Reason S20

Industrial Managed Ethernet Switch

GE´s Reason S20 managed Ethernet switch range is designed for harsh environments, such as power systems and industry applications, providing all elements needed in an IEC 61850 digital substation network, including IEEE 1588v2 Precision Time Protocol (PTP). Using Reason S20, packet switching between network devices is flexible, reliable and robust, even in situations where layer 3 routing is necessary.

The Reason S2020 is the most cost-effective choice, offering a high density of Ethernet ports in a 1U form factor for easy rack mounting. This model supports up to 5 modules with 4 ports each and allows configurations with up to 20 fast Ethernet ports (100 Mbps), or up to 4 gigabit ports plus 16 fast Ethernet ports.

The Reason S2024 is the premium model, offering full gigabit Ethernet switch functionality. This model supports up to 24 ports, provided by 6 interface modules with 4 ports each. The 1U mechanical design is identical to the S2020 model.

In both S2020 and S2024 models, layer 3 functions and IEEE 1588v2 PTP protocol are available through licensing.

Key Benefits

- Layer 2 and 3 Managed Ethernet Switch
- Media Access Control (MAC) bridges and Spanning Tree Protocol as standardized by the IEEE 802.1D
- IP Routing functionalities: Static, Routing Information Protocol (RIP) and Open Shortest Path First (OSPF)
- Virtual Router Redundancy Protocol (VRRP) to eliminate a single point of failure in static routed environments
- Fully flexible Ethernet switch for industrial applications, including PRP redundant networks
- Ready for IEC 61850 networks (tests performed by KEMA)
- IP Multicast filtering (IPMC) for phasor measurement (PMU) applications
- UltraRSTP (Rapid Spanning Tree Protocol - IEEE 802.1W) with fault recovery time less than 5 ms per hop, meeting IEC 61850-90-4 specifications
- Bridge Protocol Data Unit (BPDU) guard and filtering to prevent external interference in Spanning Tree networks
- Full cyber security features that help customers to comply with North American Electric Reliability Council (NERC) requirements
- Support for IPv4 and IPv6 protocols (Multicast, Unicast and Broadcast operation)
- Support to Simple Network Management Protocol (SNMP) v1, v2c and v3
- Operate as NTP server, using as time source IEEE 1588v2, NTP or manual configuration
- Alarm contacts for detection of critical events
- Standard USB 2.0 configuration port

Managed Networks

- Logical network segregation via Virtual LAN (VLAN)
- Traffic prioritization using Quality of Service (QoS)
- Spanning Tree Protocols (STP, rapid STP and Multiple STP) for ring topologies
- IP Routing
- Port Mirroring
- IEEE 1588v2 Transparent or Boundary clock with hardware-based time stamping in all ports

Security

- Support RADIUS and TACACS+ for remote Authentication, Authorization and Accounting (AAA) technology
- Role Based Access Control (RBAC) for local authentication of multiple users with SHA-256 encrypted password
- Secure interactive access using HTTPS and SSH
- Secure firmware update (digitally signed)
- USB port in front for local access
- Access Control List (ACL) to filter frame types and shut down port if necessary
- Several alarm functions available

Hardened

- Store-and-forward packet switching
- 68 Gbps switching capacity
- Up to 24 Gbps ports
- Natural fanless cooling
- Form C relay contact for alarming
- Redundant power supply option
- Comply with safety requirements of IEC60255-27 and UL 60950-1
- Power supply option full complaint with IEC61850-3 ed. 2 and IEEE 1613

