

## Product Overview

# RUGGEDCOM RSG2288

## Modular Managed Gigabit Switch with IEEE 1588 v2 and IRIG-B Conversion, 128-bit Encryption

The RUGGEDCOM RSG2288 from Siemens is a utility grade, fully managed modular Gigabit Ethernet switch, featuring IEEE 1588 v2 protocol with hardware time stamping that allows for high precision time synchronization over the Ethernet network and conversion to IRIG B for non 1588 devices. The RSG2288 features 2-port modules for superior flexibility, support for multiple fiber types, and long haul optics, making it ideal for creating mission critical Gigabit networks or aggregating switches into a Gigabit backbone.

Designed to operate reliably in harsh environments, the RSG2288 provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of environments found in utility substations, rail applications, and oil and gas operations. An operating temperature range of -40°C to +85°C coupled with hazardous location compliance (Class 1 Division 2), optional conformal coating and a galvanized 1U form factor steel enclosure with industrial grade DIN, panel, or 19" rack-mounting options allows the RSG2288 to be placed in almost any location.

The RSG2288's modular flexibility offers 100BaseFX or 1000BaseX fiber and 10/100/1000BaseTX copper port combinations. Optional front or rear mount connectors make the RSG2288 highly versatile for any application and can support multiple fiber connectors (ST, MTRJ, LC, SC, Micro-D) without loss of port density.

The embedded Rugged Operating System (ROS) provides advanced cyber security features and comprehensive networking functions such as Enhanced Rapid Spanning Tree (eRSTP), Port Rate Limiting, and a full array of intelligent functionality for high network availability and manageability. Coupled with ruggedness and durability that is designed in from the onset, the RSG2288 is ideal for creating mission critical, real-time, control applications where high reliability and availability is of paramount importance.

All RUGGEDCOM products are backed by a five year warranty and unsurpassed technical support.





## Features and Benefits

### Ethernet Ports

- Up to 9-Gigabit Ethernet ports – copper and/or fiber
- Up to 9 100FX Fiber Fast Ethernet ports
- 2 port modules for tremendous flexibility
- Supports many types of fiber/optics
- Long haul optics allow Gigabit distances up to 70km
- Multiple connector types (LC, SC, SFP, GBIC)

### Precision Timing

- IEEE 1588 v2 with hardware time stamping on all ports
- IEEE 1588 v2 to IRIG-B conversion
- Transparent clock operation for high precision on switched networks (better than 1 $\mu$ s accuracy, typically 100ns)
- High precision TCXO (Temperature Compensated Oscillator)
- Supports master, slave and transparent clock

### Rugged Rated for Reliability in Harsh Environments

- Immunity to EMI and heavy electrical surges
  - Zero-Packet-Loss Technology
  - Meets IEEE 1613 (electric utility substations) Class 1 with copper ports or Class 2 with all fiber ports
  - Exceeds IEC 61850-3 (electric utility substations)
  - Exceeds IEC 61800-3 (variable speed drive systems)
  - Exceeds IEC 61000-6-2 (generic industrial)
  - Exceeds NEMA TS-2 (traffic control equipment)
- -40°C to +85°C operating temperature (no fans)
- Conformal coated printed circuit boards (optional)
- 18 AWG galvanized steel enclosure
- Hazardous Location Compliance: Class 1 Division 2

### 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 (e.g. Modbus)

### Management Tools

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

### Universal Power Supply Options

- Fully integrated, dual-redundant (optional) power supplies
- Universal high voltage range: 88-300VDC or 85-264VAC
- Low voltage ranges: 24VDC (10-36VDC), 48VDC, (36-72VDC)
- Screw or pluggable terminal blocks ensure reliable maintenance free connections
- CSA/UL 60950 safety approved to +85°C



## RUGGEDCOM RSG2288

### Integrated Power Supply

- ▶ Universal high-voltage range: 88-300VDC or 85-264VAC
- ▶ Popular low voltage DC ranges: 24VDC (10-36VDC), 48VDC (36-72VDC)
- ▶ True dual redundant parallel load sharing (optional)
- ▶ Screw or pluggable terminal blocks available

### Operating Temperature

- ▶ -40°C to +85°C
- ▶ No fans

### Critical Alarm Relay

- ▶ Form-C contact ratings:  
Max voltage 250VAC, 125VDC  
Max current 2A@250VAC,  
2A@30VDC



