

# ICON<sup>®</sup>

## INTEGRATED COMMUNICATIONS OPTICAL NETWORK







**DEPENDABLE  
COMMUNICATIONS  
FOR CRITICAL  
INFRASTRUCTURE**





Dependable communications are essential for the safe and reliable operation of critical infrastructure. A dependable system requires network resiliency, comprehensive management, robust security, and the flexibility to support your future communications needs.

That's why SEL designed the ICON Integrated Communications Optical Network—a wide-area networking multiplexer optimized for industrial and utility applications. This unique device blends each of those requirements into one rugged platform, ensuring that you can maximize performance and minimize cost and upgrades.

The ICON takes a new approach to solving voice and data communications network design. By combining time-division multiplexing (TDM) and Ethernet with a comprehensive range of data interfaces, the ICON makes it easy to migrate from legacy systems and meet the evolving needs of utility communications. At the same time, SEL-5051 Network Management System (NMS) Software simplifies the challenges of provisioning and maintaining your network.

With the ICON, maintaining a reliable and flexible communications infrastructure has never been so easy. Whether it's for substation automation, security surveillance, or monitoring and protecting critical equipment, the ICON is designed and built to address demanding communications needs and operate reliably in extreme environments.



The ICON comes in two available form-factors, the standard 19-inch rack mount chassis and the half-width cube chassis.

# SECURE YOUR COMMUNICATIONS

Network security is important, and keeping your system safe from malicious attacks should not be left to chance. By combining features like automatic report generation, user access control, and advanced line encryption, the ICON helps you maintain secure communications across your entire network.

## SECURE INTERNODE LINKS

Eliminate man-in-the-middle attacks by using the optional SEL-8029 Crypto Module on line ports. The Crypto Module provides 2.5 Gbps line rate AES-256 encryption with less than 1 microsecond latency.

## SECURITY AND CRITICAL INFRASTRUCTURE PROTECTION

Protect critical infrastructure and help achieve NERC CIP compliance with SEL-5051 NMS Software, which provides the following tools:

- Password management
- Session authentication and encryption
- Automatic security report generation of all changes made to system settings, firmware, and hardware, including the physical removal of modules and attempts to access disabled Ethernet ports
- Optional AES-256 encryption

# MAINTAIN A DEPENDABLE NETWORK

When communication is critical, your network must continue to operate as expected. That's why the ICON was designed to withstand harsh environments while exceeding industry standards for substation communications equipment. With features like real-time latency monitoring, redundant line ports and power supplies, and fast network healing, the ICON maintains vital communications even when things go wrong.

## REAL-TIME LATENCY MONITORING

Measure and report data latency of every time-division multiplexing (TDM) channel to ensure critical teleprotection traffic is always transported within set performance limits.

## NETWORK RESILIENCY

Maintain critical services by restoring traffic within 5 milliseconds in the event of a fiber failure. The ICON supports single or multiple ring topologies with single or dual interconnection ties between rings. Point-to-point and linear configurations are also supported.

## RUGGED AND RELIABLE

Designed to operate in harsh environments, the ICON withstands vibration, electrical surges, electrostatic discharge, fast transients, and extreme temperatures. It meets or exceeds IEEE 1613 standards for communications networking devices in electric power substations. Hot-swappable modules and redundant line and power modules ensure communications are maintained in all situations. In the unlikely event of a hardware failure, the ICON comes backed by a ten-year, no-questions-asked warranty—the best in the industry and proof of the confidence we have in our product quality and durability.

## PRECISE TIME DISTRIBUTION

Distribute time over a wide-area network with better than 1 microsecond accuracy, even in the event of a GPS failure. Each ICON node comes with an integrated GPS receiver as standard, allowing multiple nodes to be used for network timing. With multiple time references, the ICON network is resilient from a localized GPS outage or equipment failure, such as antenna damage due to a lightning strike.

## SOLUTION DELIVERY CENTER

Ensure that your ICON network will operate as expected before transferring it to the field. The SEL Solution Delivery Center in Pullman, Washington, provides a unique approach to solving the challenge of commissioning large, complex communications networks. At this purpose-built facility, customers can perform factory acceptance testing on their complete ICON network. This eliminates any guesswork during commissioning by allowing the customer to inspect the entire network in one room and request changes before the components are shipped to separate field locations. SEL engineers are also on-hand to provide support.