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Cyber Security

The S20 cyber security enables the device to deliver full cyber security by default. This helps operators to comply with NERC CIP guidelines and regulations, by supporting core features such as:
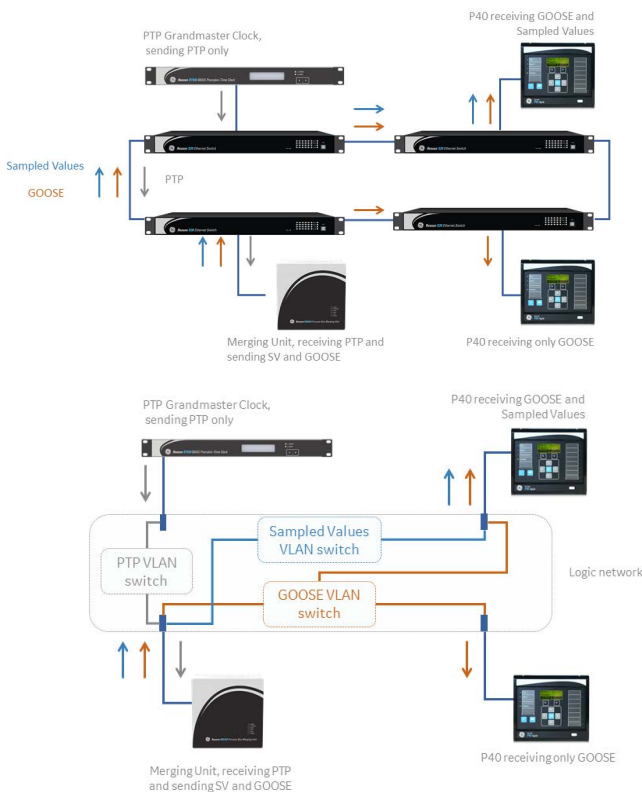
• Factory default password is different for each manufactured device

• User must change the password at first login

• Password complexity, requiring minimum 8 characters, upper/lower case, numeric and special characters

• Possibility of password expiration

• Unused Ethernet ports disabling option

• All remote access may be disabled, leaving the local USB port for interface

• AAA Server Support (Radius/TACACS+)

• Role Based Access Control (RBAC)

• Firmware digitally signed

• Syslog (local and external server possibility)

To ensure S20 has the full set of cyber security, firmware 06A02 or newer must be running.
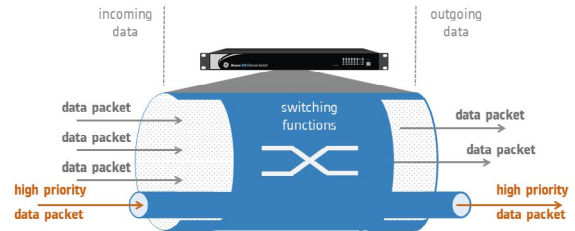
Virtual LAN (VLAN)

Traffic segregation is particularly important in modern Layer 2 network communication in order to make sure data transmission will flow as multicast communication, where each device receives the data it is supposed to received. If not properly configured, the data transmission will flow as broadcast, flooding the network and consequently the communication port from devices connected to the network.

In digital power system communication, 61850 networks have GOOSE, Sampled Values and Precision Time Protocol as multicast messages, and all of them can be mapped directly at Ethernet frame (Layer 2). Thus, each of these messages will flow separately.

PTP Grandmaster Clock, sending PTP only

P40 receiving GOOSE and Sampled Values

Sampled Values

GOOSE

PTP

Merging Unit, receiving PTP and sending SV and GOOSE

P40 receiving only GOOSE

PTP Grandmaster Clock, sending PTP only

P40 receiving GOOSE and Sampled Values

PTP VLAN switch

Sampled Values VLAN switch

GOOSE VLAN switch

Logic network

Merging Unit, receiving PTP and sending SV and GOOSE

P40 receiving only GOOSE

Quality of Service (QoS)

Quality of service function is used to guarantee traffic priority when LAN (or VLAN) network is congested. There are several ways to separate prioritized traffic from general purposes traffics, Reason S20 supports QoS function at the Class of Service (CoS) and DSCP bits, for layer 2 and layer 3 communication respectively. Considering the Ethernet port has reached its full bandwidth capacity, the QoS will ensure higher priority data bandwidth data will not be affected.

incoming data

outgoing data

data packet

data packet

data packet

switching functions

data packet

data packet

high priority data packet
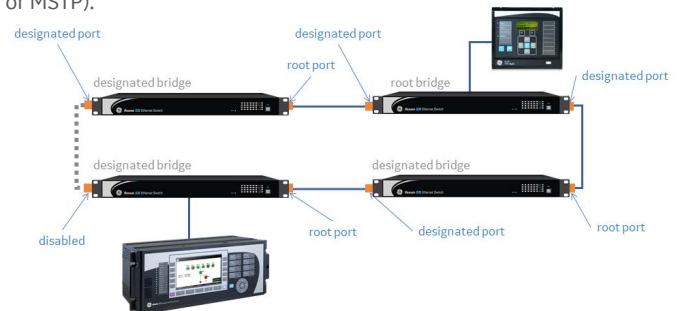
high priority data packet

