

JPAX-H

High Capacity Optical Multi-Technology Solution

JPAX-H is a FANLESS device supporting both MPLS-TP (Multi-protocol Label Switching) and Carrier Ethernet (EPL, EVPL, EPLAN, EVC defined in MEF) for packet transportation. In addition to native Ethernet transport, JPAX-H can be used as a gateway for legacy PDH and SDH/SONET networks to enter Packet Switched Networks maintaining deterministic performance, service integrity, ease of integration and at the same time increasing efficiency.

To minimize latencies, TDM data encapsulation into MPLS and asymmetric delays for teleprotection services, the JPAX-H platform implements an innovative Hybrid+ technology that allows for optionally carrying TDM services over the SONET/SDH transport layer established alongside the MPLS-TP transport layer (without impacting its capacity) over the same fiber ensuring sub-ms latency time for critical applications. This innovative transport concept offers the best of both worlds by preserving SONET/SDH performance in a packet-switched network without a need for additional fibers or advanced traffic engineering.

JPAX-H has core switching bandwidth of 400Gbps capable to transport 100GE, 40GE, 10GE and 1GE along with additional TDM interfaces, including STM-n/OC-n, E1/T1, and a rich variety of low-speed DS0 interfaces. The system is a perfect combination of PTN/CE, SDH, and PDH technologies. It supports MPLS-TP LSP 1:1/1+1 protection and ERPS, with protection switching time <50ms. Ethernet and MPLS section and end-to-end OAM are also provided for monitoring service integrity and performance. The JPAX-H is 5U in height, and its powerful functions enable customers to provision a service-grooming hub, ring, or mesh packet network with ultimate ease.

Key Benefits

- FANLESS solution
- Sub-ms latency for critical applications
- Customer data protection (encryption)
- Multi-technology platform supporting legacy, PDH, SDH, SONET, and MPLS-TP



Multiple Interface Variants

- High board density
- Conventional FXO, FXS, E&M, RS232, RS422, RS484, V.35, V.36, X.21, Nx 64k, dry contact
- Dedicated for power utilities: DTT, C37.94, TDMoE, G704 Co and Contra- Directional
- PDH/SDH/SONET: E1/T1, STM1, STM4, STM16, OC-3, OC-12, OC-48
- Ethernet with Layer 2 and Layer 3 support
- Packet: 1G, 10G, 40G, 100G MPLS-TP

Advanced Features

- PoE, PoE+ and PoE++
- Security: MacSec (auto key rotation), LSPSec, IPSec, HTTPS, SSH, SNMPv3 and syslog

Robust & Reliable

- FANLESS design (IEEE 1613)
- Extended -20°C to +60°C / -4F to +140F operating temperature
- High level of reliability via full redundancy
- Hot swappable units eliminate the need to power down the multiplexer, minimizing traffic disruptions
- SNCP, MSP (1+1), LSP 1+1/1:1, ERPS protection network topology
- Hitless protection
- Fully compliant with international standards

Network Management

- Graphical local and remote management
- End-to-end service provisioning (TDM/MPLS-TP)
- Real-time system redundancy
- SNMP-based



GE VERNOVA

GE Vernova's JPAX-H is a purpose-built fiber optic solution for high-performance industrial communication networks requiring mission-critical and time-sensitive communications within harsh utility environments. The platform provides private, secure, and reliable communication between collection/access sites, and guarantees performance over aggregation and backhaul networks for protection and/or control. The JPAX-H has been designed for utilities with standards-based MPLS-TP for superior performance of packet delivery and network operations, taking into consideration the operational and environmental conditions and addressing the communication challenges that utilities are currently facing as well as meeting future business needs.

The JPAX-H provides the following benefits:

- Designed for teleprotection and superior performance
- Scalable for high-capacity data transmission up to 100Gbps
- Single solution in a multi-technology platform converging and simplifying operations
- Ruggedized and modular design lowering total cost of ownership
- Compatible with existing GE Vernova JMUX/PAX networks and 3rd party standard devices
- Cybersecurity

Ideally Suited for Teleprotection

The JPAX-H platform has been improved to deliver teleprotection with utility-grade performance wither through MPLS-TP or Hybrid transmission with sub-ms latency time. Designed with layers of redundancy, there is no single point of failure, providing customers with an assurance that critical teleprotection circuits are delivered securely and dependably across the network.

