



SEL-2740S Software-Defined Network Switch Manual



Features and Benefits

The SEL-2740S Software-Defined Network (SDN) Switch is designed to perform reliably even in the toughest environmental conditions commonly found in electric and industrial applications. The SEL-2740S supports enterprise and operational technology (OT) requirements ranging from real-time control to process control systems (PCS), distributed control systems (DCS), and SCADA. The SEL-2740S delivers industry-leading performance and cybersecurity at an economical price.

- **Reliability.** Provides a robust design that is built and tested to function in harsh environments, meeting IEEE 1613 and IEC 61850-3 standards.
- **Dual Power Supply Connections.** Supports connectivity to primary and backup sources.
- **Network Performance.** Heals network faults in microseconds with proactive traffic engineering.
- **Disruptionless Change Management and Scalability.** Allows users to make changes without disrupting traffic or dropping packets.
- **Modularity.** Provides flexible Ethernet interface options with hot-swappable modules, allowing scalability and cost-effective change management.
- **Situational Awareness.** Provides central management of all traffic flow circuits, backup circuits, and operational statistics from SEL-5056 SDN Flow Controller.
- **Ease of Use.** Supports quick commissioning, automated circuit provisioning, and telemetry monitoring.
- **SDN Management.** Supports OpenFlow 1.3 over secure Transport Layer Security (TLS).
- **Low-Latency Forwarding.** Provides low-latency storage and forwarding.
- **Large Flow Table Size.** Supports small and large networks with an 8,192 flow entry capacity.
- **Cybersecurity.** Supports deny-by-default network access control and secure communications management with OpenFlow 1.3 through TLS and the detailed central monitoring capability of the SEL-5056.
- **Flexible Group and Action Bucket Support.** Supports 256 groups and 30 action buckets per group, enabling flexible network design and traffic engineering.
- **Switching Capacity.** Supports full backplane bandwidth with 5.6 Gbps packet data rate and full-duplex, nonblocking design.
- **Strong Network Access Control.** Provides multilayer packet inspection on all network forwarding for each flow on Layers 1, 2, 3, and 4.
- **Quality of Service (QoS).** Provides traffic priority management through four 8:4:2:1 weighted round-robin (WRR) priority queues.
- **Flexible Time Synchronization.** Simple time synchronization options with Authenticated Controller Time Synchronization (ACTS) or Network Time Protocol (NTP).
- **IEEE C37.238-2017 PTP Power Profile Transparent Clock.** Supports networks that demand precise time synchronization.
- **Syslog.** Generates and sends log events directly to a central server through use of UDP or with encrypted and authenticated TLS.

Safety Information

Dangers, Warnings, and Cautions

This manual uses three kinds of hazard statements, defined as follows:

DANGER

Indicates a potentially hazardous situation that, if not avoided, **will** result in death or serious injury.

WARNING

Indicates a potentially hazardous situation that, if not avoided, **could** result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, **may** result in minor or moderate injury or equipment damage.

Safety Symbols

The following symbols are often marked on SEL products.

	 CAUTION Refer to accompanying documents.	 ATTENTION Se reporter à la documentation.
	Earth (ground)	Terre
	Protective earth (ground)	Terre de protection
	Direct current	Courant continu
	Alternating current	Courant alternatif
	Both direct and alternating current	Courant continu et alternatif
	Instruction manual	Manuel d'instructions

Safety Marks

The following statements apply to this device.

Table 1 General Safety Marks

 CAUTION There is danger of explosion if the battery is incorrectly replaced. Replace only with Panasonic BR-1632A/DBN or equivalent recommended by manufacturer. See Owner's Manual for safety instructions. The battery used in this device may present a fire or chemical burn hazard if mis-treated. Do not recharge, disassemble, heat above 100°C or incinerate. Dispose of used batteries according to the manufacturer's instructions. Keep battery out of reach of children.	 ATTENTION Une pile remplacée incorrectement pose des risques d'explosion. Remplacez seulement avec un Panasonic BR-1632A/DBN ou un produit équi-valent recommandé par le fabricant. Voir le guide d'utilisateur pour les instructions de sécurité. La pile utilisée dans cet appareil peut présenter un risque d'incendie ou de brûlure chimique si vous en faites mauvais usage. Ne pas recharger, démonter, chauffer à plus de 100°C ou incinérer. Éliminez les vieilles piles suivant les instructions du fabricant. Gardez la pile hors de la portée des enfants.
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Table 2 Other Safety Marks

