **CAUTION**

Only qualified persons should install the INDURA. Failure to observe this caution could result in poor performance or damage to the equipment.

⚠ **CAUTION**

Install the INDURA in an operating environment where the temperature range is from *-40°C to +75°C (-104°F to +167 °F)*, with relative humidity of 5% to 90% non-condensing. Failure to observe this caution could result in poor equipment performance.

⚠ **CAUTION**

DO NOT install the INDURA in areas where strong electromagnetic fields (EMF) exist. Failure to observe this caution could result in poor equipment performance and data corruption.

Grounding the INDURA

⚠ WARNING
Disconnect power before installing and wiring the INDURA for power. Failure to observe this warning could result in an electrical shock.

Wiring considerations

The following wiring considerations are recommended:

- Use separate paths to route wiring for power and device data cables. If power wiring and deice date cables must cross, make sure that the wires are perpendicular at the intersection points.
- DO NOT run signal or communications wiring and power wiring in the same conduit. To avoid interference, wire with different signal characteristics should be wire separately.
- Keep input and output wires separated.
- Label the wiring to all devices in the system for clarity.

⚠ CAUTION
Connect the INDURA to a well-grounded surface. Failure to observe this caution could result in electromagnetic interference (EMI) problems.

Grounding

The INDURA can eliminate the effects of noise due to EMI via proper grounding. Always run the ground connection from the ground screw to the grounded surface before connecting power.
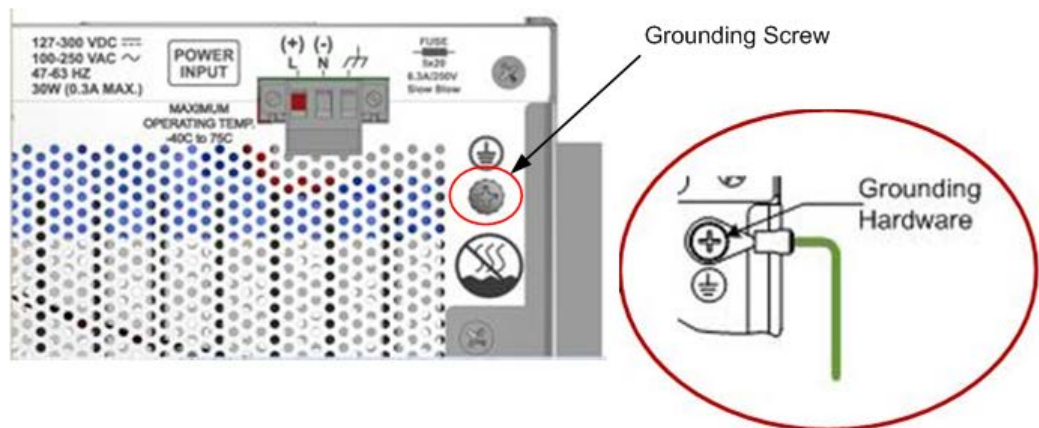
Figure 8: Switch Grounding

Powering the INDURA

No power ON/OFF Switch

The INDURA does not include a power ON/OFF switch; therefore, when power is applied to the switch, it will immediately power UP.

⚠ CAUTION
When connecting DC power wires to the terminal-block plug, pay close attention to the polarity markings shown near the terminal block of the INDURA. Failure to observe this caution could result in damage to the switch.
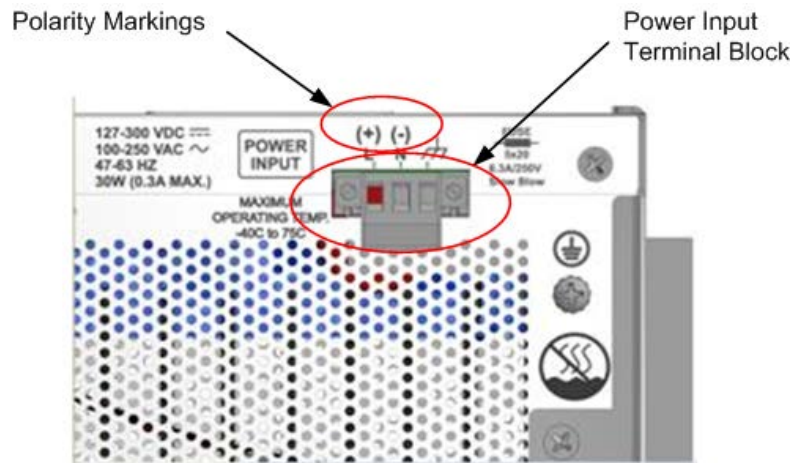

Figure 9: Power Inputs

To install power to the switch, do the following:

Removing the
terminal block

Step	Action
•	Turn the external power source OFF.
•	Loosen the "2" mounting screws, attaching the "primary" Terminal Block to the switch chassis, and then pull it from the chassis connector as shown in Figure 10 below.

TB Connector
In Indy Switch

Terminal Block

Mounting Screw
Qty (2)
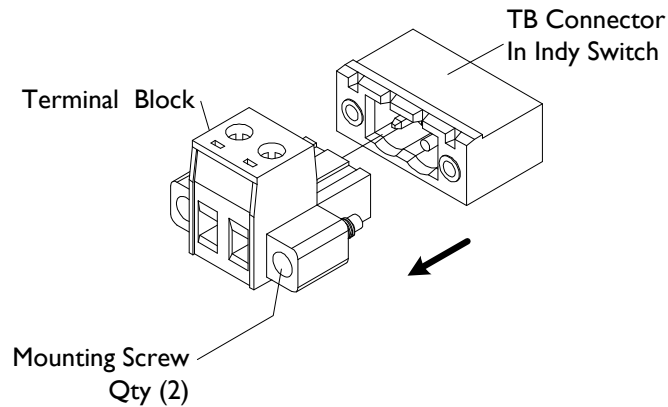
Figure 10: Terminal Block

Notes: It is a good practice to turn OFF input and load power, and unplug the power terminal block before making wire connections. Otherwise, your screwdriver blade can inadvertently short the terminal connections to the grounded enclosure.

- The range of suitable wire for the terminal block is 12 to 26 AWG.

- The power source must be safety certified.

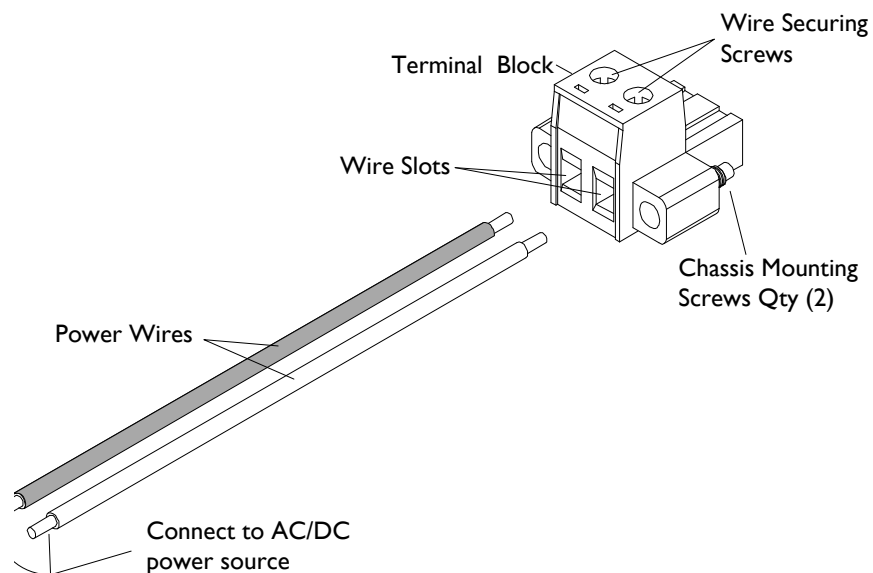| Step	Action
1.	Strip the wires to the proper length.
2.	Insert the positive and negative power wires into V+ and V- contacts respectively of the terminal block *(note polarity on the chassis of the switch)*. Make sure the wires are secure. See Figure 11.
3.	Insert the positive and negative power wires into V+ and V- contacts respectively into the power source—make sure the wires are secure. See Figure 11. Insert the positive and negative power wires into V+ and V- contacts respectively into the power source—make sure the wires are secure. See Figure 11.