Benefits of JPAX-H Platform Include:

- Perform critical low latency applications where security and dependability must be guaranteed
- Employ hardware-based fault detection with protection switching mechanisms to restore services via route diversified paths
- Utilize Synchronous Ethernet (SyncE) to tightly control variability in transmission that affects critical communication services
- Support co-routed bidirectional paths to eliminate asymmetrical delays that affect critical communication services across a network
- Provide determinism via a connection-oriented approach to packet transmission
- Permit static assignment of working and protect paths to ensure application performance and eliminate complexity associated with dynamic control plane protocols

Flexible Connectivity Future Proofs Investment

The JPAX-H platform has considerable flexibility and scalability, enabling wider deployment options and diverse network connectivity choices. The platform offers customers a solution to address the challenges of capacity constraints while maintaining essential service separation between disparate applications. JPAX-H is a converged platform that future proofs a customer's investment with a lower cost of ownership by offering flexible connectivity options to carry diverse packet and TDM-based client services.

Ruggedized for Longer Life

The JPAX-H is industrially hardened and designed for deployment in harsh substation environments where conditions are not optimal for traditional telecom equipment. The superior thermal design enables reliable operation across an extended temperature range without active cooling, enabling improved reliability, longer life and lower maintenance costs.

The rugged, industrial features of the solution include:

- Designed for compliance to IEEE 1613 and IEC 61850-3, with no cooling fans
- Extended temperature range from -20°C to +60°C (-4°F to +140°F)
- Quality component selection / design for five 9's
- Hot-swappable modules



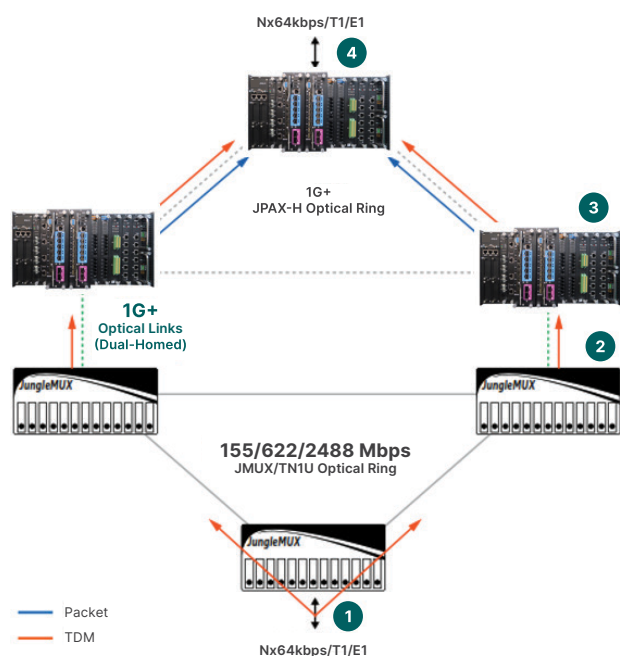


Figure 1 – Flexibility of routing either packetized traffic or preserving TDM end-to-end

Simplified Migration from JMUX/TN1U to JPAX-H Networks

The Evolution module allows compatibility and simplified migration of GE Vernova Lentonics SONET/SDH multiplexer networks to JPAX-H MPLS-TP/Hybrid networks on a ring-by-ring or node-by-node basis. The VT1.5/TU-12 traffic originated at JMUX/TN1U nodes can be terminated at JPAX-H nodes while its working and protect paths can be either partially or entirely carried over the SONET/SDH layer.

1. TDM traffic is presented into both left and right fiber directions (1+1 protection)
2. JMUX/TN1U node equipped with Evolution Modules pass the TDM traffic over 1G+ optical links to JPAX-H (single or dual-homed) equipped with JEVO module
3. JPAX-H has the flexibility to convert the TDM traffic to packet or preserve the TDM traffic over a Hybrid transport mode
4. JPAX-H terminates the Packet or TDM traffic from both redundant fiber paths

Customer Applications



Energy

- Communication between substations, generation plants, control centers, and administration offices
- Supporting teleprotection, video surveillance, SCADA, substation automation, voice and data



Oil & Gas

- Communication between well clusters, production platforms, tank storage, and control centers
- Voice, data, CCTV, IP/Ethernet telecom services for SCADA, safety/fire, and security sub-systems



Water & Wastewater

- Communication between remote wells, dams, metering, treatment facilities, pumping/compressor stations, and control centers
- Voice, data, CCTV, IP/Ethernet, security and safety sub-systems