Spanning Tree Protocol (STP, RSTP, MSTP)

Spanning Tree protocol is a mechanism created to solve the problems that arise when a loop is inserted into a LAN. Ethernet networks were not developed to work in loop topologies, but as redundant paths are generally required for most of network applications, several protocols have been developed to fulfill this need. The most common protocol to identify loops is the Spanning Tree Protocol, defined by IEEE 802.1D-2004. In addition, the IEC 61850-90-4 Technical Report specifies the Rapid Spanning Tree Protocol (RSTP) when looped topologies, such as ring topology, are required at the station level of substation networks.

path 1

path 2

The protocol works to create a logical topology that resembles a tree. The first step is to define where the root of the tree is, in the other words, which switch will act as root bridge. The root bridge will be the logical center of the topology and the remaining switches will be designated bridges. In this setup, the remaining ports from each Ethernet switch must be defined depending on the STP protocol version used (STP, RSTP or MSTP).

designated port

designated port

root port

designated bridge

root bridge

designated port

designated bridge

designated bridge

disabled

root port

designated port

root port

When using STP, only one path is available and transmits the network data. In the case of failure in any link between two Ethernet switches, the STP protocol recalculates the best path once again and after a short period of time the communication is reestablished. The time to recover the communication is also dependent on the STP protocol version.

UltraRSTP using Reason S20

With UltraRSTP, Reason S20 achieves fault recovery times with less than 5ms per hop, reducing packets loss while maintaining interoperability with others standard RSTP devices. Reason S20 supports UltraRSTP natively and as it is performed by hardware, no extra configuration other than the standard RSTP is needed.

As an example of UltraRSTP performance, consider a network of twenty Reason S20s (SW01 – SW20) in a ring topology, as the fault recovery time is better than 5ms/hop, a fault in the communication between any of the twenty switches should result in a recovery time lower than 100ms. To confirm UltraRSTP performance, such a scenario with twenty Reason S20 was assembled and tested. The results showed fault recovery time was 49 ms in the worst-case.

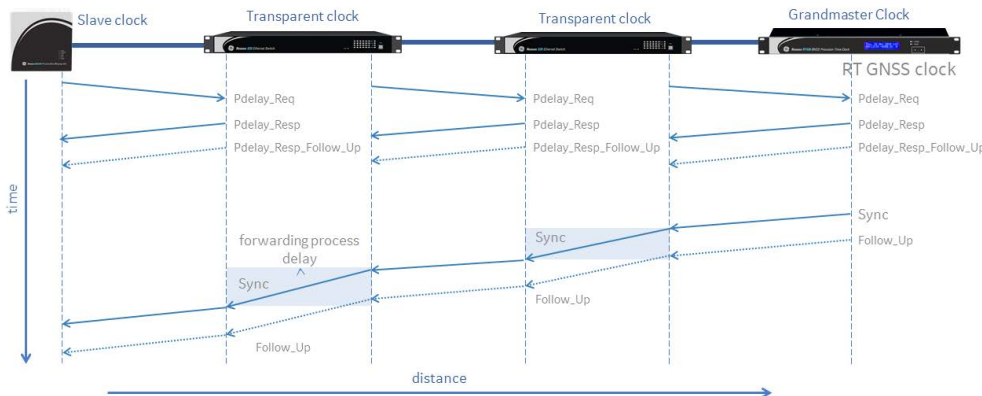## IP Multicast (IPMC) and Internet Group Management Protocol (IGMP) Snooping