Connecting power wires to the terminal block

Figure 11: Connect Power Wires to Terminal Block and Power Source

Step	Action
1.	Reinstall the terminal block into the primary location on the switch.
2.	Tighten the two screws to secure the terminal block to the chassis.
3.	Verify that the wiring to the 'primary' of the switch is connected correctly, as shown in Figure 12.

Reinstalling the terminal block and verifying power wire connections
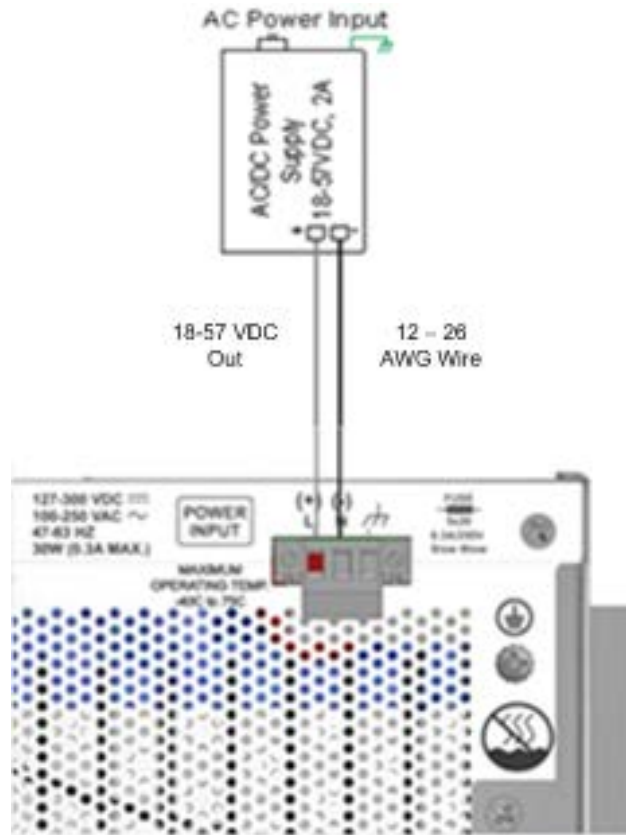
Figure 12: Properly Setup Power Configuration to the Switch

4.	Turn the power source ON and the following LEDs on the switch front panel should be lit: • Power LED, ON green (power applied to the board) • Power Source primary (PRI) LED, ON green *(good power)* See Figure 13.Power ON/OFF

PWR

PWR1 ● ○ **PWR2**

Figure 13: Power ON and Power Source LEDs

Redundant power (IND-328x-L only)

The IND-328x-L models can accommodate two different power sources for power redundancy. Power supply redundancy allows uninterrupted system operation if one of the power sources fails.

The main reason for implementing a redundant power configuration in the INDURA is to avoid single points of failure. In the redundant setup, when one power source fails, the device will transmit a trap alert, indicating a power source failure. See the figure below.
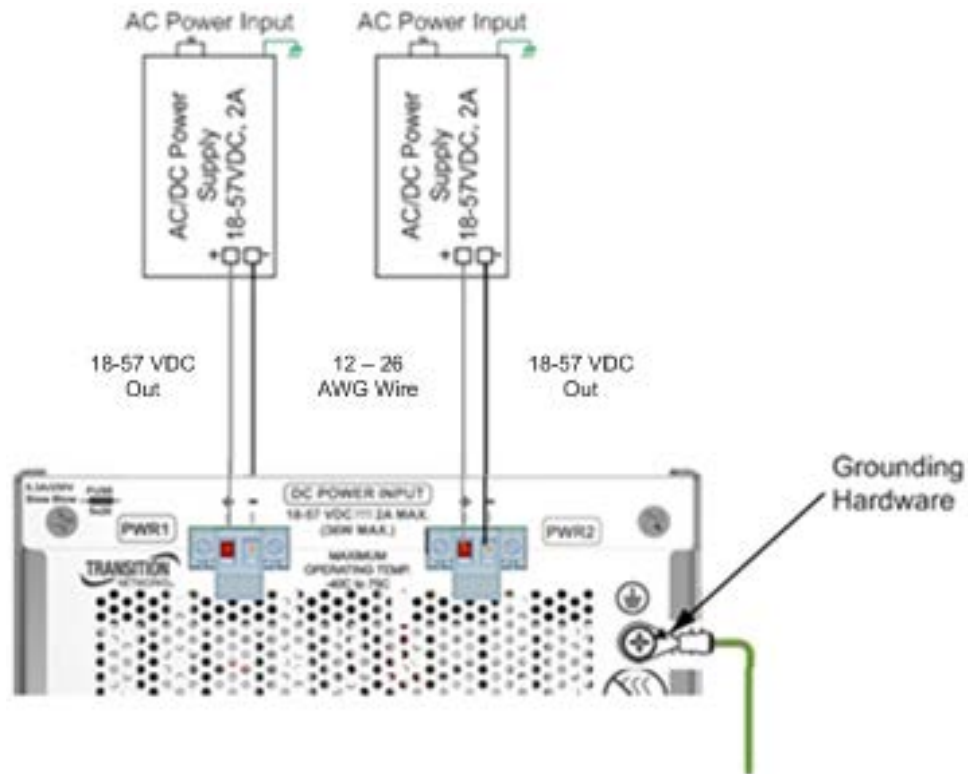
Figure 14: Redundant Power Source Configuration (IND-328x-L only)

Wiring the Dry Contact Relay

Dry contact relay

The INDURA has a dry contact relay with normally closed and open sides. It can be programmed to respond to the following conditions:

• Power supply faults

• Link failures

• Redundancy

• Etc.