Transportation

- Communication for train platforms, traction power substations, wayside cabinets, maintenance facilities, and control centers
- Data, voice, transducers and contacts, IP/Ethernet

Features

Mechanical and Electrical

- 5U height, 19" width ETSI unit (front access)
- Power supply: hot swappable DC, dual for redundancy
- Operating Temperature: -20 °C to 60 °C (-4°F to +140°F)
- Supports FANLESS operation

Digital Counters

- 2 × 100GE/40GE ports (external FAN required)
- 34 × 10GE
- 87 × 1GE
- 70 x FE Base-T
- 224 x E1/T1 ports
- 112 x DS3 ports
- 52 x STM-1/ OC-3
- 49 x STM4 ports / OC-12
- 12 x STM16 ports / OC-48

MPLS-TP

- Any Ethernet port can be configured as NNI (MPLS port) or UNI (Ethernet service port)
- Bi-directional LSP
- Static LSP/PW provisioning via NMS
- Ethernet (VPWS, VPLS, H-VPLS) and TDM (CESoPSN, CEP, and SAToP) services
- MPLS-TP OAM and QoS
- TDM PW Support per card:
 - 32TE1 card: up to 256 pseudowires
 - B16 card: up to 1024 pseudowires

Carrier Ethernet

- L2 Switching/Bridging
- STP, RSTP, MSTP
- Port based VLAN and port isolation
- VLAN Stacking (Q-in-Q)
- CE OAM
 - CFM: Ethernet Service OAM (802.1ag/Y1731)
 - EFM: Ethernet Link OAM (802.3ah)
- Flow Control
- Link Aggregation Control Protocol (LACP)
- Jumbo Frame (MTU): 9600
- Layer 2 Multicast Entries: 2K
- EPL, EVPL, EP-LAN, EPV-LAN, EP-Tree
- E-Access: EPL-Access, EPVL-Access

Network Protection

- MPLS-TP
 - LSP 1+1/1:1
 - LSP E2E protection switching < 50ms
 - PW Redundancy
 - Based on TP OAM for fault detection
- CE
 - ERPS Ring (G.8032) Protection
 - ELPS (G.8031) Linear Protection
- SDH/SONET
 - STM-n/OC-n MSP 1+1 Protection
- HITLESS

TDM Pseudowire Services

- Circuit Emulation
 - DS0 (64K timeslots): CES & multiframe PW
 - Unframed E1/T1: SAToP PW
 - VC-3/4/11/12, VT-1.5/2, STS-1/3: CEP PW
- PDH Timing recovery: ACR/DCR/System
- ACR/DCR support
- SDH Circuit Emulation over Packet (CEP)
- Encapsulation
 - PW/LSP (TDM over MPLS-TP),
 - "Dry martini", MEF 8 (TDM over Ethernet),
 - TDM over IP
- DS0 cross-connection
 - Two-way FE1(N*DS0) to FE1/VC12/STM1 cross-connection
 - Two-way FE1(N*DS0) to FE1(N*DS0) cross-connection

Ethernet Pseudowire Services

- E-Line, E-LAN, E-Tree services as defined by MEF 9 and 14 and using VPWS/VPLS
- Native Ethernet packets supported
- Encapsulation: PW/LSP (MPLS-TP), VLAN tagging (1Q), VLAN double tagging (Q-in-Q)

VPLS

- VPLS bridging
- H-VPLS bridging
- 128K MAC addresses
- 2K VPLS/VFI instances per device
- Split horizon to prevent forwarding loops

CoS/QoS

- 8 Priority Queues
- Scheduling: Strict Priority, WRR with Hierarchy
- Ingress Policing & Egress Shaping per service
- CIR / PIR (EIR) 2-rate-3-color
- MPLS: TC/EXP-Inferred-PSC (Per Hop Behavior Scheduling Class) LSP

Timing

- SSM quality level compatible
- IEEE 1588 v2 (via SyncE only)
 - PTP Clocks: Ordinary/Boundary/Transparent
 - ToD (Time of day)
 - 1-PPS (One Pulse per second) output interface
 - G.8265.1 Profile (Frequency Synchronization)
- SyncE
 - Synchronous Ethernet from all built-in and plug-in GbE, 10/40/100GbE ports
 - ITU-T Ethernet Synchronous Message Channel (ESMC)
- Stratum 3 timing
- TDM line clock: E1/T1 and STM/OC ports
- External clock input and output (2 Mbps / 2 MHz)