Using multicast filters, a group of receivers in the LAN may be configured to receive the data from sender. Without multicast filtering, multicast messages are sent as broadcast messages.
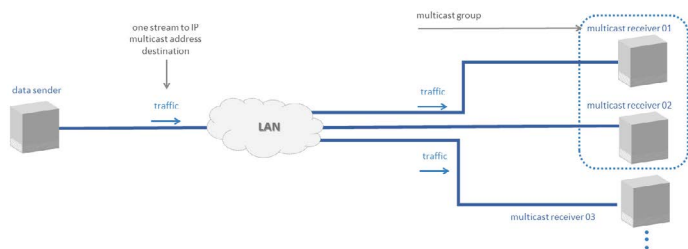
When it comes to power systems communication, IGMP protocol can be used when there is multicast communication between a Phasor Measurement Unit (PMU) and a Phasor Data Concentrator (PDC). With IGMP snooping, the receiver can send a "join group" to join an IP multicast group. To stop receiving data, the receiver sends a "leave group". Reason S20 has support to IGMPv1, IGMPv2 and IGMPv3 protocols.
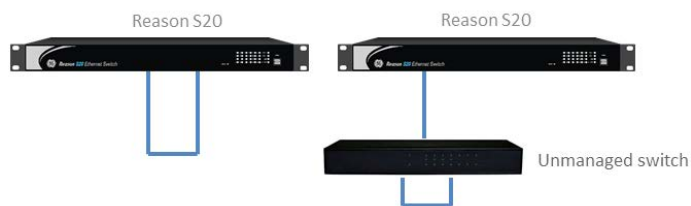
IP Routing

When S20 is operating as router, IP traffic is routed between all internal VLANs without any further configuration. S20 will recognize all IP address from VLANs and route the IP traffic internally when necessary. Static IP routing, RIP and OSPF are available on this mode and they can be used to route the traffic externally, to routers or gateways.

Loop Protection

The Loop Protection function is used to prevent loops between one port and another at the same switch, or at ports connected to unmanaged switches. For instance, unmanaged switches could drop spanning tree packets, thus interfering in its operation. To prevent problems caused by these situations, the Loop Protection function must be enabled at ports where a loop could happen.

Precision Time Protocol (PTP) - IEEE 1588v2

Precision Time Protocol (PTP) is defined in the IEEE 1588 standard, which describes the precision clock synchronization protocol for networked measurement and control systems. Reason S20 complies with IEEE1588v2, and can operate either as transparent clock or boundary clock to ensure time accuracy for PTP-aware IEDs in the network.

Link Aggregation Control Protocol (LACP)

Link Aggregation function is defined by the IEEE 802.3ad standard. The purpose of LACP is to increase the performance and the availability of network devices with more than one connection, making parallel links work as if they were a single high performance link. This function is also known as Port Trunking or Port Bundling. The main benefits of using link aggregation are increased communication capacity, load balance on links and increased communication availability.
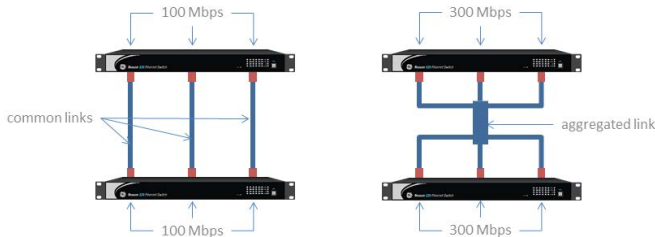
Port Mirroring

Port mirroring creates a copy of incoming and outgoing data from a specific port. The mirror port could be connected to a network analyzer, which would be useful for analysis and debugging data or network error diagnostics. Reason S20 has port-mirroring capabilities, which can be executed in the same switch or in different switches
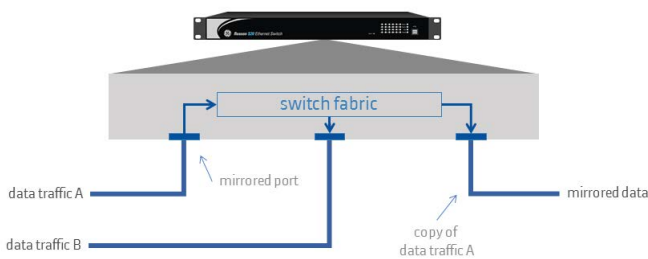
Monitoring GE´s Reason S20 with PulseNET

Monitoring and managing the health of your network is critical when designing, purchasing, and deploying equipment for your communications system. Ensuring you maximize your network´s return on assets is equally important.