The figure below shows an example of the dry-contact relay Normally Open (NO) circuit used to indicate a fault condition. When the condition is met to close the circuit, the fault indicator activates.
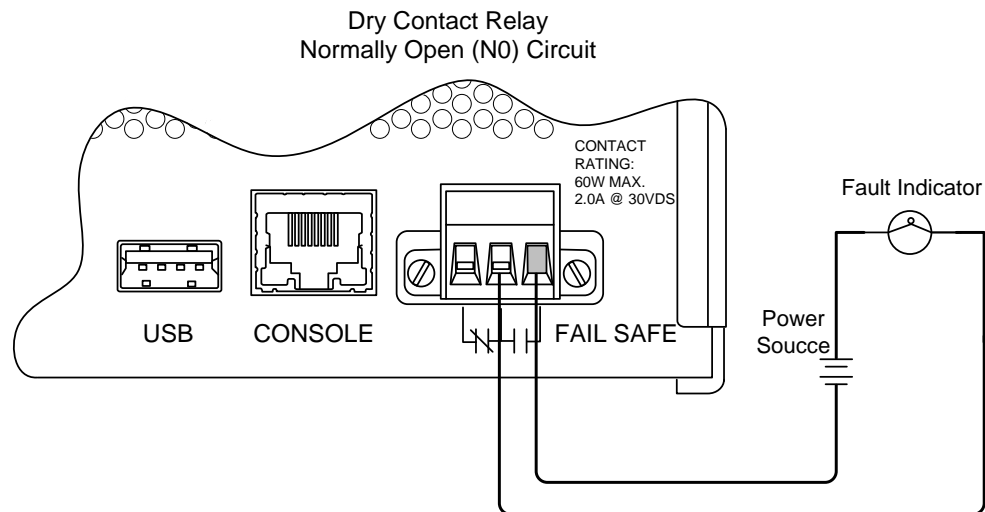
Figure 15: NO Circuit Dry Contact Relay Fault Indicator Circuit

Installing SFP modules and fiber cables

Installing SFPs

To install the SFP, do the following:

Step	Action
1.	Locate an LC fiber cable.
2.	Position the cable at the SFP as shown in the figure below.

Caution: It is strongly recommend that you do not install or remove the SFP module with fiber-optic cables attached to it because of the potential damage to the cables, the cable connector, or the optical interfaces in the SFP module. Disconnect all cables before removing or installing an SFP module.

Step	Action
3.	Insert the LC cable ends completely into the SFP as shown in the figure below.
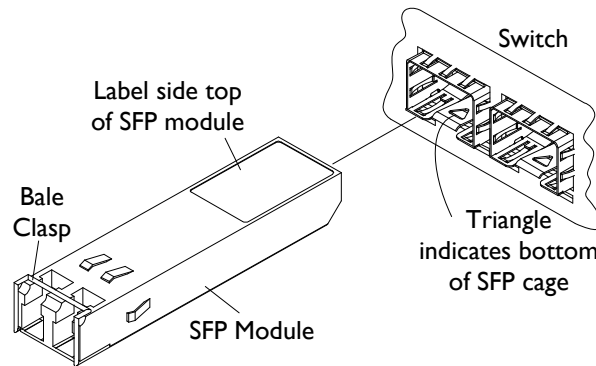
Figure 16: SFP Insertion Position

Step	Action
1.	Insert the SFP fully into the cage as shown in the figure below.
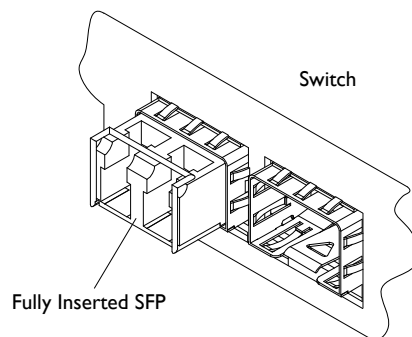
Figure 17: Fully Inserted SFP

⚠ Warning

- Visible and invisible laser radiation when open: DO NOT stare into the beam or view the beam directly with optical instruments. Failure to observe this warning could result in an eye injury or blindness.

- Use of controls, adjustments or the performance of procedures other than those specified herein may result in hazardous radiation exposure.

To install the LC cables into the SFP, do the following:

Installing LC cables

Step	Action
1.	Locate an LC fiber cable.
2.	Position the cable at the SFP as shown in the figure below.
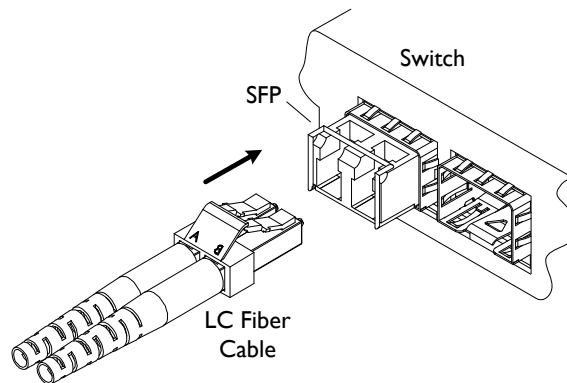
Figure 18: SFP and LC Cable Installation

Step	Action
3.	Insert the LC cable ends completely into the SFP as shown in the figure below.
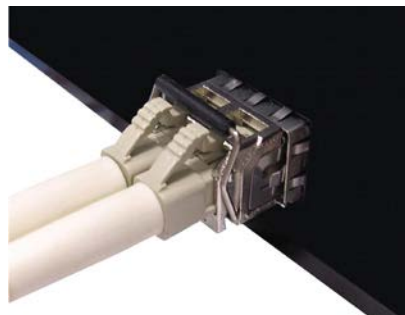
Figure 19: LC Cable Inserted into an SFP Cage

Removing SFP modules and fiber cables

Removing SFPs

To remove the SFP from the cage, do the following:

Step	Action
1.	Attach an ESD-preventive wrist strap to your wrist and to a bare-metal grounded surface.
2.	Have a replacement SFP or a transceiver-cage plug ready, as well as an antistatic mat and a rubber safety cap for the SFP.

⚠ **Caution**

Avoid bending fiber-optic cable beyond its minimum bend radius—any arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

3.	Disconnect the LC cable for the SFP.
4.	Pull the bale clasp handle out from the SFP to unlock the SFP.
5.	Grasp the SFP bale clasp and pull the SFP approximately 0.5 in (*1 .3 cm)* out of the cage.
6.	Using your fingers, grasp the body of the SFP and pull it completely from the cage.
7.	Insert the rubber protector, shown below, into the SFP module to protect it.
8.	Place the SFP module in an antistatic bag or other protective environment.

Installing copper cables

Copper cable configuration

Depending on the equipment type, data terminal equipment (DTE) or data communication equipment (DCE), use a crossover or straight-through cable. See Figure 20 below.

Straight-Through Cable Crossover Cable

Twisted Pair #1 | 1 2 | 1 2 | Twisted Pair #1 | 1 2 | 1 2

Twisted Pair #2 | 3 6 | 3 6 | Twisted Pair #2 | 3 6 | 3 6
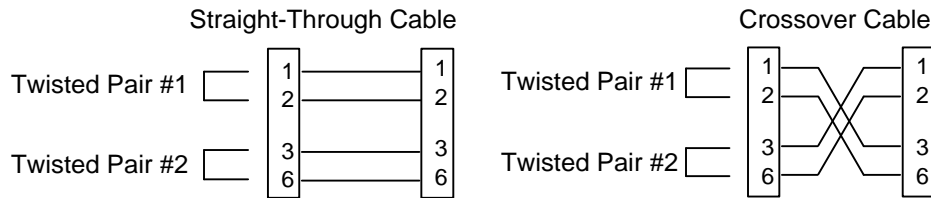
Figure 20: Straight Through and Crossover Cable Configurations

Note: Always use a crossover cable. If using a straight through cable, use a Null Modem cable type to support the Telnet option.