# GET THE BEST OF BOTH WORLDS

There is a trend to migrate applications to Ethernet to take advantage of the flexibility and ubiquity of the technology. Teleprotection, however, is a class of applications that requires low-latency deterministic communication, which is very difficult to achieve with Ethernet. To solve this problem, the ICON was designed to concurrently support TDM and Ethernet to provide an optimal solution for all applications. This means operators can choose the best network for any situation, without needing to compromise.

## TDM AND ETHERNET

With the ICON, operators can map traffic to TDM or Ethernet streams to choose the best transport solution for each application. You can apply TDM for time-critical applications that require low-latency, deterministic communications. Or, you can apply Ethernet for services that require the flexibility of Internet Protocol (IP)-based point-to-multipoint communications. The ICON's ability to give operators the choice between TDM and Ethernet supports better network traffic management and customization for a wide range of applications.

### TDM Features:

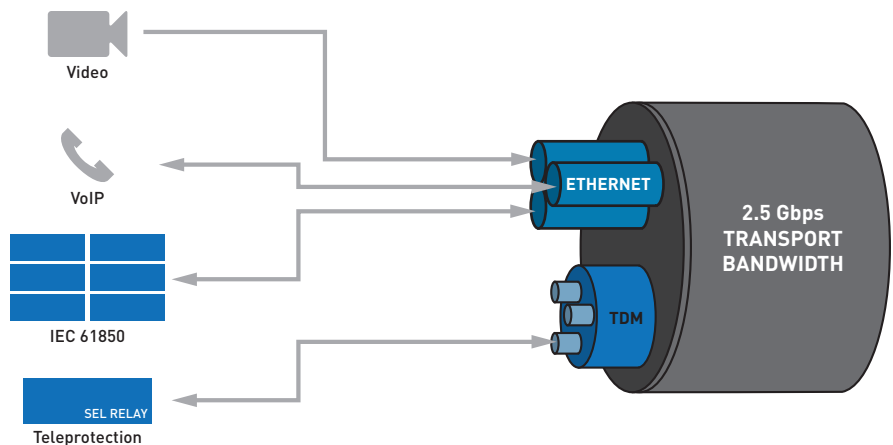
- Small form-factor pluggable (SFP) 155 Mbps, 622 Mbps, and 2.5 Gbps optical transceivers with a reach of up to 160 km
- Optional line port encryption
- Unidirectional path switch ring with <5 ms switching time
- Grooming and internal cross connect of DS0 traffic
- Optical transmit and receive level monitors
- Laser transmit current monitor
- Built-in test capabilities