Reason S20 is integrated with PulseNET Network Management Software (NMS), providing support to configuration management/backup, syslog server and numerous other GE Reason specific features.

### Optimize Devices

Increase system throughput and uptime. Improve the utilization of networked devices.

Drive Resource Efficiency

Notify and deploy maintenance resource with intelligent date. Quickly resolve equipment and radio issues.

Improving Network Performance

Access historical network data and equipment performance trends for predictive maintenance. Optimize switch availability.
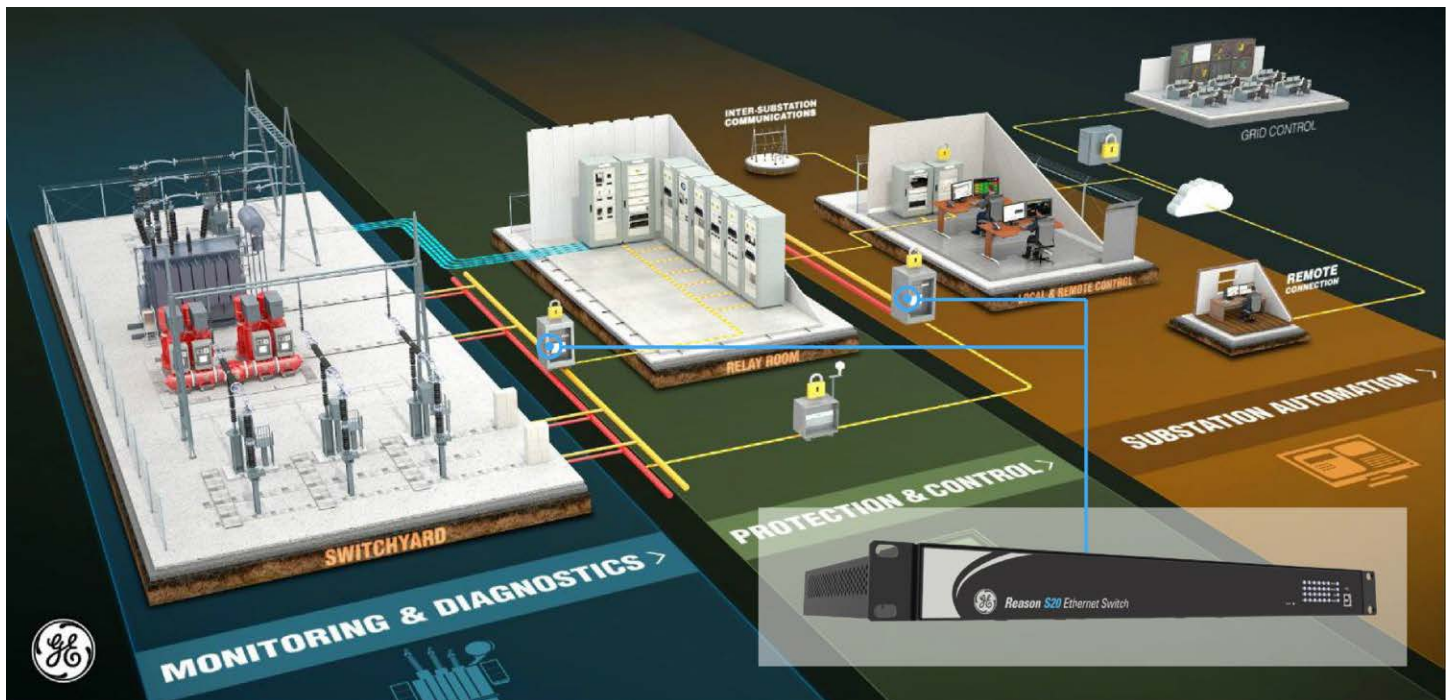
REASON S20 TECHNICAL SPECIFICATION

Switching Characteristics

Switching Capacity	68 Gbps
Switching Latency	3 μs
VLANs	up to 4095 numbers
MAC Table	up to 8192 entries (64 static)
Class of Service (CoS)	up to 8 levels

