The RUGGEDCOM RS416 from Siemens is a utility grade 16 port serial device server with an integrated, fully managed 4 port Ethernet switch. Featuring a modular design that can support IEEE 1588 and IRIG-B time synchronization, the RS416 is able to interconnect and synchronize multiple types of intelligent electronic devices (IEDs) that have different methods of communications. The time source is provided via IEEE 1588 v2 and converted to IRIG-B for distribution to the IEDs via the serial ports or dedicated IRIG-B cabling. Each serial port supports standard data communications plus an IRIG-B time-synchronization output. The high port density of the RS416 results in fewer overall serial servers, which reduces overall system costs, extends the useful life of existing legacy IEDs, and minimizes capital expenditures for new equipment.

Designed to operate reliably in electrically harsh and climatically demanding environments, the RS416 provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of environments found in electric utility substations, curb side traffic control cabinets, and factory floors. 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 steel enclosure, allows the RS416 to be placed in almost any location.

The RS416 also includes fully integrated, dual-redundant (optional) power supplies that can support a wide range of power options for multiple industries and worldwide operability. Options include 24VDC, 48VDC, 88-300VDC, and 85-264VAC, allowing for great installation flexibility.

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 RS416 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

Serial Device Server
- Modular design allows for 4, 8, 12, or 16 serial ports
- Software selectable EIA/TIA RS232, RS485, RS422 serial ports with IRIG-B outputs
- Serial Fiber Interface (ST)
- Transmit serial data over an IP network
- Support for Modbus TCP, DNP3, WIN, TIN, and Microlock serial protocols
- Baud rates up to 230 kbps
- Raw socket mode allows conversion of any serial protocol
- Point-to-point and multi-point modes
- Converts Modbus RTU to Modbus; Multiple Modbus masters
- Converts DNP3.0 to DNP over UDP/TCP

Ethernet Ports
- Integrated Ethernet Switch
- Copper or Fiber options
- Supports IEEE 1588 v2
- Non-blocking, store and forward switching

IRIG-B Option
- Conversion from IEEE 1588 v2
- One IRIG-B PWM/PPS Output
- One IRIG-B PWM Input
- Supports TTL levels (Format B002, B003)
- BNC Connectors

IEEE 1588
- Internal clock is synchronized with IEEE 1588 version 2
- 100μs time accuracy

Rugged Rated for Reliability in Harsh Environments
- Immunity to EMI and heavy electrical surges
  - Meets IEEE 1613 (electric utility substations)
  - 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)
- Fully independent 2kV (RMS) isolated serial ports
- -40°C to +85°C operating temperature (no fans)
- 18 AWG galvanized steel enclosure
- Hazardous Location Compliance: Class 1 Division 2

Universal Power Supply Options
- Fully integrated, dual-redundant (optional) power supplies
- Universal high-voltage range: 88-300VDC or 85-264VAC
- Popular low voltage ranges: 24VDC (10-36VDC), 48VDC (36-59VDC)
- Screw or pluggable terminal blocks ensure reliable maintenance free connections
- CSA/UL 60950 safety approved to +85°C

Rugged Operating System (ROS) Features
- Simple plug and play operation – automatic learning, negotiation, and crossover detection
- Integrated Cyber Security features
- 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
- IGMP Snooping for multicast filtering
- Port Rate Limiting and Broadcast Storm Limiting
- Port configuration, status, statistics, mirroring, security
- SNTP time synchronization (client and server)
RUGGEDCOM RS416

**Integrated Power Supply**
- Universal high-voltage range: 88-300VDC or 85-264VAC
- Popular low voltage DC ranges: 24VDC (12-36VDC), 48VDC (36-59VDC)
- True Dual Redundant Parallel Load Sharing (Optional)

**Operating Temperature**
- -40°C to +85°C

**Critical Alarm Relay**
- Form-C contact ratings:
  - Max voltage 250VAC, 125VDC
  - Max current 2A@250VAC, 2A@30VDC

**Mounting Options**
- Panel/Din rail
- 19" rack mount

**Serial Port Types**
- Up to 16 Serial Ports
- Software selectable EIA/TIA RS232, RS485, RS422 serial ports with IRIG-B outputs
- DB9, RJ45 or ST Fiber Optical connectors
- Mix and match types and connectors

**Fast Ethernet Port Types**
- Up to 4 Fast Ethernet Ports
- 10/100TX RJ45
- 10FL Multimode fiber
- 100FX Multimode
- IEEE 1588

