



The RuggedSwitch® i800, or i-Series, is a family of compact, fully managed Ethernet switches designed to operate reliably in harsh industrial environments. The flexibility of the i800 family allows the user to choose from managed or unmanaged, regular or extended temperature, fiber optical or copper interfaces, and fast or Gigabit Ethernet. With up to nine Ethernet ports, the i800 is the perfect choice for a wide variety of demanding industrial environments such as those found in process control applications (oil and gas, petro-chemical, metals and mining, wind farms).

The i800 is packaged in a compact, die cast aluminum, DIN mountable enclosure for efficient use of cabinet space. Dual 24VDC power inputs increase reliability in case of primary power supply faults. The i800 provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of environments found in industrial applications. An operating temperature range of -20 to +60°C (with optional -40 to +85°C), coupled with hazardous location certification (Class 1 Division 2) allows the i800 to be placed in almost any location.

The i800 features a full array of intelligent functionality for high network availability and manageability. The embedded Rugged Operating System (ROS®) provides advanced layer 2 and layer 3 networking functions, and advanced cyber security features. The Enhanced Rapid Spanning Tree Protocol (eRSTP™) ensures very fast network recovery in case of failures ensuring a high availability network and allows any topology from ring to mesh. Numerous other features like VLANs and QoS make the i800 an enterprise class switch in an industrial class package.

The i800 is backed by an industry leading five year warranty and unsurpassed technical support and service.

### Features and Benefits

#### Ethernet Ports

- Four models to choose from with up to 8 10/100 BaseTX ports and up to 3 fiber ports
- i800: 8x 10/100TX
- i801: 8x 10/100TX + 1x 1000LX or 1x 10/100/1000TX
- i802: 6x 10/100TX + 1x 100FX or 2x 100FX or 2x 1000LX or 2x 10/100/1000TX
- i803: 4x 10/100TX + 1x 100FX + (2x 1000LX or 2x 100FX)
- Industry standard LC fiber optical connectors
- Multimode and Singlemode optical transceivers

#### Cyber Security Features

- Multi-level user passwords
- SSH/SSL (128-bit encryption)
- Enable/disable ports, MAC based port security
- Port based network access control (802.1x)
- VLAN (802.1Q) to segregate and secure network traffic
- RADIUS centralized password management
- SNMPv3 authentication and 56-bit encryption

#### RuggedRated™ for Reliability in Harsh Environments

- Immunity to EMI and heavy electrical surges
- Exceeds IEC 61000-6-2 (generic industrial)
- Hazardous Location Certification: Class 1 Division 2
- -20 to +60°C operating temperature (optional -40 to +85°C)
- Conformal coated printed circuit boards (optional)
- Die cast aluminum enclosure

#### Rugged Operating System (ROS®) Features

- Simple plug and play operation - automatic learning, negotiation, and crossover detection
- RSTP (802.1w) and Enhanced Rapid Spanning Tree (eRSTP™) network fault recovery (<5ms)
- Quality of Service (802.1p) for real-time traffic
- VLAN (802.1Q) with double tagging and GVRP support
- Link aggregation (802.3ad)
- IGMP Snooping for multicast filtering
- Port Rate Limiting and Broadcast Storm Limiting
- Industrial automation features (eg. Modbus)
- MSTP (802.1Q - 2005, formerly 802.1s)

#### Management Tools

- Web-based, Telnet, CLI management interfaces
- SNMP v1/v2/v3 (56-bit encryption)
- Remote Monitoring (RMON)
- Rich set of diagnostics with logging and alarms

#### Power Supply

- Dual low-voltage DC inputs: 24VDC (10-36VDC)
- Compression fit connections
- CSA/UL 60950 safety approved to +85°C