Ethernet Communication

Number	Up to 24 Gigabit ports (up to 6 interface modules with 4 Eth ports each)
Type	Each interface module (4 Eth ports) may be either: • Fixed RJ45: 10/100 Mbps or 10/100/1000 Mbps • SFP slots: blank, with fiber SFP transceivers (100Mbps or 1000 Mbps options) or with electrical RJ45 SFP transceivers (10/100/1000 Mbps)

USB Communication

Console port	1x USB Type B 2.0 in front of chassis

Failsafe alarm

Dry-contact relay	Form C (NO-C-NC)

Power Supply

High Voltage	125-250 VDC nominal, 88-300 VDC operational 110-240 VAC nominal, 88-264 VAC operational
Low Voltage	24/48 VDC nominal, 21-75 VDC operational

Time Synchronization

PTP IEEE 1588v2	Available in all ports when enabled Hardware-based time stamping Operation as transparent, boundary or slave clock
NTP Client	Possible to configure up to 5 external NTP servers
NTP Server (available in FW 07A03 or newer)	Can act as NTP server in all ports. Source time is based on either: • External NTP Server • IEEE 1588v2 (PTP) • Manually configured
Real Time Clock (RTC) (available in HW C)	When power-off, the real-time clock remains active for 2 days

Mechanical & Environment

Dimensions	19-inch rack mount (433 mm width w/o bracket) 1U in height (43.7 mm) 310 mm in depth
Weight	approx. 3.2 kg (w/o package)
Cooling system	Fanless
Operating Temperature	-40ºC to +55ºC (continuously) -40ºC to +85ºC (16 hours)
Humidity	5-95% relative humidity, non-condensing
Ingress Protection	IP20
Compliance	IEC 61850-3 Ed. 2 IEEE 1613 & IEEE 1613.1 IEC 60255-26:2013 RoHS 3

Networking IEEE, IEC and RFC Standards Supported

IEC 61850	Power Substation applications (tests performed by KEMA)
IEEE 1588 v2 PTP	IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
IEEE 802.3i	10BASE-T
IEEE 802.3u	100BASE-T(X)/100BASE-FX
IEEE 802.3ab	1000BASE-T(X)
IEEE 802.3z	1000BASE-SX/LX/ZX
IEEE 802.3x	Full duplex operation, flow control
IEEE 802.1D	Media Access Control (MAC) bridges
IEEE 802.1w	Rapid Spanning Tree Protocol (RSTP)
IEEE 802.1s	Multiple Spanning Tree Protocol (MSTP)
IEEE 802.1Q	VLAN (Virtual Local Area Networks)
IEEE 802.1p	Class of service
IEEE 802.1X	Port-based Network Access Control
IEEE 802.3ad	Link Aggregation Control Protocol (LACP)
RFC 4363	VLAN Management Information Base (MIB)
RFC 1058	Routing Information Protocol (RIP) version 1
RFC 2453	Routing Information Protocol (RIP) version 2
RFC 2328	Open Shortest Path First (OSPF) version 2
RFC 2338	Virtual Router Redundancy Protocol (VRRP)
RFC 2819	Remote Monitoring (RMON)
RFC 1213	MIB II
RFC 1215	Traps MIB
RFC 4188	Bridge MIB
RFC 4292	IP Forwarding Table MIB
RFC 4293	MIB for the Internet Protocol (IP)
RFC 5519	Multicast Group Membership Discovery MIB
RFC 4668	RADIUS Authentication Client MIB
RFC 4670	RADIUS Accounting MIB
RFC 3635	Ethernet-like MIB
RFC 2863	Interface Group MIB using SMI v2
RFC 3636	802.3 MAU MIB
RFC 4133	Entity MIB version 3
RFC 3411	SNMP Management Frameworks
RFC 3414	User-based Security Model for SNMPv3
RFC 3415	View-based Access Control Model for SNMP
RFC 5171	Unidirectional Link Detection (UDLD)
RFC 5905	Network Time Protocol (NTP) Synchronization
RFC 5424	Syslog Messages
RFC 5426	Log Messages through UDP protocol
RFC 1157	SNMP Protocol
RFC 3418	SNMP MIB
RFC 3584	SNMP v1, v2c, v3
RFC 4604	IGMPv3 &Multicast Listener Discovery (MLD) v2 Snooping
RFC 3260	Differentiated Services Code Point (DSCP)
RFC 6040	Explicit Congestion Notification (ECN)