**Modularity**
- 6 available slots
- 4, 8, 12, 16 Serial Port Configurations
- 2 or 4 Fast Ethernet ports

**Optional IRIG-B Input**
- BNC Connector
- PWM TTL

**Optional IRIG-B Output**
- BNC Connector
- PWM TTL
- PPS

**Modular HMI**
- Front or rear mount
Typical Network Architecture

Distributing a Time Source over IRIG-B TTL

Distributing a Time Source over IEEE 1588 Version 2
ROS Features

Serial IP Encapsulation
Many ‘legacy’ devices (RTU, PLC, IED, etc.) only support serial communications via RS232, RS422 or RS485. ROS encapsulates the serial data within a TCP connection allowing these devices to be reached via an IP network. A wide range of baud rates, frame packetization options, and diagnostics allows any serial protocol to function. The RS400 has specific support for the following serial protocols:
- Raw socket serial encapsulation
- Modbus TCP (client and server)
- DNP 3
- WIN and TIN
- Microlok

Modbus TCP
The Modbus protocol is ubiquitous in the industrial control and automation world. ROS converts Modbus RTU master/slave serial data packets to Modbus TCP client/server packets for transmission over an IP network. This allows communications to Modbus RTU slaves via Ethernet and allows multiple masters to poll the same slave device.

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 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 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.

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.”

1 eRSTP fault recovery times may be approximated as follows:
   For 100 Mbps, fault recovery performance is <5ms/hop

Serial Device Server with Integrated 4-Port Managed Ethernet Switch, IEEE 1588 v2 & IRIG-B Conversion, 128-bit Encryption
RUGGEDCOM RS416
ROS Features

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

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.

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.

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

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Test Levels</th>
<th>Severity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61000-4-2</td>
<td>ESD</td>
<td>Enclosure contact +/- 8kV</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enclosure air +/- 15kV</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-3</td>
<td>Radiated RFI</td>
<td>Enclosure ports 20 V/m</td>
<td>Note 1</td>
</tr>
<tr>
<td>IEC 61000-4-4</td>
<td>Burst (fast transient)</td>
<td>Signal ports +/- 4kV @ 2.5kHz</td>
<td>Note 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports +/- 4kV</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports +/- 4kV</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth ground ports 3 +/- 4kV</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-5</td>
<td>Surge</td>
<td>Signal ports +/- 4kV line-to-earth, +/- 2kV line-to-line</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports +/- 2kV line-to-earth, +/- 1kV line-to-line</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports +/- 4kV line-to-earth, +/- 2kV line-to-line</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-6</td>
<td>Induced (conducted) RFI</td>
<td>Signal ports 10V</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 10V</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 10V</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth ground ports 3 10V</td>
<td>3</td>
</tr>
<tr>
<td>IEC 61000-4-8</td>
<td>Magnetic field</td>
<td>Enclosure ports 40 A/m continuous, 1000 A/m for 1 s</td>
<td>Note 1</td>
</tr>
<tr>
<td>IEC 61000-4-29</td>
<td>Voltage dips and interrupts</td>
<td>D.C. power ports 30% for 0.1s, 60% for 0.1s, 100% for 0.05s</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 30% for 1 period, 60% for 50 periods</td>
<td>N/A</td>
</tr>
<tr>
<td>IEC 61000-4-11</td>
<td>Damped oscillatory</td>
<td>Signal ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>3</td>
</tr>
<tr>
<td>IEC 61000-4-16</td>
<td>Mains frequency voltage</td>
<td>Signal ports 30V Continuous, 300V for 1s</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 30V Continuous, 300V for 1s</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-17</td>
<td>Ripple on D.C. power supply</td>
<td>D.C. power ports 10%</td>
<td>3</td>
</tr>
<tr>
<td>IEC 60255-5</td>
<td>Dielectric strength</td>
<td>Signal ports 2kVac (Fail-safe relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 1.5kV DC</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 2kVac</td>
<td>N/A</td>
</tr>
<tr>
<td>IEC 60255-5</td>
<td>H.V. impulse</td>
<td>Signal ports 5kV (Fail-safe relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. Power ports 5kV</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. Power ports 5kV</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### IEEE 1613 (C37.90.x) EMI Immunity Type Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Test Levels</th>
<th>Severity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE C37.90.3</td>
<td>ESD</td>
<td>Enclosure contact +/-2kV, +/-4kV, +/-8kV</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enclosure air +/-4kV, +/-8kV, +/-15kV</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.2</td>
<td>Radiated RFI</td>
<td>Enclosure ports 35 V/m</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Fast transient</td>
<td>Signal ports +/- 4kV @ 2.5kHz</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports +/- 4kV</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports +/- 4kV</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth ground ports 3 +/- 4kV</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Oscillatory</td>
<td>Signal ports 2.5kV common mode@1MHz</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>H.V. impulse</td>
<td>Signal ports 5kV (Fail-safe relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 5kV</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 5kV</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>Dielectric strength</td>
<td>Signal ports 2kVac</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D.C. power ports 1.5kVVac</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.C. power ports 2kVac</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Environmental Type Tests