# RuggedSwitch® i800

### Power Input

- ▶ Dual 24VDC Power Inputs

### Critical Alarm Relay

- ▶ Optional Form-C Failsafe Alarm Relay

### Operating Temperature

- ▶ -20 to +60°C Operating Temperature Range
- ▶ Optional -40 to +85°C

### Rugged Construction:

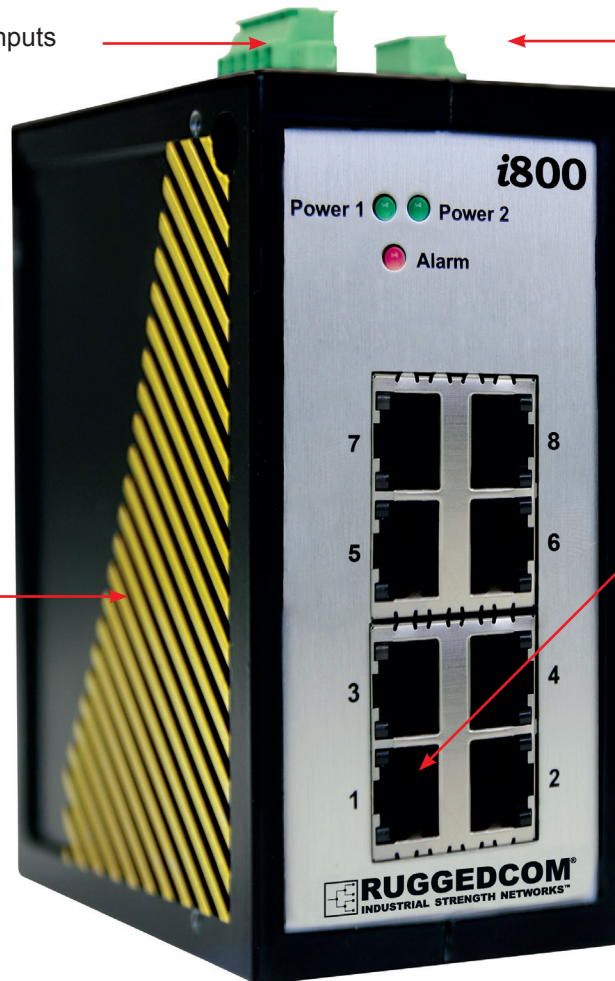
- ▶ Heavy Duty Cast Aluminum Enclosure
- ▶ HazLoc Rated
- ▶ Compact Size 4.5"x2"x3.5"

### Fast Ethernet Ports:

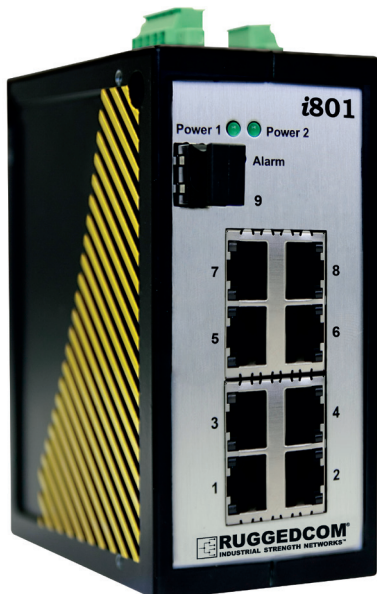
- ▶ 8 Ports 10/100TX Auto Negotiation and Crossover

### Console Port

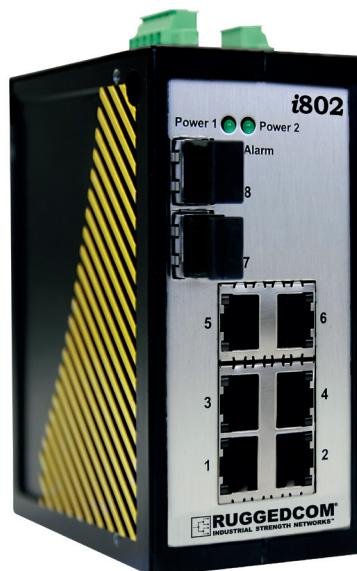
- ▶ Optional CPU Management with ROS®



### Other Available Models:



i801: 8x 10/100TX + 1x 1000LX or  
1x 10/100/1000TX



i802: 6x 10/100TX + 2x 100FX or  
2x 1000LX or 2x 10/100/1000TX



i803: 4x 10/100TX + 1x 100FX  
+ (2x 1000LX or 2x 100FX)

# ROS® Features



## Cyber Security

Cyber security is an urgent issue in many industries where advanced automation and communications networks play a crucial role in mission critical applications and where high reliability is of paramount importance. Key ROS® features that address security issues at the local area network level include:

- **Passwords** - Multi-level user passwords secures switch against unauthorized configuration
- **SSH / SSL** - Extends capability of password protection to add 128-bit encryption of passwords and data as they cross the network
- **Enable / Disable Ports** - Capability to disable ports so that traffic can not pass
- **802.1Q VLAN** - Provides the ability to logically segregate traffic between predefined ports on switches
- **MAC Based Port Security** - The ability to secure ports on a switch so only specific Devices / MAC addresses can communicate via that port
- **802.1x Port Based Network Access Control** - The ability to lock down ports on a switch so that only authorized clients can communicate via this port
- **RADIUS** - authentication service using MD5 hash and providing centralized password management
- **SNMPv3** - encrypted authentication access security and data encryption (CBC-DES with 56-bit encryption key)
- **Secure Socket Layer** - Web-based management using SSL with data encryption (128-bit encryption key)
- **RSA** - 1024 bit key for key management and key exchange
- **TACACS+** - Terminal Access Control and Accounting Services Client provides encrypted authentication and authorization
- **Point to Point (PPP)** - using CHAP (MD5 Hash) authentication service
- **SFTP** - Secure File Transfer Protocol using SSH encryption

The ROS® cyber security features are included to help address the various industry specific security standards such as NERC CIP, ISA S99, AGA 12, IEC 62443, ISO 17799:2005 and PCSRF SPP-ICS.

## Enhanced Rapid Spanning Tree Protocol (eRSTP™)

RuggedCom eRSTPTM allows the creation of fault-tolerant ring and mesh Ethernet networks that incorporate redundant links that are 'pruned' to prevent loops. eRSTPTM yields worst-case fault recovery of 5ms times the 'bridge diameter' and allows rings of up to 160 switches. For example, a ring of ten switches will have fault recovery times under 50ms. eRSTPTM implements both STP and RSTP to ensure interoperability with commercial switches unlike other proprietary 'ring' solutions.

## Quality of Service (IEEE 802.1p)

Some networking applications such as real-time control or VoIP (voice over IP) require predictable arrival times for

Ethernet frames. Switches can introduce latency in times of heavy network traffic due to the internal queues that buffer frames and then transmit on a first come first serve basis. ROS® supports 'Class of Service' in accordance with IEEE 802.1p that allows time critical traffic to jump ahead to the front of the queue thus minimizing latency and reducing jitter to allow such demanding applications to operate correctly. ROS® allows priority classification by port, tags, MAC address, and IP type of service (ToS). A configurable "weighted fair queuing" algorithm controls how frames are emptied from the queues.

## VLAN (IEEE 802.1Q)

Virtual local area networks (VLAN) allow the segregation of a physical network into separate logical networks with independent broadcast domains. A measure of security is provided since hosts can only access other hosts on the same VLAN and traffic storms are isolated. ROS® supports 802.1Q tagged Ethernet frames and VLAN trunks. Port based classification allows legacy devices to be assigned to the correct VLAN. GVRP support is also provided to simplify the configuration of the switches on the VLAN.

## Link Aggregation (802.3ad)

The link aggregation feature provides the ability to aggregate several Ethernet ports into one logical link (port trunk) with higher bandwidth. This provides an inexpensive way to set up a high speed backbone to improve network bandwidth. This feature is also known as "port trunking", "port bundling", "port teaming", and "Ethernet trunk".

## IGMP Snooping

ROS® uses IGMP snooping (Internet Group Management Protocol v1&v2) to intelligently forward or filter multicast traffic streams (e.g. MPEG video) to or from hosts on the network. This reduces the load on network trunks and prevents packets from being received on hosts that are not involved. ROS® has a very powerful implementation of IGMP snooping that:

- Can be enabled on a per VLAN basis.
- Detects and filters all multicast streams regardless of whether subscribers exist.
- Supports "router-less" operation by supporting an "active" mode.
- Restores traffic streams immediately after an RSTP topology change.

## SNMP (Simple Network Management Protocol)

SNMP provides a standardized method for network management stations the ability to interrogate devices from different vendors. SNMP versions supported by ROS® are v1, v2c, and v3. SNMPv3 in particular provides security features such as authentication, privacy with data encryption (CBC-DES with 56-bit encryption key) and access control not present in earlier SNMP versions. ROS® also supports numerous standard MIBs (Management Information Base) allowing for easy integration with any network management system (NMS).