S20 Ordering

Model Type	S20	*	*	*	P	*	*	*	*	*	*	*	*	07	*	S20 Industrial Managed Ethernet Switch
Number of Ports		20														Up to 20 ports (4x Gigabit)
		24														Up to 24 Gigabit ports
Power Supply 1			1													24-48 Vdc
			3													125-250 Vdc / 110-240 Vac
Power Supply 2				1												24-48 Vdc
				3												125-250 Vdc / 110-240 Vac
				X												Not installed
Mounting Options					P											19" Rack Mount / Rear Mount
Software Functionality (Licensing)						2										Standard Layer 2 packet switching (MAC Based)
						3										Advanced Layer 2 and Layer 3 packet switching (MAC Based and IP Based)
PTP Support (Licensing)							P									With PTP (IEEE 1588v2) support
							X									Without PTP (IEEE 1588v2) support
Interface Module 1								A								Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports
								B								Four slots for SFP transceivers (up to 1 Gbps)
								C								Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km
								D								Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km
								E								Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km
								F								Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km
								H								Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
								I								Four RJ45 copper 10/100BASE-TX
								J								Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T 10/100BASE-TX/1000BASE-T
								K								Two 1 Gbps RJ45 SFP transceivers 10/100BASE-TX/1000BASE-T Ethernet ports + Two 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km
								L								Two 1 Gbps RJ45 SFP transceivers 10/100BASE-TX/1000BASE-T Ethernet ports + Two 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
								M								Two 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km + Two 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
Interface Module 2									A							Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports*
									B							Four slots for SFP transceivers (Up to 1 Gbps in the 24 ports model / Up to 100 Mbps in the 20 ports model)
									C							Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km*
									D							Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km*
									E							Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km*
									F							Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km*
									H							Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
									I							Four RJ45 copper 10/100BASE-TX
									J							Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T *
									X							Not installed
Interface Module 3										A						Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports*
										B						Four slots for SFP transceivers (Up to 1 Gbps in the 24 ports model / Up to 100 Mbps in the 20 ports model)
										C						Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km*
										D						Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km*
										E						Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km*
										F						Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km*
										H						Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
										I						Four RJ45 copper 10/100BASE-TX
										J						Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T *
										X						Not installed
Interface Module 4											A					Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports*

Order code continues below

					Description
	B				Four slots for SFP transceivers (Up to 1 Gbps in the 24 ports model / Up to 100 Mbps in the 20 ports model)
	C				Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km*
	D				Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km*
	E				Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km*
	F				Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km*
	H				Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
	I				Four RJ45 copper 10/100BASE-TX
	J				Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T *
	X				Not installed
Interface Module 5		A			Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports*
		B			Four slots for SFP transceivers (Up to 1 Gbps in the 24 ports model / Up to 100 Mbps in the 20 ports model)
		C			Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km*
		D			Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km*
		E			Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km*
		F			Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km*
		H			Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
		I			Four RJ45 copper 10/100BASE-TX
		J			Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T *
		X			Not installed
Interface Module 6 (Only available in the 24 ports model)			A		Four 1 Gbps RJ45 copper 10/100BASE-TX/1000BASE-T Ethernet ports*
			B		Four slots for SFP transceivers (Up to 1 Gbps in the 24 ports model / Up to 100 Mbps in the 20 ports model)
			C		Four 1 Gbps LC-type SFP transceivers multi mode fiber 1000BASE-SX Ethernet for up to 0.5 km*
			D		Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-LX Ethernet for up to 20 km*
			E		Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 40 km*
			F		Four 1 Gbps LC-type SFP transceivers single mode fiber 1000BASE-ZX Ethernet for up to 80 km*
			H		Four 100 Mbps LC-type SFP transceivers multi mode fiber 100BASE-FX Ethernet for up to 2 km
			I		Four RJ45 copper 10/100BASE-TX
			J		Four 1 Gbps RJ45 SFP transceivers Ethernet 10/100BASE-TX/1000BASE-T *
			X		Not installed
Firmware Version				07	Firmware release number 07
Hardware Design Suffix				B	Hardware B version
				C	Hardware C version

* Only available in the 24 ports model

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