Management

- Fully manageable via SNMP (v1, v2, v3)
- Fully manageable via CLI
 - Serial port
 - SSH, Telnet via Ethernet
- GbE Interface in-bands
- Account Security
 - Two types of privileges: Operator (read only) and Administrator (read and write)
 - Radius Client and 802.1x Authentication
- Upload/Download NE configuration
- Syslog, NTP
- SNMP Port 1:1 Protection
- Console 1+1 Protection

Layer 3

- VRF without multicast protocols
- ARP, Ping, Trace route
- VRRP
- Static Route
- RIP v1/v2
- OSPF
- Routing among Physical Ethernet ports, VLAN virtual port (VLAN routing), and PW ports.
- 32 Subinterfaces
- IGMP v2/v3
- PIM-SM
- NTP server/client

Network Security

- MACSec (Media Access Control Security)
 - IEEE 802.1AE MACsec
 - AES-128-CMAC or AES-256-CMAC
 - Authentication using Certificate or Pre-Shared Keys (PSK)
 - Switch-to-Switch (static CAK) mode
 - Switch-to-Host (dynamic CAK) mode
- IPSec (Internet Protocol Security)
 - IPSec/IKE VPN tunnel for Control-plane
 - IKEv1/IKEv2 support
 - Support encryption algorithms: AES128, AES256
 - Support integrity algorithms – md5, sha1, sha256
 - Password- (PSK) based and certificate- (pubkey) based keys

Ordering Information

Note: RoHS compliant units are identified by the letter **G** appearing at the end of the ordering code

ORDERING CODE	DESCRIPTION
Main Unit	
GE-JPAX-H-CHB-G	5U height rack chassis for JPAX-H without CPU, power, connector board, fan and plug-in cards.
Connector Board	
GE-JPAX-H-CBB-G	1* DB15 for TOD/PPS 1* RJ45 for CLK I/O (2*IN & 2*OUT for 2M/E1) 1* RJ45 for ALARM I/P (4 alarm Inputs) 1* RJ45 for ALARM O/P (4 alarm outputs)
CPU Module	
GE-JPAX-H-CC2-LITE-G	Controller/CPU module for JPAX-H chassis with RS232 console port. It supports core switching bandwidth up to 400Gbps and I/O bandwidth up to 396Gbps with full-duplex at wire-speed. This module also supports built-in line interfaces including — 2 × 10GE SFP+ ports, and additional 10GE ports available with activation license — 4 × 1GE SFP ports, and additional 1GE ports available with activation license — Optional two 100GE/40GE ports available with activation license
Port Activation License	
GE-JPAX-H-CC2-100G-LIC	100G/40G port activation license on single CC2 controller One license will activate all 100G/40G ports on single controller. For systems with CC2 controller redundancy, each CC2 requires its own license activation respectively
GE-JPAX-H-CC2-10G-LIC	License to activate ONE 10GE Port on single CC2 controller One license will activate ONE 10G port on single controller. For systems with CC2 controller redundancy, each CC2 requires its own 10G license activation respectively
GE-JPAX-H-CC2-1G-LIC	100G/40G port activation license on single CC2 controller One license will activate ONE 1GE port on single controller. For systems with CC2 controller redundancy, each CC2 requires its own 1GE license activation respectively
External Fan Control Module	
GE-JPAX-H-eFBC-G	External Fan Control card on the master unit to control the eFBOX unit (optional)