Connecting Ethernet cables

To connect the INDURA to the network, do the following:

1.	Locate or build an IEEE 802.3 compliant 10Base-T or 100Base-TX cables, with male RJ-45 connectors installed onto both ends. See Figure 21 below.
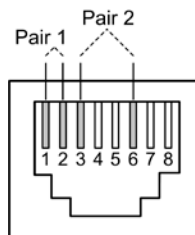
Pin	Out Jack Pin Assignments
1	Outgoing Data 1 (+)
2	Outgoing Data 2 (-)
3	Incoming Data 1 (+)
4	Not Connected
5	Not Connected
6	Incoming Data 2 (-)
7	Not Connected
8	Not Connected

Figure 21: RJ-45 Connector and Out Jack Pin Assignments

2.	Connect the RJ-45 connector at one end of the cable to the RJ-45 port on the INDURA. See Figure 20.
3.	Connect the RJ-45 connector at the other end of the cable to the RJ-45 Ethernet network port. See Figure 22 below.
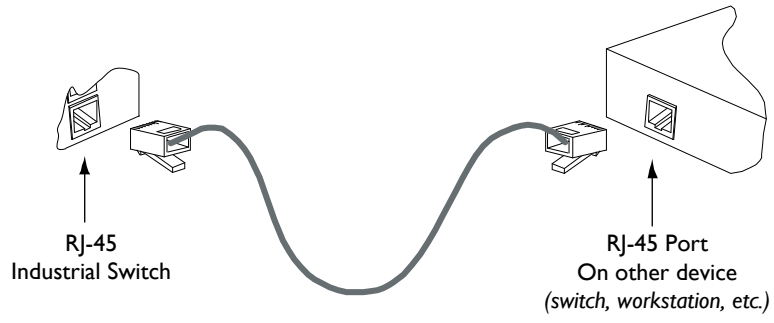
Figure 22: INDURA Connection to another Device

Mounting the switch to a DIN-Rail

DIN-Rail bracket

The aluminum DIN-Rail bracket should already be mounted to the back surface of the INDURA, as shown in Figure 23 below.

Rear View

DIN-Rail Bracket

Stiff Metal Spring
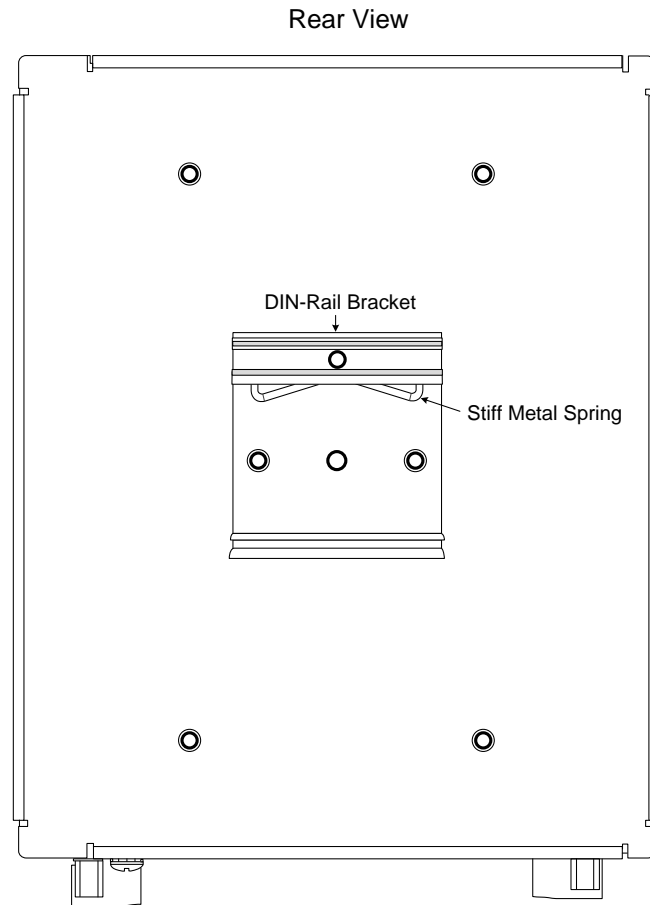
Figure 23: DIN-Rail Bracket *(rear view)*

Mounting considerations

Consider the following before mounting the DIN-Rail to a surface and attaching the INDURA:

• The surface must support the Indura switch weight and dimensions (with or without the Vent Hood (Mouse Guard) Accessory installed.

• Do not place any objects on the Indura switch.

• A suitable power source must be accessible.

Continued on next page

Mounting the switch to a DIN-Rail, Continued

⚠️**Caution**

Please exercise caution when using power tools. Install this unit away from damp or wet locations, or in close proximity to very hot surfaces. Failure to observe this caution could result in damage to the INDURA and cables.

⚠️**Caution**

Make sure that the INDURA is mounted with proper space for ventilation *(heat dissipation)*. Failure to observe this caution could result in damage to the switch.

To mount the INDURA to the DIN Rail, do the following:

Installing on a DIN Rail

1.	Align and then position the DIN Rail bracket spring to the top of the DIN Rail, as shown in Figure 24A.
2.	Snap the INDURA into place on the DIN Rail by pressing DOWN, then inward on the INDURA, as shown in Figure 24A.
3.	When the INDURA is correctly installed on the DIN Rail, it will appear as shown in Figure 24B.

Figure 24 A/B: INDURA DIN Rail Mounting

3. Messages and Troubleshooting

This section provides general and specific INDURA problem solving suggestions, general error recovery steps, and specific web interface messages, meanings, examples, and possible recovery steps.
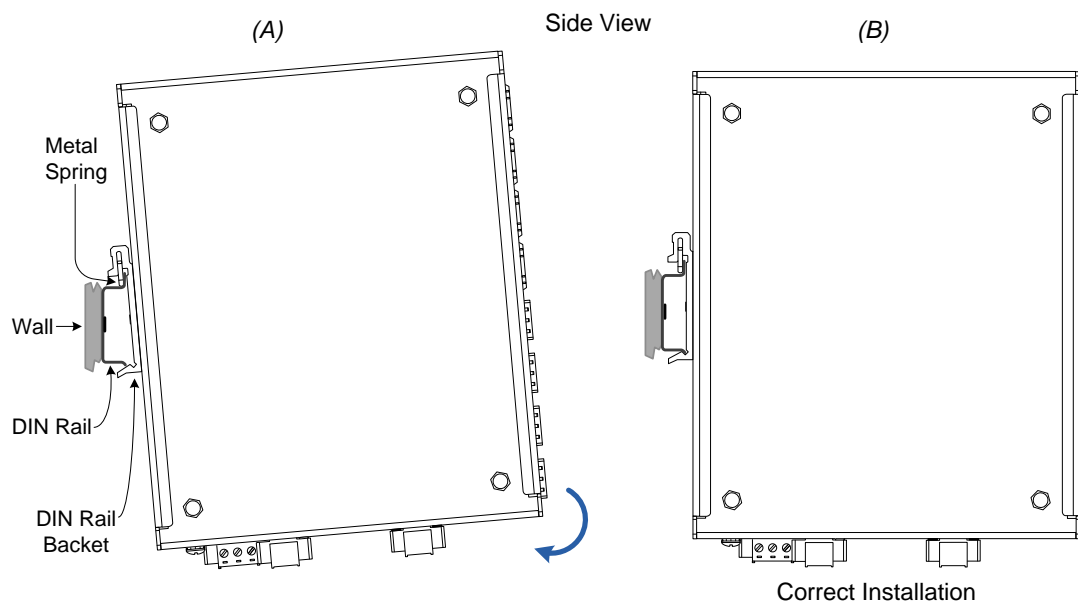
INDURA Troubleshooting