## **ROS® Features**



A feature of SNMP supported by ROS® is the ability to generate “traps” upon system events. RuggedNMSTM, the RuggedCom management solution, can record traps from multiple devices providing a powerful network troubleshooting tool. It also provides a graphical visualization of the network and is fully integrated with all RuggedCom products.

<sup>1</sup> eRSTP fault recovery times may be approximated as follows:

For 100 Mbps, fault recovery performance is <5ms/hop

For 1,000 Mbps, fault recovery performance is <5ms/hop + 20msSNTP (Simple Network Time Protocol)

SNTP automatically synchronizes the internal clock of all ROS® devices on the network. This allows for correlation of time stamped events for troubleshooting.

### **SCADA and Industrial Automation**

ROS® contains features that optimize network performance and simplify switch management based on the unique requirements found in SCADA and industrial automation applications. Features such as Modbus TCP management for retrieval of switch data using the ubiquitous Modbus protocol and DHCP Option 82, a Rockwell Automation ODVA requirement for IP address assignment based on the location of the end device, provide capabilities not found in typical “commercial” or “office grade” Ethernet switches.

### **Port Based Network Access Control (802.1x)**

ROS® supports the IEEE 802.1x standard that defines a mechanism for port-based network access control which provides a means of authenticating and authorizing devices attached to LAN ports.

### **Port Rate Limiting**

ROS® supports configurable rate limiting per port to limit unicast and multicast traffic. This can be essential to managing precious network bandwidth for service providers. It also provides edge security for denial of service (DoS) attacks.

### **Broadcast Storm Filtering**

Broadcast storms wreak havoc on a network and can cause attached devices to malfunction. This could be disastrous on a network with mission critical equipment. ROS® limits this by filtering broadcast frames with a user-defined threshold.

### **Loss of Link Management**

Some intelligent electronic devices (IEDs) have dual fiber optic ports with automatic failover to a backup port should the primary fail. ROS® ensures this mechanism works reliably under all failure modes by appropriately disabling link signals when required. ROS® also flushes learned MAC addresses to ensure the failover occurs quickly.

### **Port Mirroring**

ROS® can be configured to duplicate all traffic on one port to a designated mirror port. When combined with a network analyzer, this can be a powerful troubleshooting tool.

### **Port Configuration and Status**

ROS® allows individual ports to be ‘hard’ configured for speed, duplex, auto-negotiation, flow control and more. This allows proper connection with devices that do not negotiate or have unusual settings. Detailed status of ports with alarm and SNMP trap on link problems aid greatly in system troubleshooting.

### **Port Statistics and RMON (Remote Monitoring)**

ROS® provides continuously updating statistics per port that provide both ingress and egress packet and byte counters as well as detailed error figures. Also provided is full support for the RMON statistics, history, alarms, and event groups. RMON allows for very sophisticated data collection, analysis and detection of traffic patterns.

### **Event Logging and Alarms**

ROS® records all significant events to a non-volatile system log allowing forensic troubleshooting. Events include link failure and recovery, unauthorized access, broadcast storm detection, and self-test diagnostics among others. Alarms provide a snapshot of recent events that have yet to be acknowledged by the network administrator. An external hardware relay is de-energized during the presence of critical alarms allowing an external controller to react if desired.

### **HTML Web Browser and Telnet User Interfaces**

ROS® provides a simple, intuitive user interface for configuration and monitoring via a standard graphical web browser or via Telnet. All system parameters include detailed on-line help to make setup a breeze. ROS®, presents a common look and feel and standardized configuration process allowing easy migration to other RuggedCom managed products.

### **Configuration via ASCII Text File**

All configuration parameters are stored in an ASCII formatted text file that can easily be transferred via TFTP or Xmodem. The configuration file can be saved for backup purposes and easily manipulated by a text editor. The same text file can be downloaded to the switch at a later date in order to re-configure or restore a previous configuration.

### **Command Line Interface (CLI)**

A command line interface can be used in conjunction with remote shell to automate data retrieval, configuration updates, and firmware upgrades. A powerful SQL-like capability allows expert users the ability to selectively retrieve or manipulate any parameters the device has to offer.