### Ethernet Features:

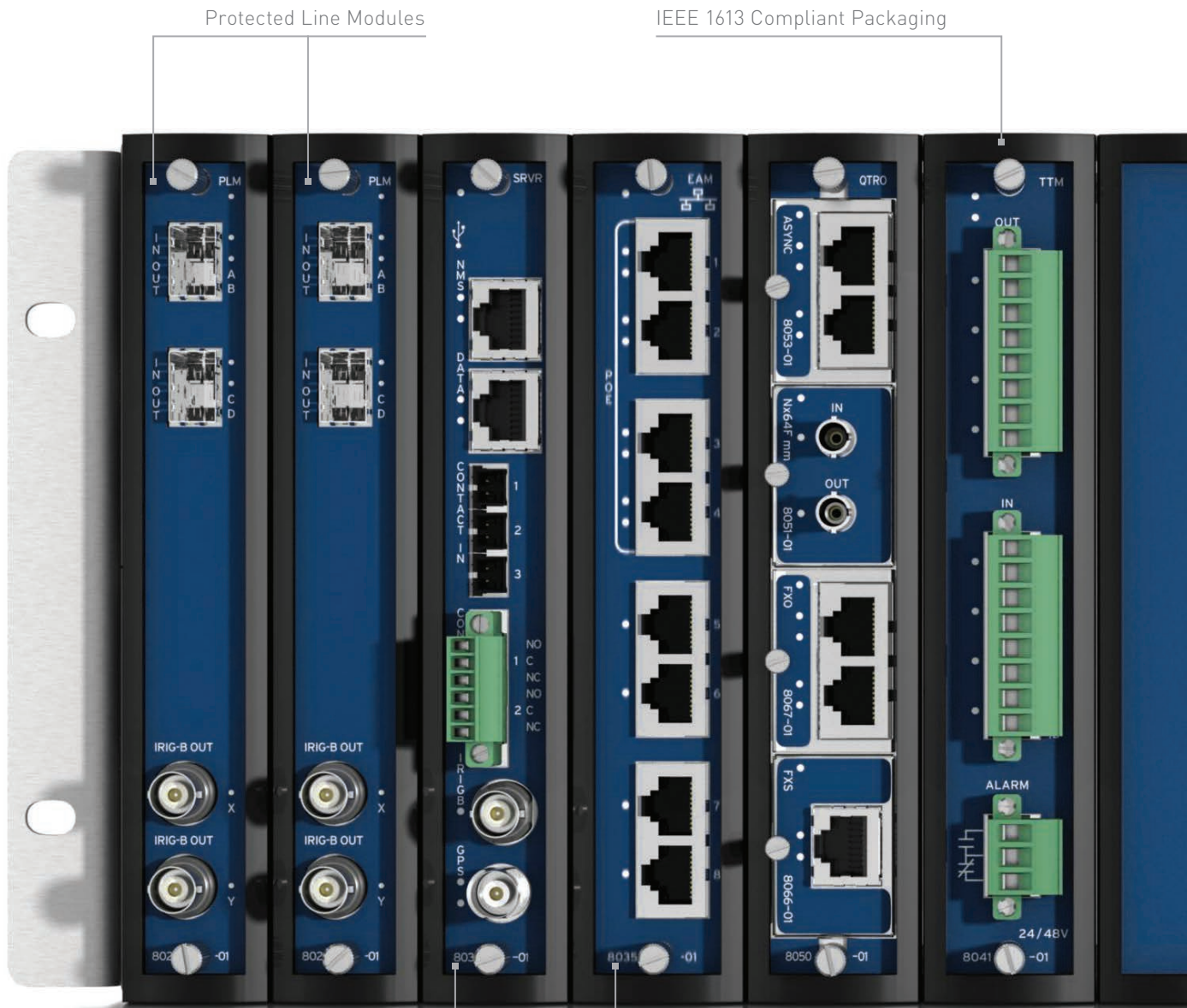
- 10/100BASE-T
- 1000BASE-FX
- Power over Ethernet (PoE)
- MAC table learn, lock, and aging
- IEEE 802.1Q virtual local-area networks (VLANs)
- Port-based VLANs
- Manage latency with eight priority queues per port
- Ports disabled by default
- Port mirroring

## APPLICATION TRAFFIC ISOLATION

The ICON is able to segregate different traffic types using TDM or Ethernet pipes (Epipes). You can dedicate isolated bandwidth to specific services, which will prevent high-bandwidth Ethernet applications from consuming all the available resources and reducing network throughput for other services. The Ethernet interfaces support IEEE 802.1Q and port-based VLANs.



# PRODUCT OVERVIEW





Dual Redundant Power Supplies



# CUSTOMIZE YOUR SYSTEM

**WITH MULTIPLE MODULE OPTIONS, THE ICON ALLOWS YOU TO SUPPORT A WIDE RANGE OF TIME-SENSITIVE, DATA-INTENSE, AND LOW-BANDWIDTH APPLICATIONS IN ONE DEVICE.**

## Line Module

The Line Module provides the TDM and Ethernet transport interface between adjacent nodes. It contains an integrated switch capable of supporting two 1000 Mbps SFP ports and eight 10/100 Mbps Ethernet copper ports for local Ethernet traffic. Two IRIG-B output ports provide time distribution to connected IEDs.

## Protected Line Module (PLM)

The PLM provides a redundant TDM line interface to ensure communications are maintained in the event of a module failure. Users have the option to install two PLMs in place of the single line module.

## Server Module

The Server Module provides the interface between the ICON and the SEL-5051 NMS Software or third-party SNMP manager. The Server Module also contains a GPS satellite receiver for network timing and for providing the real-time clock for time distribution to connected IEDs.

## Access Modules

Quattro Module—provides the interface for as many as four Access Submodules.

Ethernet Access Module—provides eight 10/100 Mbps Ethernet ports with PoE.

Transfer Trip Module—provides four contact inputs and four high-speed hybrid contact outputs for direct transfer trip (DTT), all permissive transfer trip applications (POTT, PUTT), and directional comparison blocking and unblocking schemes (DCB, DCUB).

Crypto Module—provides low-latency AES-256 encryption of the line ports between adjacent ICON nodes and is capable of securing two 2.5 Gbps line channels simultaneously.

## Access Submodules—Data

Nx64F—provides IEEE C37.94 teleprotection.

Async—enables EIA-232, EIA-422, and EIA-485 communications.

DS1 Async—provides an asynchronous DS1/T1 interface.

DS1 Sync—provides a synchronous DS1/T1 interface.