Select 1 to 7 cards from High-Speed and Low-Speed Tributary Module Lists

High Speed or High Density Tributary Modules

ORDERING CODE	DESCRIPTION
GE-JPAX-H-TE1-32CEM-G	32-port E1(120 ohm) or 32-port T1 software programmable plug-in module with SCSI interfaces. Used for T1/E1 CEM over PTN
GE-JPAX-H-TE1-16CEM-G	16-port E1(120 ohm) or 16-port T1 software programmable plug-in module with SCSI interfaces. Used for T1/E1 CEM over PTN
GE-JPAX-H-GFEO-G	10 × 1G or 1 × 10G Ethernet SFP Optical Interface Card (10G BP slots) 10 × FE SFP Optical Interface Card (1G BP slots)
GE-JPAX-H-GEO-1XG-G	1 × 10G Ethernet SFP Optical Interface card
GE-JPAX-H-GEO-10S-G	10 × 1G Ethernet Optical Interface card
GE-JPAX-H-XGEO-G	9 × 10G Ethernet Port SFP Optical Interface
GE-JPAX-H-GFET-8T-G	8 × 1000/100/10Mbps Ethernet Twist-Pair RJ45 (10G BP slots) 8 × 100/10Mbps Twist-Pair RJ45 (1G BP slots)
GE-JPAX-H-GFET-8POE1-G	Powered by the backplane 8 × 1000/100/10Mbps Ethernet Twist-Pair w/ PoE RJ45 (10G BP slots) 8 × 100/10Mbps FE Twist-Pair w/ PoE RJ45 (1G BP slots)
GE-JPAX-H-GFET-8POE2-G	External power for PoE+ 8 × 1000/100/10Mbps Ethernet Twist-Pair w/ PoE/PoE+ RJ45 (10G BP slots) 8 × 100/10Mbps FE Twist-Pair w/ PoE/PoE+ RJ45 (1G BP slots)
GE-JPAX-H-GFET-4POEP-G	External Power for PoE+/PoE++ (PoE++ for 4 ports only) 8 × 1000/100/10Mbps Ethernet Twist-Pair w/ PoE/PoE+/++ RJ45 (10G BP slots) 8 × 100/10Mbps FE Twist-Pair w/ PoE/PoE+/++ RJ45 (1G BP slots)
GE-JPAX-H-B2G5-1CEM-G	One STM-16/OC-48 or Four STM-4/STM-1/OC-12/OC-3 interfaces without SFP (mini-GBIC) optical modules (10G BP slots) One STM-4/OC-3 or Four STM-1/OC-3 interfaces without SFP (mini-GBIC) optical modules (1G BP slots)
GE-JPAX-H-B2G5-2CEM-G	Two STM-16/OC-48 or Eight STM-4/STM-1/OC-12/OC-3 interfaces without SFP (mini-GBIC) optical modules (10G BP slots)
GE-JPAX-H-B2G5-EoS-G	Ethernet over SDH/SoNET with 1 x STM16 / 1 x OC48 worth traffic over CEM card.
GE-JPAX-H-JEVO-G	JEVO card is used to interface with GE Vernova JMUX/JPAX devices via proprietary 1G+ (WIS WAN Ethernet) interface (slot 3 & 4)

ORDERING CODE	DESCRIPTION
Low Speed Tributary Modules	
GE-JPAX-H-12FXOA-G	12-channel FXOA plug-in card with 600/900 Impedance, Battery Reverse and Loop Start. Without Ground Start and Metering Pulse. Used with 12 RJ11.
GE-JPAX-H-12FXSA-GMP-G	12-channel FXSA plug-in card with 600/900 Impedance, Battery Reverse, Loop Start, PLAR, [PLAR bit programmable], [Ground Start] and [Metering Pulse]. Used with 12 RJ11.
GE-JPAX-H-8EMA-G	8-channel 2W/4W E&MA plug-in card. Used with 8 RJ45 connectors or 1 Telco 64 connector
GE-JPAX-H-4E1-G	4-channel E1 plug-in card
GE-JPAX-H-4T1-G	4-channel T1 plug-in card
GE-JPAX-H-6UDTEA-G	6-port universal data interface card that supports three software configurable modes: Port 1 to 4: two DB44 connectors Port 5 to 6: two RJ48 connectors Mode 1: Port 1 to 4: RS232/RS422/X.21, Async/Sync 64kbps and subrate with V.110 encoding Port 5 to 6: RS232 for ASYNC only Mode 2: Port 1 to 4: X.21/RS422 SYNC N*64k (N=1~32) Port 5 to 6: Disabled Mode 3: Port 1 to 3: X.21/RS422 SYNC N*64k, (N=1~32). Port 4: X.21/RS422 SYNC, N*64k, (N=1~20). Port 5 to 6: RS232 N*64k (N=1~6) oversampling for ASYNC data. Mode 4: Port 1 to 4: RS232/RS422/X.21/V.35/V.36/EIA530 SYNC 38.4K and subrate Port 5 to 6: Disabled Mode 5: Port 1 to 4: X.21/RS449/RS422/RS232/V.35/V.36/EIA530 SYNC N*64k (N=1~32) Port 5 to 6: Disabled
GE-JPAX-H-8UDTEA-G	8-port universal data interface card that supports RS232/RS422/RS485 full-duplex DCE interface which is software configurable Available option mode: Terminal Server, Omnibus, and Clock Pass Through
GE-JPAX-H-8RS232-RJ-G	8-port RS232 plug-in card with X.50 subrate multiplexing scheme and X.54 encoding, with 8 RJ48 connectors for 8 RS232 Async ports
GE-JPAX-H-8RS232-DB-G	8-port RS232 plug-in card with X.50 subrate multiplexing scheme and X.54 encoding, with 2 RJ48 connectors and 2 DB44 connectors for Async and Sync ports
GE-JPAX-H-6RS232i-RJ-G	6-port RS232 card with port isolation, 6 x RJ connectors for 6 Sync/Async RS232 ports
GE-JPAX-H-6CDA-G	6-channel G.703 Interface at 64 Kbps data rate. Per port configurable for Co-directional or Contra-directional interfaces.
GE-JPAX-H-8DCC-G	8-channel dry contact type A plug-in card with maximum voltage 100 Vdc or 250 Vac
GE-JPAX-H-8DCB-G	8-channel dry contact type B plug-in card with maximum voltage 220 Vdc or 250 Vac
GE-JPAX-H-4C37-G	4-channel C37.94 plug-in card
GE-JPAX-H-RTB-G	8-LAN port/64 WAN ports router/bridge plug-in card
GE-JPAX-H-DTT-G	Transfer trip plug-in module with two ports for DTT input and output. Complied with 48/125V voltage.