## EMI and Environmental Type Tests

IEC 61000-6-2 EMC Generic Standard: Immunity for Industrial Environments			
Test	Description		Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 4kV
		Enclosure Air	+/- 8kV
IEC 61000-4-3	Radiated RFI	Enclosure ports	10 V/m, 80 to 1000Mhz
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 1kV @ 5kHz
		D.C Power ports	+/- 2kV @ 5kHz
IEC 61000-4-5	Surge	Signal ports	+/- 1kV line-to-earth
		D.C Power ports	+/- 0.5kV line-to-earth/line
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V @ 0, 5-80 MHz
		D.C Power ports	10V @ 0, 5-80 MHz
		Earth ground ports	10V @ 0, 5-80 MHz
IEC 61000-4-8	Magnetic Field	Enclosure ports	30 A/m @ 50, 60 Hz
IEC 61000-4-29	Voltage Dips	D.C. Power ports	30% reduction for 0.5 period
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV diff. mode@1MHz
		D.C. Power ports	2.5kV common, 1kV diff. mode@1MHz
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continuous, 300V for 1s
		D.C. Power ports	30V Continuous, 300V for 1s
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%

IEEE 1613 (C37.90.x) EMI IMMUNITY TYPE TESTS				
Test	Description		Test Levels	Severity Levels
IEEE C37.90.3	ESD	Enclosure Contact	+/- 8kV	N/A
		Enclosure Air	+/- 15kV	N/A
IEEE C37.90.2	Radiated RFI	Enclosure ports	35 V/m	N/A
IEEE C37.90.1	Fast Transient	Signal ports	+/- 4kV @ 2.5kHz	N/A
		D.C. Power ports	+/- 4kV	N/A
		Earth ground ports <sup>3</sup>	+/- 4kV	N/A
IEEE C37.90.1	Oscillatory	Signal ports	2.5kV common mode @1MHz	N/A
		D.C. Power ports	2.5kV common, 1kV diff. mode@1MHz	N/A
IEEE C37.90	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
IEEE C37.90	Dielectric Strength	Signal ports	2kVac	N/A
		D.C. Power ports	1.5kV DC	N/A

Environmental Type Tests			
Test	Description		Test Levels
IEC 60068-2-1	Cold Temperature		Test Ad -40°C, 16 Hours
IEC 60068-2-2	Dry Heat		Test Bd +85°C, 16 Hours
IEC 60068-2-30	Humidity (Damp Heat, Cyclic)		Test Db 95% (non-condensing), 55°C , 6 cycles
IEC 60255-21-1	Vibration		Tests Fc 1g @ (10 - 500) Hz
IEC 60255-21-2	Shock		Tests Ea 30g @ 11ms

## Technical Specifications

### Power Supply

- Power Consumption: 9W MAX
- 10-36 VDC, 0.4A @ 24VDC
- Non-isolated

### Critical Alarm Relay

- Form-C failsafe contact relay: 1A@30VDC

### Physical

- Height: 4.5" / 11.4cm
- Width: 2" / 5.1cm
- Depth: 3.5" / 8.9cm
- Weight: 2.2lbs / 1.0kg
- Ingress Protection: IP40 (1mm objects)
- Enclosure: Cast Aluminum Enclosure
- Mounting: DIN rail

### Switch Properties

- Switching method: Store & Forward
- Switching latency: 8 us (100Mbps)
- Switching bandwidth: 5.2Gbps  
(for i802 6x100bps ports + 2xGig ports)
- MAC address table size: 16kbytes
- Priority Queues: 4
- Frame buffer memory: 1 Mbit
- Simultaneous VLANs: 255
- VLAN ID Range: 1 to 4094
- IGMP multicast groups: 256
- Port rate limiting: 128kbps, 256, 512, 4, 8Mbps
- No head of line blocking

### Approvals

- Hazardous Location: cUL 1604 Class 1 Div 2 (Hazloc)
- ISO: Designed and manufactured using a ISO9001: 2000 certified quality program
- CE Marking
- Emissions: FCC Part 15 (Class A),  
EN55022 (CISPR22 Class A)
- Safety: cUL508 (UL508/CSA C22, EN61010-1)
- Laser Eye Safety (FDA/CDRH): Complies with 21 CFR Chapter1, Subchapter J.
- ATEX Zone 2 (IEC/EN 60079-15)