### Modularity

- ▶ 6 available slots
- ▶ Dual and single port modules
- ▶ Up to 9 Gigabit ports
- ▶ PTP Card

### Mounting options

- ▶ Panel/Din rail
- ▶ 19" rack mount
- ▶ Front or rear mount



### Gigabit Port Types

- ▶ 10/100/1000 TX RJ45
- ▶ 1000 BaseX Fiber
- ▶ 100FX Fiber
- ▶ Pluggable Optics (SFP)
- ▶ SC, ST, LC and MTRJ

### Modular HMI

- ▶ Front or rear mount

# RUGGEDCOM RSG2288 Optional Clock Source Card

## IEEE 1588 v2 Support

- ▶ Hardware time stamping on all ports
- ▶ Transparent clock operation for high precision on switched networks (better than 1µs accuracy)
- ▶ Peer-to-peer path delay measurements
- ▶ High precision TCXO (Temperature Compensated Oscillator)
- ▶ Supports slave, master and transparent clock

## Accuracy

- ▶ Better than 1µs, typically 100ns – (IEEE 1588)
- ▶ Better than 1µs – (IRIG-B)



## IRIG-B Outputs

- ▶ Conversion from IEEE 1588 v2
- ▶ IRIG-B unmodulated (TTL) or PPS
- ▶ IRIG-B modulated (AM)
- ▶ Supports TTL levels PWM output (Format B002, B003), 50 ohm BNC female connector
- ▶ Supports 1kHz AM output (Format B122, B123), 5Vp-p, ratio 3:1 ± 10%, 50 ohm BNC female connector

## IRIG-B Input

- ▶ IRIG-B (TTL)
- ▶ Supports TTL levels PWM output (Format B002, B003), 50 ohm BNC female connector
- ▶ >200K ohm input impedance

## GPS Input

- ▶ NEMA 0183 protocol compatible
- ▶ Frequency stability: 0.5ppm
- ▶ PPS accuracy: +/- 1µs
- ▶ 50 ohm BNC female connector RF input with remote antenna suitable for low-loss coaxial cable
- ▶ Support active antenna with +5V DC power feed

# 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/SFTP** – 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 eRSTP allows the creation of fault-tolerant ring and mesh Ethernet networks that incorporate redundant links that are 'pruned' to prevent loops. eRSTP yields worst-case fault recovery<sup>1</sup> 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. eRSTP implements both STP and RSTP to ensure interoperability with commercial switches unlike other proprietary 'ring' solutions.

<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 + 20ms

## 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 and v3) 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

# ROS Features

## SNMP (Simple Network Management Protocol)

SNMP provides a standardized method for network management stations 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).

A feature of SNMP supported by ROS is the ability to generate “traps” upon system events. RUGGEDCOM NMS, 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.

## SNTP (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.

## 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.

## 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 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/SSH User Interfaces

ROS provides a simple, intuitive user interface for configuration and monitoring via a standard graphical web browser or via Telnet/SSH. 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, SFTP 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 61850-3 EMI Type Tests				
Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure contact	+/- 8kV	4
		Enclosure air	+/- 15kV	4
IEC 61000-4-3	Radiated RFI	Enclosure ports	20 V/m	Note 1
IEC 61000-4-4	Burst (fast transient)	Signal ports	+/- 4kV @ 2.5kHz	Note 1
		D.C. power ports	+/- 4kV	4
		A.C. power ports	+/- 4kV	4
		Earth ground ports <sup>3</sup>	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (conducted) RFI	Signal ports	10V	3
		D.C. power ports	10V	3
		A.C. power ports	10V	3
		Earth ground ports	10V	3
IEC 61000-4-8	Magnetic field	Enclosure ports <sup>3</sup>	40 A/m continuous, 1000 A/m for 1 s	Note 1
			1000 A/m for 1 s	5
IEC 61000-4-29	Voltage dips and interrupts	D.C. power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
IEC 61000-4-11		A.C. power ports	30% for 1 period, 60% for 50 periods 100% for 5 periods, 100% for 50 periods	N/A
IEC 61000-4-12	Damped oscillatory	Signal ports	2.5kV common, 1kV diff. mode@1MHz	3
		D.C. power ports	2.5kV common, 1kV diff. mode@1MHz	3
		A.C. power ports	2.5kV common, 1kV diff. mode@1MHz	3
IEC 61000-4-16	Mains frequency voltage	Signal ports	30V Continuous, 300V for 1s	4
		D.C. power ports	30V Continuous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. power supply	D.C. power ports	10%	3
IEC 60255-5	Dielectric strength	Signal ports	2kVac (Fail-safe relay output)	N/A
		D.C. power ports	1.5V DC	N/A
		A.C. power ports	2kVac	N/A
IEC 60255-5	H.V. impulse	Signal ports	5kV (Fail-safe relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A