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

1 RUGGEDCOM specified severity levels.
2 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”).
3 Only applicable to functional earth connections separated from the safety earth connection.
Technical Specifications

Power Supply
- Power consumption: 15W Max
- 24VDC: 10-36VDC Max
- 48VDC: 36-59VDC Max
- HI voltage AC/DC: 88-300VDC or 85-264VAC Max

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” (464mm)
- Depth: 12.4” (315mm)
- Weight: 5.2kg
- Ingress protection: IP40 (1mm objects)
- Enclosure: 18 AWG galvanized steel enclosure
- Mounting: DIN rail or panel mounted

Switch Properties
- Switching method: Store and forward
- Switching latency: 7µs
- Switching bandwidth: 800 Mbps
- MAC addresses: 4096
- MAC address table size: 32kbytes
- Priority queues: 4
- Frame buffer memory: 2 Mbit
- Simultaneous VLANs: 255
- VLAN ID range: 1 to 4096
- IGMP multicast groups: 256
- Port rate limiting: 128kbps, 256, 512, 4, 8Mbps
- 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
- HTTP graphical web-based, SSL (128-bit encryption)
- SNMP v1, v2c, v3 (64-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

IRIG-B Ports
- Input Impedance: greater than 1MΩ
- Output Impedance: 50Ω

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
- Hazardous Locations: Class 1 Division 2

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

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
- RFC2068-RTSP
- 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-SNTpv2-MIB
- RFC2012-TCP-MIB
- RFC2013-UDP-MIB
- RFC2578-SNMPv2-SMI
- RFC2579-SNMPv2-TC
- RFC2819-RMON-MIB
- RFC2863-IF-MIB
- RFC3190-BRIDGE-MIB
- RFC3414-IF-MIB
- RFC3415-IF-MIB
- RFC3416-IF-MIB
- draft-ietf-bridge-rstpmib-03-00
- draft-ietf-bridge-rstpmib-03-01
- IANAIfType-MIB

IRIG-B Ports
- Input Impedance: greater than 1MΩ
- Output Impedance: 50Ω
Fiber Specifications and Dimension Drawings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fiber Port Type</th>
<th>10BaseFL</th>
<th>100BaseFX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Multimode</td>
<td>Multimode</td>
<td>Singlemode</td>
</tr>
<tr>
<td>Connectors</td>
<td>ST</td>
<td>MTRJ, ST, SC, LC</td>
<td>LC, SC, ST</td>
</tr>
<tr>
<td>Typical dist. (km)</td>
<td>2</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Optical wavelength (nm)</td>
<td>820</td>
<td>1310</td>
<td>1310</td>
</tr>
<tr>
<td>Cable size core/cladding (um)</td>
<td>50/125 or 62./125</td>
<td>50/125 or 62./125</td>
<td>8/125 or 9/125</td>
</tr>
<tr>
<td>TX power (dBm)</td>
<td>-34.4</td>
<td>-15.7</td>
<td>-15.5</td>
</tr>
<tr>
<td>RX sensitivity (dBm)</td>
<td>-8.2</td>
<td>-33.5</td>
<td>-32</td>
</tr>
<tr>
<td>Typical budget (dB)</td>
<td>22</td>
<td>17</td>
<td>16.5</td>
</tr>
</tbody>
</table>

Longer segment lengths dependent on fiber specifications. Consult factory for further details.

Overall dimensions

All dimensions are in millimeters, unless otherwise stated.
Rack mount dimensions

All dimensions are in millimeters, unless otherwise stated.
Dimension Drawings

Panel and DIN rail mount dimensions

All dimensions are in millimeters, unless otherwise stated.
Order Code

<table>
<thead>
<tr>
<th>Slot 1</th>
<th>Slot 3</th>
<th>Slot 5</th>
<th>RS416</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot 2</td>
<td>Slot 4</td>
<td>Slot 6</td>
<td></td>
</tr>
</tbody>
</table>

**PM1: Power Module 1**
- 1 = 24VDC (12-36VDC)
- 2 = 48VDC (36-59VDC)
- 3 = 85-264VDC or 88-300VDC
- 4 = 24VDC (10-36VDC), pluggable terminal block
- 5 = 48VDC (36-59VDC), pluggable terminal block
- 6 = 88-300VDC or 85-264VAC, pluggable terminal block