Select 1 to 7 cards from High-Speed and Low-Speed Tributary Module Lists

High Speed or High Density Tributary Modules

ORDERING CODE	DESCRIPTION
GE-JPAX-H-S1T1-G	1-channel T1 interface card
GE-JPAX-H-S1E75-G	1-channel of E1plug-in card w/ 75 ohm
GE-JPAX-H-S1E120-G	1-channel of E1 plug-in card w/ 120 ohm
GE-JPAX-H-SM4T1-G	Mini Quad T1 plug-in card
GE-JPAX-H-SM4E75-G	Mini Quad E1 plug-in card with 75 ohm
GE-JPAX-H-SM4E120-G	Mini Quad E1 plug-in card with 120 ohm
GE-JPAX-H-SFOM-opt-G	Fiber Optical plug-in card
GE-JPAX-H-S1V35-G	1-channel V.35 plug-in card
GE-JPAX-H-S1X21-G	1-channel X.21 plug-in card
GE-JPAX-H-S1RS232-G	1-channel RS232 plug-in card
GE-JPAX-H-S3RS232a-G	3-channel RS232 Async/Sync, DCE/DTE plug-in card
GE-JPAX-H-SQEMA-wr-m- Tn-x-G	Jumper selectable: 2/4 WIRE; A/B side Quad E&M voice card, complied with IEEE 1613 standard.

ORDERING CODE	DESCRIPTION
GE-JPAX-H-SQFXOA-x-G	Quad FXO voice plug-in card used with 4 RJ11
GE-JPAX-H-SQFXOA-GS-x-G	Quad FXO with GS plug-in card used with 4 RJ11
GE-JPAX-H-SQFXSA-x-pt-G	Quad FXSA voice plug-in card
GE-JPAX-H-SQFXSA-M-x-pt-G	Quad FXSA with MP 16 KHz voice plug-in card
GE-JPAX-H-SQFXSA-M12-x-pt-G	Quad FXSA with MP 12 KHz voice plug-in card used
GE-JPAX-H-SQFXSA-GS-x-pt-G	Quad FXSA with GS plug-in card
GE-JPAX-H-SQFXSA-GM-x-pt-G	Quad FXSA with GS and MP 16 KHz voice plug-in card
GE-JPAX-H-SRTA-G	2-LAN ports/64 WAN port router/bridge plug-in card
GE-JPAX-H-SM1C37-LSFOM-G	1- channel C37.94 plug-in mini card
Accessories	
GE-JPAX-H-SDA-G	Single -48 Vdc (-36 to 75 Vdc) power module
GE-JPAX-H-SDB-G	Single 130 Vdc (67.2 to 154 Vdc) power module (future)
External FAN Module	
GE-JPAX-H-eFBOX-G	1U External Fan Box with fan slots for master unit cooling This External Fan Box includes one DB15 cable and one DC power cable for connection between eFBOX and master unit
GE-JPAX-H-eFAN-G	Fan plug-in module which fits into eFBOX.