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
		A.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
		A.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
		A.C. power ports	5kV	N/A
IEEE C37.90	Dielectric strength	Signal ports	2kVac	N/A
		D.C. power ports	1.5kVac	N/A
		A.C. power ports	2kVac	N/A

Environmental Type Tests				
Test	Description		Test Levels	Severity Levels
IEC 60068-2-1	Cold temperature	Test Ad	-40°C, 16 hours	N/A
IEC 60068-2-2	Dry heat	Test Bd	+85°C, 16 hours	N/A
IEC 60068-2-30	Humidity (damp heat, cyclic)	Test Db	95% (non-condensing), 55°C, 6 cycles	N/A
IEC 60255-21-1	Vibration	Test Fc	2g @ (10 - 150) Hz	Class 2 <sup>2</sup>
IEC 60255-21-2	Shock	Test Ea	30g @ 11mS	Class 2 <sup>2</sup>

<sup>1</sup> RUGGEDCOM specified severity levels.

<sup>2</sup> Class 2 refers to "Measuring relays and protection equipment for which a very high security margin is required or where the vibration levels are very high, (e.g. shipboard application and for severe transportation conditions)".

<sup>3</sup> Only applicable to functional earth connections separated from the safety earth connection. Purchase from Multicom  www.multicominc.com | 800-423-2594

# Technical Specifications

## Power Supply

- Power consumption: 28W Max
- 24VDC: 10-36VDC, 1.2A
- 48VDC: 36-72VDC, 0.6A
- HI voltage AC/DC: 88-300VDC or 85-264VAC

## Critical Alarm Relay

- Form-C contact ratings:
  - Max Voltage 250VAC, 125VDC
  - Max Current 2A@250VAC, 2A@30VDC

## Physical Dimensions

- Height: 1.74" (44mm)
- Width: 18.3" (465mm)
- Depth: 12.4" (315mm)
- Weight: 4.8kg
- Ingress protection: IP40 (1mm objects)
- Enclosure: 18 AWG galvanized steel enclosure
- Mounting: 19" rack, DIN rail or panel mounted

## Switch Properties

- Switching method: Store and forward
- Switching latency: 7  $\mu$ s (100Mbps)
- Switching bandwidth: 18 Gbps
- MAC addresses: 8192
- MAC address table size: 64kbytes
- Priority queues: 4
- Frame buffer memory: 2 Mbit
- Simultaneous VLANs: 255
- VLAN ID range: 1 to 4094
- IGMP multicast groups: 256
- Port rate limiting
- No head of line blocking

## Regulatory Approvals

- ISO: Designed and manufactured using an ISO9001: 2000 certified quality program
- CE marking
- Emissions: FCC Part 15 (Class A), EN55022 (CISPR22 Class A)
- Safety: cCSAus (Compliant with CSA C22.2 No. 60950, UL 60950, EN60950)
- Laser eye safety (FDA/CDRH): Complies with 21 CFR Chapter 1, Subchapter J

## Network Management

- HTTPS 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

## Warranty

- 5 Years – Applicable to design and manufacturing related product defects

## EMI Immunity and Environmental Compliance

- IEC 61000-6-2 Industrial (Generic)
- IEC 61800-3 Industrial (Variable Speed Drive Systems)
- IEC 61850-3 Electric Utility Substations
- IEEE 1613 Electric Utility Substations
- NEMA TS 2 Traffic Control Equipment

## IEC 61850 Compliance

- IEC 61850-9-2 Sampled Values
- IEC 61850-8-1 GOOSE Messages

## 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
- 1588 v2 Precision Time Protocol

## 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
- RFC3376 IGMP v3
- 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
- IANAifType-MIB