## Access Submodules—Voice

4-Wire Voice Frequency (VF)—provides analog modem communications.

2-Wire FXS and FXO—offer analog voice communications for telephone and PBX circuit transport.

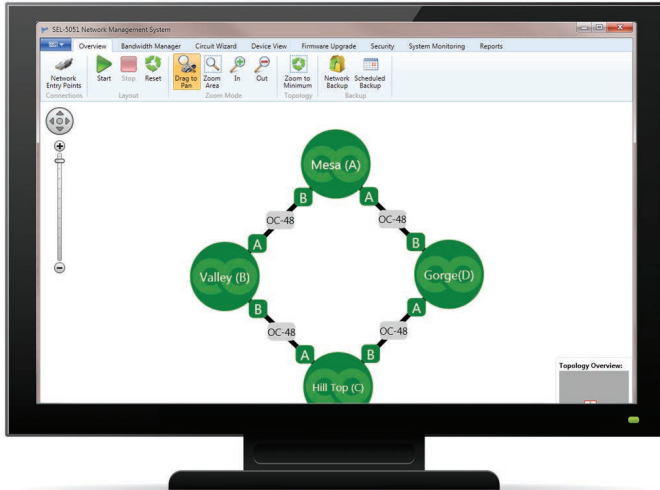


**ONE DEVICE THAT  
MEETS ALL YOUR  
COMMUNICATIONS  
NEEDS**



# MANAGE YOUR NETWORK

Whether your network is large or small, keeping it running smoothly can be a challenge. The ICON simplifies this task with SEL-5051 NMS Software—an indispensable tool for maintaining a secure, reliable, and efficient communications infrastructure.



SEL-5051 Network Management System Software

## SEL-5051 NMS SOFTWARE

SEL-5051 Software offers the following features for the configuration and management of your ICON network:

### Graphical Network Representation

Provide network discovery and graphical display of a complete ICON network. Users can view the status of each ICON node and associated line links.

### Configuration Management

Provision Ethernet and TDM circuits. Manage firmware upgrades remotely, and schedule upgrades for specific times and dates.

### Event Management

Track administrator and shared user access, and monitor valid and invalid user logon attempts as well as session settings change logs.

### Alarm Management

View, sort, filter, and archive the time-stamped alarm history for each node on the network.

### Security Management

Automatically generate security reports for compliance with NERC CIP security logging.

### Performance Monitoring

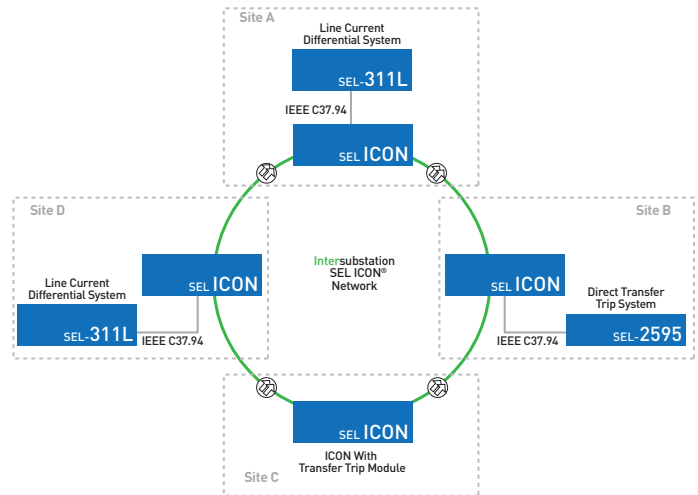
Monitor the performance of TDM and Ethernet communications using comprehensive network statistics.