**PM2: Power Module 2**
- 0 = no power supply
- 1 = 24VDC (12-36VDC)
- 2 = 48VDC (36-59VDC)
- 3 = 85-264VAC or 88-300VDC
- 4 = 24VDC (10-36VDC), pluggable terminal block
- 5 = 48VDC (36-59VDC), pluggable terminal block
- 6 = 88-300VDC or 85-264VAC, pluggable terminal block

**Mount: Mounting Options**
- A = No mounting hardware
- D = 19" rack mount kit
- E = DIN and panel mount kit
- F = 19" rack, DIN and panel mount kit

**Main: Ethernet and Power Connectors**
- B = Ethernet on rear; LED panel on front; power connector on rear
- C = Ethernet on front; LED panel on front; power connector on rear
- D = Ethernet on rear; LED panel on top; power connector on rear
- E = Ethernet on front; LED panel on top; power connector on rear

**MOD: Manufacturing Modifications**
- 0 = None
- 1 = Conformal coating

**S1: Port**
- 01 = 4 x RS232/RS422/RS485 via DB9
- 02 = 4 x RS232/RS422/RS485 via RJ45
- 03 = 4 x Fiber Serial Interface (ST Connector)
- 04 = 4 x RS232/RS422/RS485 & IRIG-B via DB9
- 05 = 4 x RS232/RS422/RS485 & IRIG-B via RJ45

**S2, S3, S4: Serial Port Modules for slots 2,3,4**
- 00 = none
- 01 = 4 x RS232/RS422/RS485 via DB9
- 02 = 4 x RS232/RS422/RS485 via RJ45
- 03 = 4 x Fiber Serial Interface (ST Connector)
- 04 = 4 x RS232/RS422/RS485 & IRIG-B via DB9
- 05 = 4 x RS232/RS422/RS485 & IRIG-B via RJ45

**S5, S6: Ethernet Modules for Slots 5 and 6**
- 00 = None (S6 only)
- 01 = 2 x 10/100T x RJ45
- 02 = 2 x 10FL – Multimode, 850 nm, ST
- 03 = 2 x 100FX – Multimode, 1300nm, ST
- 04 = 2 x 100FX – Multimode, 1300nm, SC
- 05 = 2 x 100FX – Multimode, 1300nm, LC
- 06 = 2 x 100FX – Multimode, 1300nm, MTRJ
- 07 = 2 x 100FX – Singlemode, 1300nm, ST, 20km
- 08 = 2 x 100FX – Singlemode, 1300nm, SC, 20km
- 09 = 2 x 100FX – Singlemode, 1300nm, LC, 20km
- 10 = 2 x 100FX – Singlemode, 1300nm, SC, 50km
- 11 = 2 x 100FX – Singlemode, 1300nm, LC, 50km
- 12 = 2 x 100FX – Singlemode, 1300nm, SC, 90km
- 13 = 2 x 100FX – Singlemode, 1300nm, LC, 90km
- 14 = 1 x IRIG-B in, BNC, 1 x IRIG-B out, BNC (S5 only)

1 When IR or ID are ordered the IRIG module must be ordered for slot 5.
2 IEEE 1588 Hardware Assist and Internal clock capable units are only available on units sold with the IRIG module.
3 PS1 and PS2 must be both either pluggable or screw terminal block.
Example Order Codes

6GK6041-6AT22-3E1-Z A03+B00+C00+D00+E01+F00
Power Module 1 48VDC (36-59VDC), Power Module 2 87-264VAC or 88-300VDC, DIN and panel mount kit, Ethernet on front; LED panel on top; power connector on rear, Conformal Coating, S1: 4 x Fiber Serial Interface (ST Connector), S2: none, S3: none, S4: none, S5: 2 x 10/100T x RJ45, S6: none

6GK6041-6AT23-1FD1-Z A01+B03+C02+D01+E02+F02
Power Module 1 87-264VAC or 88-300VDC, Power Module 2 24VDC (10-36VDC), 19” Rack, DIN, and panel mount kit, Ethernet on rear; LED panel on top; power connector on rear, Conformal Coating, S1: 4 x RS232/RS422/RS485 via DB9, S2: 4 x Fiber Serial Interface (ST Connector), S3: 4 x RS232/RS422/RS485 via RJ45, S4: 4 x RS232/RS422/RS485 via DB9, S5: 2 x 10FL – Multimode, 850nm, ST, S6: 2 x 10FL – Multimode, 850nm, ST

Accessories/Options

6GK6000-8MQ00-0AA0 – Cable support bracket (one)

6GK6000-8BA00-0AA0 – Power cable (North America three prong connector -> beau)
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