 DANGER Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.	 DANGER Débrancher tous les raccordements externes avant d'ouvrir cet appareil. Tout contact avec des tensions ou courants internes à l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
 DANGER Contact with instrument terminals can cause electrical shock that can result in injury or death.	 DANGER Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
 WARNING High touch current. Earth connection is essential before making telecommunication network connections.	 AVERTISSEMENT Courant de fuite élevé. Une connexion à la terre est essentielle avant de faire des connexions au réseau de télécommunications.
 WARNING Earth ground connections should not be removed when the equipment is energized.	 AVERTISSEMENT Il ne faut pas enlever les connexions de mise à la terre pendant que l'équipement est sous tension.
 WARNING Use of this equipment in a manner other than specified in this manual can impair operator safety safeguards provided by this equipment.	 AVERTISSEMENT L'utilisation de cet appareil suivant des procédures différentes de celles indiquées dans ce manuel peut désarmer les dispositifs de protection d'opérateur normalement actifs sur cet équipement.
 WARNING Have only qualified personnel service this equipment. If you are not qualified to service this equipment, you can injure yourself or others, or cause equipment damage.	 AVERTISSEMENT Seules des personnes qualifiées peuvent travailler sur cet appareil. Si vous n'êtes pas qualifiés pour ce travail, vous pourriez vous blesser avec d'autres personnes ou endommager l'équipement.
 WARNING Do not perform any procedures or adjustments that this instruction manual does not describe.	 AVERTISSEMENT Ne pas appliquer une procédure ou un ajustement qui n'est pas décrit explicitement dans ce manuel d'instruction.
 WARNING Do not look into the fiber ports/connectors.	 AVERTISSEMENT Ne pas regarder vers les ports ou connecteurs de fibres optiques.
 WARNING Do not look into the end of an optical cable connected to an optical output.	 AVERTISSEMENT Ne pas regarder vers l'extrémité d'un câble optique raccordé à une sortie optique.

4 Introduction and Hardware Specifications

⚠️ WARNING Incorporated components, such as LEDs and transceivers are not user serviceable. Return units to SEL for repair or replacement.	⚠️ AVERTISSEMENT Les composants internes tels que les leds (diodes électroluminescentes) et émetteurs-récepteurs ne peuvent pas être entretenus par l'usager. Retourner les unités à SEL pour réparation ou remplacement.
⚠️ CAUTION Equipment components are sensitive to electrostatic discharge (ESD). Undetectable permanent damage can result if you do not use proper ESD procedures. Ground yourself, your work surface, and this equipment before removing any cover from this equipment. If your facility is not equipped to work with these components, contact SEL about returning this device and related SEL equipment for service.	⚠️ ATTENTION Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-détectables peuvent résulter de l'absence de précautions contre les DES. Raccordez-vous correctement à la terre, ainsi que la surface de travail et l'appareil avant d'en retirer un panneau. Si vous n'êtes pas équipés pour travailler avec ce type de composants, contacter SEL afin de retourner l'appareil pour un service en usine.
⚠️ CAUTION Insufficiently rated insulation can deteriorate under abnormal operating conditions and cause equipment damage. For external circuits, use wiring of sufficiently rated insulation that will not break down under abnormal operating conditions.	⚠️ ATTENTION Un niveau d'isolation insuffisant peut entraîner une détérioration sous des conditions anormales et causer des dommages à l'équipement. Pour les circuits externes, utiliser des conducteurs avec une isolation suffisante de façon à éviter les claquages durant les conditions anormales d'opération.

General Safety Notes

The SEL-2740S is designed for restricted access locations. Access should be limited to qualified service personnel.

To ensure proper safety and operation, check the equipment rating, installation instructions, and operating instructions before commissioning or maintaining the equipment. Also check the integrity of any protective conductor connection before taking any other actions. It is the responsibility of the user to ensure that the equipment is installed, operated, and used for its intended function and in the manner this manual specifies. If this equipment is used for anything other than its intended function or in a manner this manual does not specify, any safety protection the equipment provides may be impaired.

Warranty

The SEL-2740S is backed by the SEL worldwide, ten-year product warranty.

Introduction and Hardware Specifications

The SEL-2740S is a standards-based, OpenFlow 1.3-compatible, 20 port switch for critical infrastructure. With versatile Ethernet interface options, redundant power supplies, and three mounting options, the SEL-2740S supports a wide diversity of deployment options. Achieve microsecond network healing, multilayer packet inspection and deny-by-default filtering for the highest level of cybersecurity, and centralized situational awareness with an easy-to-use and flexible rack-mount, panel-mount, or surface-mount SDN switch.

Traditional networking integrates the operation of determining how to forward packets (control plane) and the action of forwarding the packets (data plane) into the same device. The abstraction of the control plane from the data plane simplifies the deployed switch and enables centralized traffic engineering,

reducing the total cost of ownership. The OT SDN solution from SEL offers the SEL-5056 Flow Controller with two switch options: the SEL-2742S with a DIN-rail mount or the SEL-2740S with a rack mount, panel mount, or surface mount. Select the best options for your needs, knowing you can scale the management to cover all of your deployed assets and manage them as one asset.

The SEL-5056 is the SEL flow controller that is used to program the SEL-2740S. The SEL-2740S network appliance acts like a large look-up table, which the SEL-2740S uses to match and forward packets. Once a packet matches an entry, the switch executes actions for that match. This combination of match and action is called a flow entry.