Specifications

PHYSICAL/ELECTRICAL	
Dimensions	5U, 442× 220 × 223.5 mm (W x H x D) / 17.4 × 8.7 × 8.8 inches (WxHxD)
Power	--- 24 Vdc/-48 Vdc (-18 to -75 Vdc) power module --- 130Vdc (future)
Temperature	-20 to +60°C / -4 to +140°F (operation) -30 to +70°C / -22 to 158°F (storage)
Humidity	0-95%RH (non-condensing)
Mounting	Desk-top stackable, 19/23 inch rack mountable

Standard Compliance

RFC (IETF)	
1042	Standard for the transmission of IP Datagrams over IEEE 802 Networks
1112	IGMP V1
1305	Network Time Protocol (NTP) Version 3
2236	Internet Group Management Protocol, Version 2 SNMPv3Applications
2273	OSPF Version 2
2328	RIP Version 2
2453	An Architecture for Describing SNMP
2571	Management Frameworks Message Processing and Dispatching for the
2572	Simple Network Management Protocol (SNMP) SNMP Applications Entity MIB (Management Information Base)
2573	(Version 2)
2737	Remote Authentication Dial-In User Service (RADIUS)
2865	Multiprotocol Label Switching Architecture MPLS Label Stack Encoding

RFC (IETF)	
3031	MPLS Support of Differentiated Services
3032	Internet Group Management Protocol, Version 3
3270	Introduction and Applicability Statements for
3376	Internet Standard Management Framework An Architecture for Describing SNMP
3410	Management Frameworks Message Processing and Dispatching
3411	SNMP Applications User-based Security Model
3412	View-based Access Control Model
3413	Transport Mappings for the SNMP
3414	Management Information Base (MIB) for the
3415	Simple Network Management Protocol (SNMP)
3417	Virtual Router Redundancy Protocol VRRPv2
3418	Defense of Textural Conventions (TCs) for MPLS Management MPLS Traffic Engineering (TE) Management Information Base (MIB)

Standard Compliance

RFC (IETF)	
3768	MPLS Label Switching Router (LSR) Management Information Base (MIB)
3811	The Advanced Encryption Standard (AES) Cypher Algorithm in the SNMP User-based
3812	Security Model Pseudo Wire Emulation Edge-to-Edge
3813	Architecture A Differentiated Service Two-Rate, Three-Color
3826	Marker with Efficient Handling of In-Profile Traffic Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures
3985	Pseudowire Emulation Edge-to-Edge (PWE3) Encapsulation Methods for Transport of Ethernet
4115	over MPLS Use over an MPLS PSN SAToP (Structured Agnostic TDM over Packet Switched Networks) Networks
4379	Framework for L2VPNs (VPLS/VPWS) Service Requirements for Layer 2
4385	Provider-Provisioned Virtual Private Networks (QoS)
4448	Encapsulation Methods for Transport of Ethernet over MPLS Networks
4553	SAToP (Structured Agnostic TDM over Packet Switched Networks) Networks
4664	Framework for L2VPNs (VPLS/VPWS)
4665	Service Requirements for Layer 2 Provider-Provisioned Virtual Private Networks (QoS)
4842	Considerations for a Transport Profile
5085	Pseudowire Virtual Circuit Connectivity Verification (VCCV)
5086	CESoPSN
5254	Requirements for Multi-Segment PWE3
5317	Multiprotocol Label Switching (MPLS) MPLS Generic Associated Channel
5462	MPLS Label Stack Entry
5586	MPLS Generic Associated Channel
5601	Pseudowire (PW) Management Information Base (MIB)
5602	PW over MPLS PSN MIB
5603	Ethernet PW MIB
5654	Requirements OAM for MPLS-TP
5659	An Architecture for Multi-Segment PWE3
5710	Path Error Message Triggered MPLS and GMPLS LSP Reroutes
5718	An In-band Data Communication Network for MPLS-TP
5798	Virtual Router Redundancy Protocol VRRP Version 3 for IPv4 and IPv6
5860	Requirements for OAM in MPLS-TP
5880	Bidirectional Forwarding Detection (BFD)
5882	Generic Application of Bidirectional Forwarding Detection
5884	BFD for MPLS Label Switched Paths
5885	BFD for the Pseudowire VCCV