1. Check the INDURA Back Panel Connections (see page 30)
2. Verify the Installation. Check the Operating System, Web Browser, Telnet Client, and/or Terminal Emulation package support (see page 32).
3. Make sure your particular model supports the function attempted.
4. Check the INDURA Front Panel Connectors (see page 24) and LEDs (see page 25).
5. Respond to any INDURA error messages (see "INDURA Error Recovery" below).
6. Run the INDURA Diagnostics tests and verification functions (e.g., Ping, Link OAM Mib Retrieve, Ping6, VeriPHY). See the "Diagnostics" section of the INDURA User Guide manual.
7. Perform the INDURA troubleshooting and service functions (e.g., Restart Device, Reset to Factory Defaults, Software Upload, Image Select). See "3. Messages and Troubleshooting" on page 39.
8. Check the INDURA operating parameters (e.g., Information, CPU Load, Log, Detailed Log). See the "Operation" section of the INDURA User Guide manual.
9. If you can access the INDURA via PuTTY or HyperTerminal but not via the web interface, enter the **restore default keep_ip** CLI command and try accessing the INDURA web interface again.
10. If you have problems displaying the INDURA web interface in IE, try displaying in Compatibility View from the IE **Tools** > **Compatibility View** menu path.

Warning - Do not disconnect equipment unless power has been switched off.

Caution - No Operator Serviceable Parts Inside. Refer Servicing to Qualified Personnel.

INDURA Error Recovery

The INDURA displays error and information messages from the CLI and Web interface. This section lists the messages, provides an example, and discusses the message meaning of and possible recovery steps.

As a general troubleshooting step for problems encountered using the INDURA web interface, try the related CLI command. For many messages, recovery involves reviewing the command/function description and verifying the entry selection/syntax. For example, for many CLI messages, the first recovery step would be to refer to the "INDURA CLI Reference Guide" manual.

For any error condition, you can check the TN Tech Support web site for possible solutions. For any problem that persists, contact TN Tech Support in the US or Canada at 1-800-260-1312, International at 00-1-952-941-7600; via fax at +1 952-941-2322; or via Email at techsupport@transition.com.

See the following sections for general and specific error message recovery.

Generic Message Recovery (e.g., you tried a function, but the operation failed or is still in process):

1. Wait for a few moments for the operation to complete.
2. Use the **Help** or **?** command to get assistance (help) on a group of commands or on a specific command.
3. Make sure this is the function you want and that the device/port/configuration supports this function.
4. Verify the parameters entered and re-try the function. See the related section of this manual for specifics.
5. Try using the CLI to perform the function. See the "INDURA CLI Reference Guide" manual.
6. If the "*continue y(es) n(o) prompt*" displays, type **y** and press **Enter** to continue.
7. Use the Monitor sub-menu functions (System, Ports, Link OAM, MAC Table, VLANS) to view related status, statistics, events, etc. related to a specific function.
8. Use the Diagnostics sub-menu functions (Ping, Link OAM MIB Retrieval, VeriPHY) to test a general functionality.
9. Use the Maintenance sub-menu functions (Restart the INDURA, Reset the INDURA to factory defaults, Upgrade the INDURA firmware).
10. If the problem persists, contact TN Tech Support. US/Canada: 1-800-260-1312, International: 00-1-952-941-7600; TN Tech Support web; fax: +1 952-941-2322; Email: techsupport@transition.com.

Specific Messages Recovery:

1. For messages (e.g., ACL messages) that are the result of a switch memory shortage:

   a. Reduce other system activity to ease memory demands.

   b. Use a less complicated configuration that requires less memory.

   c. Modify the ACL configuration to use fewer resources, or rename the ACL with a name or number that alphanumerically precedes the other ACL names or numbers.

   d Reduce the number of IP or MAC access lists to be applied to interfaces.

   e. Reduce other system activity to ease memory demands (e.g., remove ACLs that are defined but not used; use simpler ACLs with fewer ACEs; use fewer VLANs / remove unneeded VLANs from the VLAN database).

2. For messages that indicate the configuration is too complicated for the ACL code to support, there is likely too many separate access lists in a single VLAN map or policy map. Reduce the number of IP or MAC access lists separately) in any one VLAN or policy map to fewer than the number of levels. Or try to use the same ACLs on multiple interfaces if possible.

3. For messages that indicate an illegal configuration, reconfigure the port / device, removing the illegal configuration.

4. For messages that indicate the temperature is high reduce the temperature in the room.

5. For messages that indicate that the number of MAC address entries for the VLAN exceeds the maximum number allowed, have your system administrator configure an action.

6. For messages that indicate that an unauthorized device attempted to connect on a secure port, identify the device that attempted to connect on the secure port and notify your network system administrator of the condition.

7. For messages that indicate that the amount of traffic detected on the interface has exceeded the configured threshold values, determine and fix the root cause of the excessive traffic on the interface.

8. For messages that indicate an unrecoverable software error has occurred, copy the message exactly as it appears on the console or in the system log and contact TN Support.

For functional level troubleshooting for INDURA web interface operation, see the "Web Interface Messages" section of the INDURA™ Series Web Interface User Guide, 33510. Topics there include EPS Troubleshooting, ERPS Troubleshooting, IPv6 Troubleshooting, Troubleshooting High CPU Load Conditions, etc.

See "INDURA Error Recovery" on page 39 for specific messages and the recommended recovery steps.

Appendix A - Connectors, Cables and Ports

Connector Types

The DMI connector type indicates the external optical or electrical cable connector provided as the interface. The information below is from SFF-8472 Rev 11.0. For additional information see the latest SFF-8472 Specification at ftp://ftp.seagate.com/sff/SFF-8472.PDF.

Table 4: Connector Descriptions

Value	Description of connector
00h	Unknown or unspecified
01h	**SC**
02h	Fibre Channel Style 1 copper connector
03h	Fibre Channel Style 2 copper connector
04h	BNC/TNC
05h	Fibre Channel coaxial headers
06h	FiberJack
07h	**LC**
08h	**MT-RJ**
09h	MU
0Ah	SG
0Bh	Optical pigtail
0Ch	MPO Parallel Optic
0D-1Fh	Unallocated
20h	HSSDC II
21h	Copper pigtail
22h	**RJ45**
23h-7Fh	Unallocated
80-FFh	Vendor specific

The LC, MT-RJ, LC, SC, ST, or VF-45 connector types (jacks) are shown below.

Figure 25: Connector Types

RJ-45 Data Port Specs

The INDURA has four or eight 10/100/1000Base-T, RJ-45 (Auto MDI/MDI-X) ports. The "Auto" means that the switch can connect to another switch or workstation without changing cables (AutoCross feature). See table below for RJ-45 pin assignments. See Figure 26 below.