### Warranty

- 5 Years – Applicable to design or manufacturing related product defects.
- Note: The i800 product family has been designed specifically for the Industrial Automation segment, and as such RuggedCom does not recommend the use of this product family for Electric Utility Substations applications. Should these products be used for Electric Utility Substation Applications, the following applies,
  - Product performance is not guaranteed
  - The manufacturers warranty will not be applicable (i.e. it will be voided and technical support will not be provided)
  - RuggedCom does not accept any liabilities as a result of performance issues

### Network Management

- HTTP graphical web-based, SSL (128-bit encryption)
- SNMP v1, v2c, v3 (56-bit encryption)
- Telnet, VT100, SSH/SFTP (128-bit encryption)
- Command Line Interface (CLI)
- RSA Key Management (1024 bit key)
- Authentication and Accounting - TACACS+ (encrypted), RADIUS client, PPP

### IEEE Compliance

- 802.3-10BaseT
- 802.3u-100BaseTX, 100BaseFX
- 802.3x-Flow Control
- 802.3z-1000BaseLX
- 802.3ab-1000BaseTX
- 802.3ad-Link Aggregation
- 802.1D-MAC Bridges
- 802.1D-Spanning Tree Protocol
- 802.1p-Class of Service
- 802.1Q-VLAN Tagging
- 802.1w-Rapid Spanning Tree Protocol
- 802.1x-Port Based Network Access Control
- 802.1Q-2005 (formerly 802.1s) MSTP

### IETF RFC Compliance

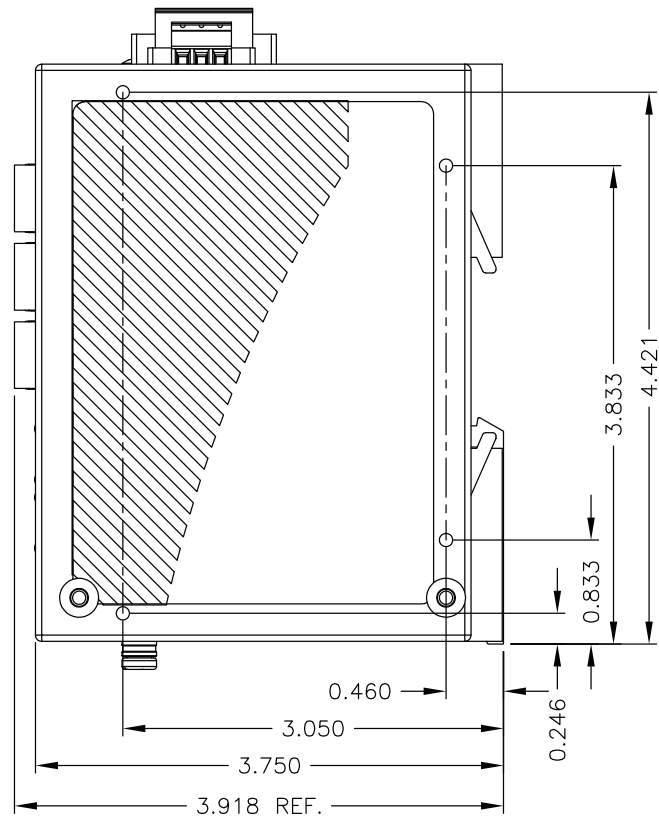
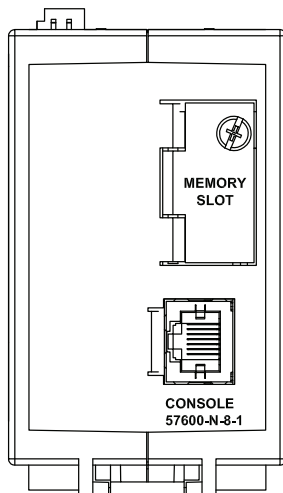
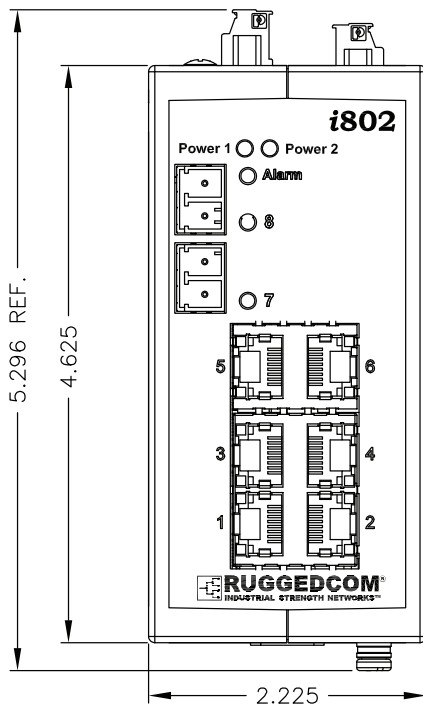
- RFC768-UDP
- RFC783-TFTP
- RFC791-IP
- RFC792-ICMP
- RFC793-TCP
- RFC826-ARP
- RFC854-Telnet
- RFC894-IP over Ethernet
- RFC1112-IGMP v1
- RFC1519-CIDR
- RFC1541-DHCP (client)
- RFC2030-SNTP
- RFC2068-HTTP
- RFC2236-IGMP v2
- RFC2284-EAP
- RFC2475-Differentiated Services
- RFC2865-RADIUS
- RFC3414-SNMPv3-USM
- RFC3415-SNMPv3-VACM