RFC (IETF)	
5920	Security Framework for MPLS and GMPLS Networks
5921	A Framework of MPLS in Transport Network
5950	MPLS-TP Network Management Framework
5951	Network Management Requirements for MPLS-TP
5960	MPLS-TP Data Plane Architecture
6215	MPLS-TP User-to-Network and Network-to-Network Interfaces
6291	Guidelines for Using "OAM" in the IETF
6370	MPLS Transport Profile (MPLS-TP) Identifier
6371	OAM Framework for MPLS-Based Transport Networks
6372	MPLS-TP Survivability Framework
6373	MPLS-TP Control Plane Framework
6374	Packet Loss and Delay Measurement for MPLS Networks
6375	A Packet Loss and Delay Measurement Profile for MPLS-Based Transport Networks
6378	MPLS-TP Linear Protection
6426	On Demand Connectivity Verification
6427	MPLS Fault Management OAM
6428	Proactive Connectivity Verification
6478	Pseudowire Status for Static Pseudowire
6639	MPLS-TP MIB-Based Management Overview
6669	Overview of the OAM Toolset for MPLS-Based Transport Networks
6941	MPLS Transport Profile (MPLS-TP) Security Framework
7213	MPLS Transport Profile (MPLS-TP) Next-Hop Ethernet Addressing
7276	An Overview of OAM
7331	Bidirectional Forwarding Detection (BFD) Management Information Base (MIB)
826	Address Resolution Protocol (ADP)
854	MIL STD 1782 Telnet Protocol Specification

ITU-T	
G.8031	EPLS
G.8032	ERPS
G.8101	Terms and Definitions for MPLS Transport Profile
G.811	Timing Characteristics of Primary Reference Clocks
G.8110	MPLS Layer Network Architecture
G.8110.1	Architecture of MPLS-TP Layer Network
G.8112	Interfaces for the MPLS-TP Transport Profile Layer Network
G.8113.2	MPLS-TP OAM
G.8121	Characteristics of MPLS-TP Network Equipment Functional Blocks
G.8121.2	Characteristics of MPLS-TP Equipment Functional Blocks Supporting ITU-T G.8113.2/Y.1372.2

Standard Compliance

ITU-T	
G.8131	MPLS-TP Linear Protection
G.8151	Management Aspects of the MPLS-TP Network Element
G.8271	Time and Phase Synchronization Aspects of Packet Networks
G.8262	Timing Characteristics of a Synchronous Ethernet Equipment Slave Clock Timing and Synchronization Aspects in Packet Networks
G.8261	Ethernet OAM
Y.1731	Operations, Administration and Maintenance (OAM) Functions and Mechanisms for Ethernet-Based Networks

EMC/EMI	
FCC 15 Class A	
EN 55032 Class A/EN 55035	
EN 50121-4	
IEC 61850-3	
ANSI C63.4a-2017	
ETSI EN 300386	
ETSI ES 201468	
ETSI EN 300 019-1-1, 1-2, 1-3, 2-1, 2-2, 2-3	
IEC 61000-4-3	
IEC 61000-4-4	
IEC 61000-4-6	
IEC 60068-2-1	
IEC 60068-2-3	
IEC 60068-2-52	
IEC 60068-2-64	

IEEE	
802.1d	STP
802.1p	Traffic Prioritization
802.1w	RSTP
802.1s	MPSP
802.1q	VLAN
802.1ab	Local and Metropolitan Area Networks – Station and Media Access Control Connectivity Discovery
802.1ad	VLAN Tag Stacking (Q-in-Q)

IEEE	
802.1ag	Ethernet OAM (CFM)
802.1X	Local and Metropolitan Area Networks: Port-based
802.3	Carrier Sense Multiple Access with Collision Detection
802.3ab	Gigabit Ethernet over Copper
802.3ad	Link Aggregation Control Protocol
802.3ae	10 Gigabit Ethernet
802.3ah	Ethernet in the First Mile (EFM)
802.3u	Type 100Base-T MAC Parameters, Physical Layer, MAUs, and Repeater for 100Mb/s Operation
802.3x	Flow Control
802.3z	Gigabit Ethernet standard over Fiber (1000Base-SX/LX)
1588 v2	Precision Time Protocol (PTP)
1613	Environmental and Testing Requirements for Communication Networking Devices Installed in Electric Power Substations

SAFETY	
EN62368-1	

MEF	
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MEF Carrier Ethernet (CE) 2.0 Compliant for EPL (Ethernet Private Line), EVPL (Ethernet Virtual Private Line), EVP-LAN (Ethernet Virtual Private LAN), EP-Tree (Ethernet Private Tree), and EVP-Tree (Ethernet Virtual Private Tree)	

ENVIRONMENTAL PROTECTION STANDARDS	
2011/65/EU & (EU)2015/863	
2012/19/EU (WEEE)	

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