RJ-45 Pin Assignments

Pin Number	Assignment
1	Tx+
2	Tx-
3	Rx+
6	Rx-

RJ-45 Port with LEDs

Figure 26: RJ-45 Port and Pin Assignments

Note: Plus (+) or Minus (-) signs represent the polarity of the wires that make up each wire pair.

SFP Cage and Connector Specs

The INDURA has 4 SFP ports that accommodate SFP modules. These ports fully comply with the Multi-Sourcing Agreement (MSA). See Figure 27 below. Module connectivity includes:

- SGMII (Gigabit Ethernet to Fast Ethernet)
- 1000Base-X (Gigabit Ethernet over fiber)
- 100Base-FX (Fast Ethernet over optic fiber)
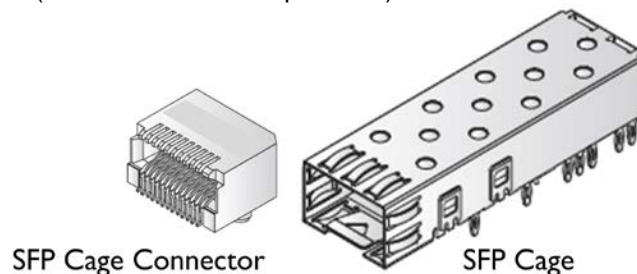
Figure 27: SFP Cage and Connector

RJ-45 Console Port Specs

The console port of the INDURA is a female 8-pin RJ-45 port, which allows out-of-band CLI access to the switch via a computer. The console port supports the following baud rates:

- 9600 bps
- 38400 bps
- 57600 bps
- 115200 bps

The port allows remote access to the CLI of the switch without using the network. This creates an out-of-band path to the switch for initially configuring or remotely managing the switch. See Figure 28 below.

Pin No.	Mnemonic	Description
1	RTS	Request To Send
2	DTR	Data Terminal Ready
3	Signal (GND)	Ground
4	TxD	Transmit Data
5	RxD	Receive Data
6	DCD	Data Carrier Detected
7	DRS	Request To Send
8	CTS	Clear To Send

Pin 1

Figure 28: RJ-45 Serial Port

Cable Types

The cabling specifications are provided for troubleshooting purposes.

Copper (TP / UTP) CAT 1 – CAT 7 Cabling

ANSI/EIA Standard 568 is one of several standards that specify "categories" (each a "CAT") of twisted pair cabling systems. Assigned by the American National Standards Institute/Electronic Industries Association, these standards categories include CAT 1 – CAT 7, as shown below.

Table 5: Copper Cabling

Category	Max Data Rate	Typical Application
CAT 1	Up to 1 Mbps (1 MHz)	Analog voice (POTS), ISDN BRI
CAT 2	4 Mbps	IBM Token Ring network cabling systems
CAT 3	16 Mbps	Voice (analog mainly); 10BASE-T Ethernet
CAT 4	20 Mbps	Used in 16 Mbps Token Ring, but not much else.
CAT 5	100 MHz	100 Mbps TPDDI. 155 Mbps ATM. No longer supported; replaced by 5E. 10/100BASE-T.
CAT 5E	100 MHz	100 Mbps TPDDI, 155 Mbps ATM, Gigabit Ethernet. Offers better near-end crosstalk than CAT 5.
CAT 6	Up to 250 MHz	Minimum cabling required for data centers in TIA-942. CAT 6 is quickly replacing CAT 5e.
CAT 6E	Up to 500 MHz	Field-tested to 500 MHz. Supports 10 Gigabit Ethernet (10GBASE-T). May be either shielded (STP, ScTP, S/FTP) or unshielded (UTP). Standard published in Feb. 2008. The minimum requirement for Data Centers in the ISO Data Center standard.
CAT 7 (ISO Class F)	600 MHz, 1.2 GHz in pairs with Siemon connector	Full-motion video, Teleradiology, Government and manufacturing environments. Fully Shielded (S/FTP) system using non-RJ45 connectors but backwards compatible with hybrid cords. Standard published in 2002. Until Feb. 2008, the only standard to support 10GBASE-T for a full 100m.

CAT 7A/Class FA and Category 6A/Class EA specifications were published in February, 2008.

Fiber (10/100/1000BASE-xx) Cabling

The IEEE recommends the maximum fiber cable distances shown below.

Table 6: Fiber Cabling

Standard	Data Rate (Mbps)	Cable Type	IEEE Standard Distance
10BASE-FL	10	850nm Multimode 50/125 μm or 62.5/125 μm	2 km
100BASE-FX	100	1300nm Multimode 50/125 μm or 62.5/125 μm	2 km
100BASE-SX	100	850nm Multimode 50/125 μm or 62.5/125 μm	300 m
1000BASE-SX	1000	850nm Multimode 50/125 μm 850nm Multimode 62.5/125 μm	550 m 220 m
1000BASE-LX	1000	1300nm Multimode 50/125 μm or 62.5/125 μm 1310nm Single mode 9/125 μm	550 m 5 km
1000BASE-LH	1000	1550nm Single mode 9/125 μm	70 km

Fiber Cables

The four SFP ports on the INDURA support SFPs that can handle the following fiber cables:

- Single mode fiber (recommended): 9 μm
- Multimode fiber (recommended): 62.5/125 μm
- Multimode fiber (optional): 100/140, 85/140, 50/125 μm

Typical fiber cable connectors for SFPs are LC connectors. See Figure 29 below.
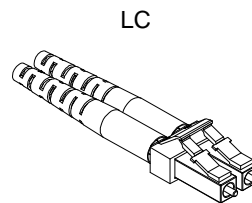
LC

Figure 29: LC Fiber Cable Connectors for SFP Devices

DCE Cable (PC to IND-328x)

Use a straight through cable from the PC to the IND-328x. The IND-328x uses DCE pinning:

Pin	Signal
1	NC
2	TXD (output)
3	RXD (input)
4	NC
5	Ground
6	NC
7	NC
8	NC
9	NC

MDI/MDIX Copper Cables

The four RJ-45ports on the INDURA support the detection of MDI or MDI-X cable automatically via its AutoCross feature. The 10BASE-T/100BASE-TX/1000BASE-T MDI and MDI-X port pinouts are shown in the table below.

Table 7: MDI/MDIX Copper Cabling

MDI/MDI-X Pin Assignments

Pin MDI-X	Signal Name	MDI Signal Name
1	Receive Data plus (RD+)	Transmit Data plus (TD+)
2	Receive Data minus (RD-)	Transmit Data minus (TD-)
3	Transmit Data plus (TD+)	Receive Data plus (RD+)
6	Transmit Data minus (TD-)	Receive Data minus (RD-)

MDI/MDI-X Pin Config

All of the fast Ethernet ports will auto-detect the signal from connected devices to negotiate the link speed and duplex mode. Auto MDI/MDIX allows users to connect another switch, hub, or workstation without changing straight through or crossover cables.