# APPLICATIONS

## TRANSMISSION LINE PROTECTION

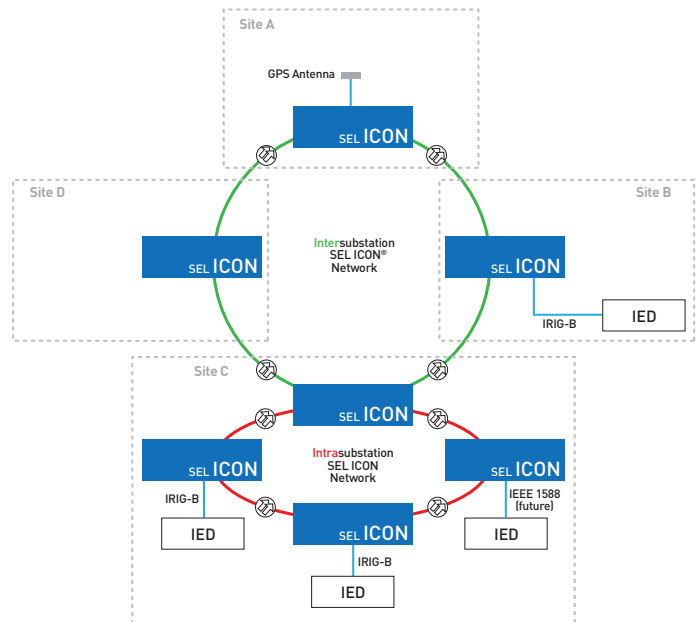
Implement current differential protection and direct transfer trip schemes with SEL relays. Communicate between relays with IEEE C37.94 circuits carried over an SEL ICON Integrated Communications Optical Network 2.5 Gbps fiber-optic link. Apply the ICON's Transfer Trip Module to sense or assert contact closures for pilot protection schemes. The ICON network monitors and reports channel latency in real time. Select the shortest path between terminals as the primary path. This ensures that the system always reverts back to your primary configuration in the event of a path failure and subsequent restoration. These features, combined with robust IEEE 1613 environmental operating specifications, make the ICON ideal for critical power applications.



Example of teleprotection of a transmission system.

## SYNCHROPHASOR COMMUNICATIONS

Inspect synchronized phasor measurements (synchrophasors) to provide a real-time measurement of electrical quantities across a power system. These time-synchronized measurements can be used for analysis and control of the power system. The ICON provides all necessary timing and Ethernet communications for synchrophasor information reporting. The ICON distributes time across the entire network and can maintain better than 1  $\mu$ s accuracy among all terminals in the network. This allows synchrophasor systems to continue to operate accurately even in the event of a local or system-wide GPS failure.

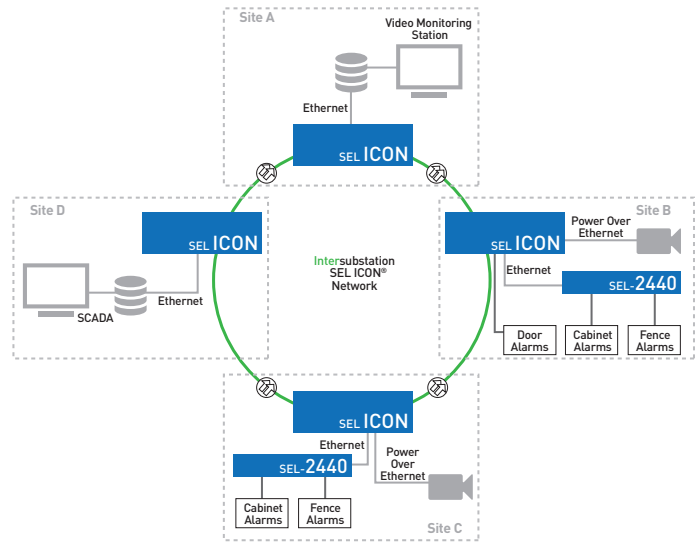


Example network time distribution application.



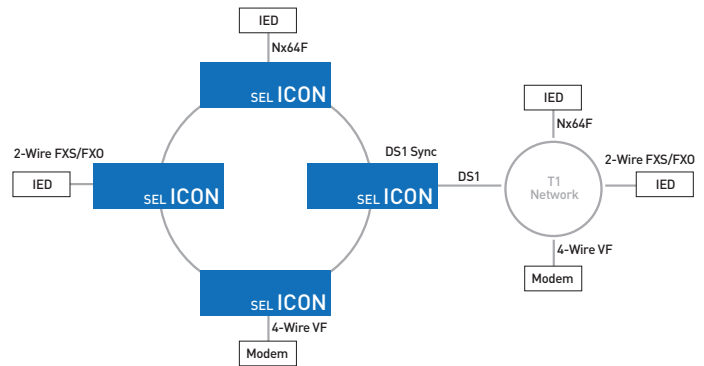
## SECURITY MONITORING

Use the ICON to build substation security applications. Fence, motion, panel, and door sensors can connect to the SEL-2440 DPAC Discrete Programmable Automation Controller digital inputs, and strobes, sirens, and substation lighting connect to the control outputs. The ICON network can then communicate information back to a SCADA master. The ICON Ethernet ports support Power over Ethernet (PoE), which allows devices (such as video cameras).