### IETF SNMP MIBS

- RFC1493-BRIDGE-MIB
- RFC1907-SNMPv2-MIB
- RFC2012-TCP-MIB
- RFC2013-UDP-MIB
- RFC2578-SNMPv2-SMI
- RFC2579-SNMPv2-TC
- RFC2819-RMON-MIB
- RFC2863-IF-MIB
- draft-ietf-bridge-rstpmib-03-BRIDGE-MIB
- draft-ietf-bridge-bridgemib-smiv2-03-RSTP-MIB
- ANAifType-MIB

# Fiber Specifications and Mechanical Drawing

Fiber Optical Specifications		
Parameter	Fiber Port Type	
Mode	Multimode	Singlemode
Connectors	LC	LC
Typical Dist. (km)	2	20
Optical Wavelength (nm)	1310	1310
Cable Size Core/Cladding (um)	50 or 62.5/125	8 or 9/125
TX Power (dBm)	-15.7	-15.5
Rx Sensitivity (dBm)	-33.5	-32
Typical Budget (dB)	17	16.5



Note: Other i800 models have the same dimensions; see install guide for complete information.

## Order Codes

**i800** -      -      -       
          M      T      MOD

**i801** -      -      -      -       
          M      T      P9      MOD

**i802** -      -      -      -       
          M      T      P78      MOD

**i803** -      -      -      -      -       
          M      T      P5      P6P7      MOD

### M: Management Option

- M = Managed with ROS®
- U = Unmanaged

### T: Temperature Option

- T = -20 to +60°C
- U = -40 to +85°C

### P9: i801 Port 9 Options

- 1CG01 = 10/100/1000Base TX
- 1FG01 = 1000SX Multimode LC 850nm 500m
- 1FG03 = 1000LX Singlemode LC 1310nm 10km

### P78: i802 Port 7&8 Options

- 1FX11 = 1x 100FX Multimode LC 1310nm, 2km
- 1FX06 = 1x 100FX Singlemode LC 1310nm, 20km
- FX11 = 2x 100FX Multimode LC 1310nm, 2km
- FX06 = 2x 100FX Singlemode LC 1310nm, 20km
- FG01 = 2x 1000SX Multimode LC 850nm 500m
- FG03 = 2x 1000LX Singlemode LC 1310nm 10km
- CG01 = 2x 10/100/1000TX

### P5: i803 Port 5 100FX Fiber Optic Options

- 1FX11 = 1x 100FX Multimode LC 1310nm, 2km
- 1FX06 = 1x 100FX Singlemode LC 1310nm, 20km

### P6P7: i803 Port 6&7 Fiber Optic Options

- FX11 = 2x 100FX Multimode LC 1310nm, 2km
- FX06 = 2x 100FX Singlemode LC 1310nm, 20km
- FG01 = 2x 1000SX Multimode LC 850nm 500m
- FG03 = 2x 1000LX Singlemode LC 1310nm 10km

### MOD: Manufacturing Modifications

- XX = None
- C01 = Conformal Coating



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Patent Pending

All specifications in this document are subject to change without notice.

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