Note that crossover cables simply cross-connect the transmit lines at each end to the received lines at the opposite end. The figure below shows the cable pin configuration for straight through MDI and crossover MDI-X copper cables.
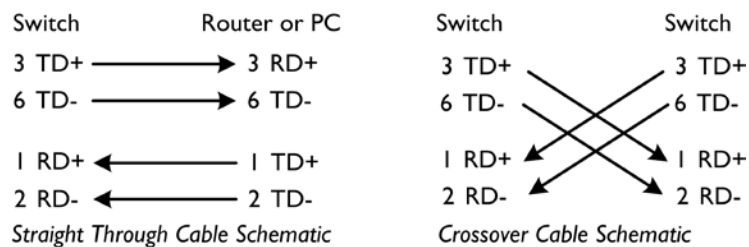

Figure 30: MDI/MDI-X Cable Pinouts

Category 5e Wire

Use category 5e (the "e" signifies cabling for computer networks) or the above cables for RJ-45 port connections. The cable between the switch and its linked device (switch, hub, workstation, etc.) must not exceed 100 meters (328 ft).

Appendix B: Application Notes

INDURA Applications Support

The INDURA targets the CPE (Customer Premise Equipment) or the PE (Provider Edge) equipment and can be used to implement the access functions in these devices. The INDURA provides the required set of UNI features in a cost-effective manner, including:

- Map customer frame formats into Provider frame formats.
  - Classify frames and map to appropriate QoS profiles.
  - Apply Provider Bridge (Q-in-Q) encapsulations.
- Meter the customer traffic and ensure that the customer SLA (Service Level Agreement) is met.
  - Polices using Dual Leaky Bucket algorithm.
  - Mark frames as Committed (Green) or Discard Eligible (Yellow).
  - Provide correct QoS treatment (traffic management).
  - Provide traffic statistics per Customer in a manner consistent with the SLA.
- Enable end to end Service OAM (SOAM) by the customer, if allowed.
- Implement the Service as defined by the SLA.
  - E-LINE for point-to-point or backhaul services.
  - E-LAN for multi-point/bridged services.
  - E-Tree for video distribution or backhaul services.
- Enable management and protection schemes as required by the Provider.
  - Link Aggregation or other port protection schemes if used for access.
  - OAM at the Operator and Service Provider levels for remote management, fault diagnosis, and protection switching.
- Support network timing and synchronization requirements as required.
- Provide Sync-E (Synchronous Ethernet) and IEEE 1588 functionality.

Available INDURA Application Notes

Application notes on certain specific functions / environments are available from your TN Technical Support specialist. See the Contact Us section on page 48 for contact information. Topics include:

1. Service OAM (SOAM)
2. IEEE 1588 Precision Time Protocol (PTP)
3. EVC - MEF Service Configuration (MEF E-Line - E-LAN - E-Tree Services)
4. Ethernet Ring Protection Switching (ERPS)
5. EVC Behavior - ELAN Configuration

Not Intended for Use in Life Support Products: INDURA products are not intended for use in life support products, systems, or environments where failure of an INDURA product could reasonably be expected to result in death or personal injury. Anyone using an INDURA product in such an application without express written consent of an officer of Transition Networks, Inc. does so at their own risk, and agrees to fully indemnify Transition Networks, Inc. for any damages that may result from such use or sale.

Appendix C: Service, Warranty & Compliance Information

Contact Us

Technical Support
Technical support is available 24 hours a day.
US and Canada: 1-800-260-1312
International: 00-1-952-941-7600
Chat live via the Web with Transition Networks Technical Support.
Log onto www.transition.com and click the Tech Support/Transition Now link.

Web-Based Seminars
Transition Networks provides seminars via live web-based training.
Log onto www.transition.com and click the Learning Center link.

E-Mail
To ask a question anytime, send an e-mail to our technical support staff at techsupport@transition.com.

Address
Transition Networks
10900 Red Circle Drive,
Minnetonka, MN 55343, U.S.A.
Telephone: 952-941-7600
Toll free: 800-526-9267
Fax: 952-941-2322

Limited Lifetime Warranty

Effective for Products Shipped May 1, 1999 and After. Every Transition Networks labeled product purchased after May 1, 1999, and not covered by a fixed-duration warranty will be free from defects in material and workmanship for its lifetime. This warranty covers the original user only and is not transferable.

This warranty does not cover damage from accident, acts of God, neglect, contamination, misuse or abnormal conditions of operation or handling, including over-voltage failures caused by use outside of the product's specified rating, or normal wear and tear of mechanical components. If the user is unsure about the proper means of installing or using the equipment, contact Transition Networks's free technical support services.

Transition Networks will, at its option:

- Repair the defective product to functional specification at no charge
- Replace the product with an equivalent functional product
- Refund a portion of purchase price based on a depreciated value

Return Authorization

To return a defective product for warranty coverage, contact Transition Networks's technical support department for a return authorization number. Transition's technical support department can be reached through any of the following means:

Service Hours

USA: 8:00 PM Sunday through 8:00 PM Friday CST

After Hours: Calls will be answered by an on call engineer.

Direct Contact Numbers

Domestic: + 1 800-260-1312

International: + 1 952-358-3601

Fax: +1 952-941-2322

Email: techsupport@transition.com Online Support

Live Help: Chat live with a Transition Networks representative.

Return Instructions

Send the defective product postage and insurance prepaid to the following address:

   Transition Networks, Inc.
   10900 Red Circle Drive
   Minnetonka, MN 55343 USA
   Attn: RETURNS DEPT: CRA/RMA # _____

Failure to properly protect the product during shipping may void this warranty. The return authorization number must be written on the outside of the carton to ensure its acceptance. We cannot accept delivery of any equipment that is sent to us without a CRA or RMA number.

CRA's are valid for 60 days from the date of issuance. An invoice will be generated for payment on any unit(s) not returned within 60 days.

Upon completion of a demo/ evaluation test period, units must be returned or purchased within 30 days. An invoice will be generated for payment on any unit(s) not returned within 30 days after the demo/ evaluation period has expired.

The customer must pay for the non-compliant product(s) return transportation costs to Transition Networks for evaluation of said product(s) for repair or replacement. Transition Networks will pay for the shipping of the repaired or replaced in-warranty product(s) back to the customer (any and all customs charges, tariffs, or/and taxes are the customer's responsibility).

Before making any non-warranty repair, Transition Networks requires a $200.00 charge plus actual shipping costs to and from the customer. If the repair is greater than $200.00, an estimate is issued to the customer for authorization of repair. If no authorization is obtained, or the product is deemed ?not repairable,? Transition Networks will retain the $200.00 service charge and return the product to the customer not repaired. Non-warranted products that are repaired by Transition Networks for a fee will carry a 180-day limited warranty. All warranty claims are subject to the restrictions and conventions set forth by this document.

Transition Networks reserves the right to charge for all testing and shipping incurred, if after testing, a return is classified as "No Problem Found."

THIS WARRANTY IS YOUR ONLY REMEDY. NO OTHER WARRANTIES, SUCH AS FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSED OR IMPLIED. TRANSITION NETWORKS IS NOT LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY. AUTHORIZED RESELLERS ARE NOT AUTHORIZED TO EXTEND ANY DIFFERENT WARRANTY ON TRANSITION NETWORKS'S BEHALF.

Compliance Information

Standards
CISPR22/EN55022 Class A, CE Mark, and IEC 61850-3

FCC Regulations
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian ICES-003
This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numériqué de la classe A est conformé à la norme NMB-003 du Canada.