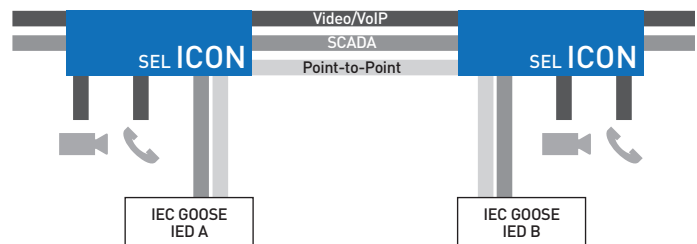
## LEGACY COMMUNICATIONS AGGREGATION

Consolidate legacy DS1 and DS0 circuits between locations onto the ICON WAN to eliminate redundant circuit lease and maintenance costs. Apply the ICON FXS/FXO modules to establish analog telephone, PBX, fax, and modem circuits in every location. Accept channelized DS1 circuits from any source, and groom the individual DS0 circuits to terminate anywhere within the network.



## IEC 61850 NETWORK OPTIMIZATION

Ensure optimal performance of IEC 61850 based systems by supporting virtual local-area networks (VLANs) and Ethernet Pipes (Epipes). Epipes can contain and isolate Layer 2 broadcast commands, such as IEC 61850 Generic Object-Oriented Substation Event (GOOSE) messages, from all other noncritical traffic on the network, ensuring very low latency data communications paths between intelligent electronic devices (IEDs).



## SPECIFICATIONS

<b>Line Modules</b>	<b>8020-01 Line Module</b>	SFP ports A/B/C/D: 2.5 Gbps Ports E/F: GigE 10/100 Ethernet ports: 8 RJ45 with 4 PoE IRIG-B out: 2 BNC
	<b>8021-01 Protected Line Module</b>	SFP ports A/B: 155 Mbps, 622 Mbps, or 2.5 Gbps IRIG-B out: 2 BNC
<b>Server Module</b>	<b>8030-01 Server Module</b>	NMS ports: USB, RJ45 GPS antenna: TNC IRIG-B in: BNC
<b>Power Modules</b>	<b>19-Inch Rack Mount Chassis</b>	
	8011-01 HV AC/DC 120–240 V, IEC C6 Line Cord	Supply voltage: 102–264 Vac, 50/60 Hz or 88–300 Vdc
	8011-02 HV AC/DC 120–240 V, Terminal Block	Supply voltage: 102–264 Vac, 50/60 Hz or 88–300 Vdc
	8011-03 MV DC 24–48 V, Terminal Block	Supply voltage: 18–56 Vdc
	<b>Half-Width Cube Chassis</b>	
	8010-01 HV AC/DC 120–240 V, IEC C6 Line Cord	Supply voltage: 102–264 Vac, 50/60 Hz or 88–300 Vdc
	8010-02 HV AC/DC 120–240 V, Terminal Block	Supply voltage: 102–264 Vac, 50/60 Hz or 88–300 Vdc
<b>Access Modules</b>	<b>8035-01 Ethernet Access Module</b>	10/100 Ethernet ports: 8 RJ45 with 4 PoE
	<b>8051-01 Data Nx64F Multimode Submodule</b>	ST ports: 1 Rx, 1 Tx Standard: IEEE C37.94
	<b>8053-01 Data Async Submodule</b>	Ports: 2 RJ45 Standards: EIA-232, EIA-422, EIA-485
	<b>8065-01 4-Wire VF Submodule</b>	Ports: 2 RJ45
	<b>8066-01 2-Wire FXS Submodule</b>	Port: 1 RJ11
	<b>8067-01 2-Wire FXO Submodule</b>	Ports: 2 RJ11
	<b>8041-01, -04 Transfer Trip Module</b>	Commands: 4
	<b>8057-01 DS1 Async Submodule</b>	Ports: 4 RJ48C
	<b>8057-02 DS1 Sync Submodule</b>	Ports: 4 RJ48C
<b>Other</b>	<b>8029-01 Crypto Module</b>	Ports: 4 SFP
<b>System Specifications</b>	<b>Network Topologies</b>	Point-to-point, linear, and multiple rings with single or dual interconnected nodes
	<b>Path Switching Time</b>	<5 ms
	<b>Convection-Cooled</b>	No fans
	<b>Operating Temperature</b>	–20° to +65°C (–4° to +149°F)
	<b>Mounting</b>	8", 19", or 23" rack or panel mount
<b>Certifications</b>	IEEE 1613, IEC 60068, IEC 60255, IEC 61000	



**MAKING ELECTRIC POWER SAFER,  
MORE RELIABLE, AND MORE ECONOMICAL**

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