CE Marking
This is a Class A product. In a domestic environment, this product could cause radio interference; as a result, the customer may be required to take adequate preventative measures.

UL Recognized
Tested and recognized by the Underwriters Laboratories, Inc.

UL 508 Listing
The units are powered by either an AC or DC integral open-type power supply.
The power source to the products are intended for Field-Wire connection via terminal blocks labeled **PWR1** & **PWR2** for the DC input models and **POWER INPUT** for the AC input models.

Field-Wire Grounding
The main bonding is achieved through the use of a dedicated screw installed on the side of the enclosure.

Main Earthing/Bonding connection is achieved using a dedicated metal screw, with 6/32 thread size (i.e., #6), with a minimum of 2 full threads, installed on the side of the enclosure.

If a ring-type connector is used to secure earthing/bonding wire via screw, the connector must be UL Listed and suitable for use with the type and size of wire.

European Regulons

WARNING:

This is a Class A product. In a domestic environment, this product could cause radio interference in which case the user may be required to take adequate measures.

Achtung !

Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkstörungen auftreten. In diesem Fäll ist der Benutzer für Gegenmaßnahmen verantwortlich.

Attention !

Ceci est un produit de Classe A. Dans un environment domestique, ce produit risque de créer des interférences radioélectriques, il appartiendra alors à l'utilsateur de prende les measures spécifiques appropriées.

In accordance with European Union Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003, Transition Networks will accept post usage returns of this product for proper disposal. The contact information for this activity can be found in the 'Contact Us' portion of this document.

CAUTION: RJ connectors are NOT INTENDED FOR CONNECTION TO THE PUBLIC TELEPHONE NETWORK. Failure to observe this caution could result in damage to the public telephone network.

Der Anschluss dieses Gerätes an ein öffentlickes Telekommunikationsnetz in den EG-Mitgliedstaaten verstösst gegen die jeweligen einzelstaatlichen Gesetze zur Anwendung der Richtlinie 91/263/EWG zur Angleichung der Rechtsvorschriften der Mitgliedstaaten über Telekommunikationsendeinrichtungen einschliesslich der gegenseitigen Anerkennung ihrer Konformität.

GB 4943.1-2011 (Safety of Information Technology Equipment)
IEC 60950-1 is the International Standard for Safety of Information Technology Equipment. It encompasses under its scope information technology equipment, communications equipment, office appliances and multi-media equipment for use in the home, office, business, school, computer room and similar locations.
IEC 60950-1 is developed/maintained by IEC Technical Committee (TC) 108, Maintenance Team No. 2 (MT2): Safety and Energy Efficiency of Information Technology Equipment. In China, the ITE Standard, formally designated GB 4943.1-2011, is based on the Second Edition of IEC 60950-1, and like its predecessors includes China Deviations to address National requirements not in the base IEC document.

Used only at altitudes not more than 2000m above sea level.
"仅适用于海拔2000m 以下地区安全使

用"或类似的警告语句

Used only in non-tropical conditions.
"仅适用于非热带气候条件下安全使用"

或类似的警告语句

Disconnect Device – Since the products are evaluated as Permanently Connected Equipment, disconnect devices shall be provided in accordance with sub clause 1.7.2.2. A readily accessible disconnect device shall be incorporated outside the equipment. These devices can be isolating switch, circuit breaker, or equivalent as specified in sub clause 3.4.2. For Permanently Connected Equipment, a readily accessible disconnect device shall be incorporated external to the equipment.

Industrial Control Equipment - UL 508

These requirements cover industrial control devices, and devices accessory thereto, for starting, stopping, regulating, controlling, or protecting electric motors. These requirements also cover industrial control devices or systems that store or process information and are provided with an output motor control function(s).
This equipment is for use in ordinary locations in accordance with the National Electrical Code, NFPA 70.

These requirements cover devices rated 1500 volts or less.

The INDURA is capable of utilizing high voltage and was certified under the UL508 standard for Industrial Control Equipment.

Declaration of Conformity

Declaration of Conformity

Transition Networks, Inc.
Manufacture's Name

10900 Red Circle Drive, Minnetonka, Minnesota 55343 U.S.A.
Manufacture's Address

Declares that the product(s):
Indura™ Series
IND-3280-H, IND-3280-L, IND-3284-H, IND-3284-L

Conforms to the following Product Regulations:

FCC Part 15 Class A, EN 55022:2010, EN 55024:2010
Directive 2004/108/EC
Low-Voltage Directive 2006/95/EC
IEC /EN 60950-1
IEC 61850-3:2002

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standards(s).

Minnetonka, Minnesota   *November 13, 2012*
Place   Date   Signature

Stephen Anderson   *Vice President of Engineering*
Full Name   Position   28141B

Safety Instructions for Rack Mount Installations

The instructions below (or similar) are intended for INDURA rackmount installation environments:

1. Elevated Operating Ambient: if installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may exceed room ambient. Install the equipment in an environment compatible with the maximum ambient temperature (Tma) specified.

2. Reduced Air Flow: install the equipment in a rack so that the amount of air flow required for safe operation is not compromised.

3. Mechanical Loading: Mount the equipment in the rack so that a hazardous condition does not occur due to uneven mechanical loading (weight distribution/rack balance).

4. Circuit Overloading: give consideration to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Consider all equipment nameplate ratings when addressing this concern.

5. Reliable Earthing: maintain reliable earthing of rack-mounted equipment; pay particular attention to supply connections other than direct connections to the branch circuit (e.g., use of power strips).

Translated Electrical Safety Warnings

Electrical Safety
IMPORTANT: This equipment must be installed in accordance with safety precautions.

Elektrische Sicherheit
WICHTIG: Für die Installation dieses Gerätes ist die Einhaltung von Sicherheitsvorkehrungen erforderlich.

Elektrisk sikkerhed
VIGTIGT: Dette udstyr skal ☐nstallers I overensstemmelse med sikkerhedsadvarslerne.

Elektrische veiligheid
BELANGRIJK: Dit apparaat moet in overeenstemming met de veiligheidsvoorschriften worden geïnstalleerd.

Sécurité électrique
IMPORTANT : Cet équipement doit être utilisé conformément aux instructions de sécurité.

Sähköturvallisuus
TÄRKEÄÄ : Tämä laite on asennettava turvaohjeiden mukaisesti.

Sicurezza elettrica
IMPORTANTE: questa apparecchiatura deve essere installata rispettando le norme di sicurezza.

Elektrisk sikkerhet
VIKTIG: Dette utstyret skal ☐nstallers I samsvar med sikkerhetsregler.

Segurança eléctrica
IMPORTANTE: Este equipamento tem que ser instalado segundo as medidas de precaução de segurança.

Seguridad eléctrica
IMPORTANTE: La instalación de este equipo deberá llevarse a cabo cumpliendo con las precauciones de seguridad.

Elsäkerhet
OBS! Alla nödvändiga försiktighetsåtgärder måste vidtas när denna utrustning används

Index

Transition Networks

10900 Red Circle Drive

Minnetonka, MN 55343 USA

Tel: 952- 941-7600 or 1-800-526-9267

Fax: 952-941-2322

Printed in the U.S.A.

INDURA™ Series Industrial Managed Switches Installation Guide 33514 Rev G