SEL-2740S Front Panel Overview

Figure 1 shows the front panel of the SEL-2740S. The front panel includes device activity and status LED indicators, and a front out-of-band flow controller management port. The activity of the front management port is built into the connector itself. LEDs for the power supplies (PWR A and PWR B) indicate the presence of a power supply in the slot. Other LEDs indicate the status of the unit as a whole.



Figure 1 SEL-2740S Front Panel

General Status Indicators

Figure 2 shows the layout of the status indicators on the front panel of the SEL-2740S.

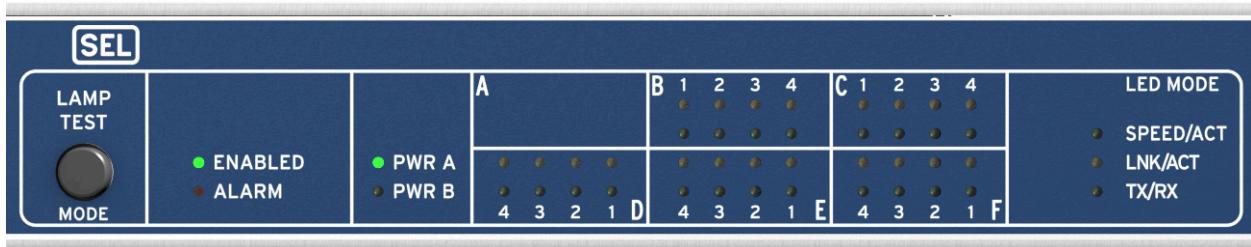


Figure 2 SEL-2740S Front-Panel Status Indicators

SEL-2740S Rear Panel

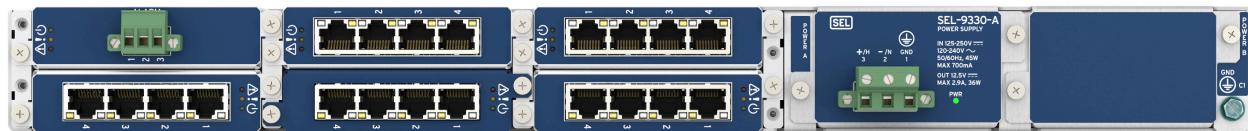


Figure 3 SEL-2740S Rear Panel

The SEL-2740S is a modular switch platform designed for enabling flexible Ethernet interface ordering options to match user-specified system integration requirements. The device provides six slots for interface modules and two slots for power supplies.

Interface Modules

The SEL-2740S has six modular slots, identified by letters in the rear-panel diagram in *Figure 4*, and the front panel, shown in *Figure 5*.

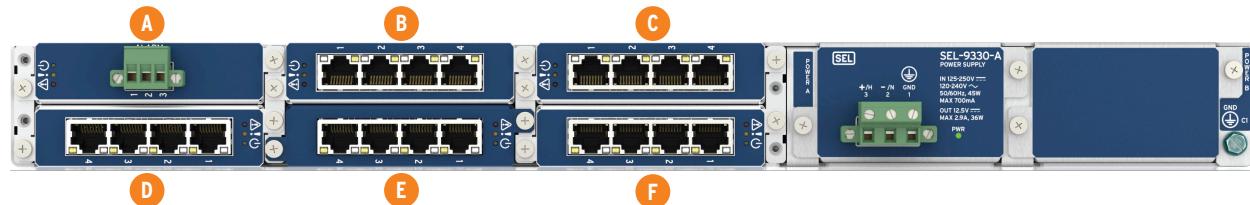


Figure 4 Rear-Panel Module Identifiers

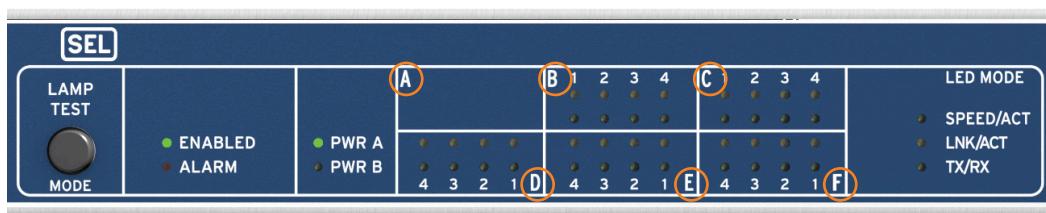


Figure 5 Front-Panel Module Identifiers

Available SEL-2740S Ordering Option

The SEL-2740S supports the interface modules listed in *Table 3*. The SEL-9620 alarm contact and coprocessor must be placed in Slot A for the SEL-2740S to operate. The Ethernet modules may be inserted into any of the remaining slots supported by the module.

An Ethernet module may be placed in any of Slots B–F, regardless of the placement of any other Ethernet module.

Table 3 Interface Modules

Module	Part Number ^a	Supported Slots	Number of Ports	Max Cable Distance
Alarm contact and coprocessor ^b	SEL-9620-0007	A	N/A	N/A
10/100/1000BASE-T RJ45 ^c	SEL-9620-0008	B, C, E, F (10/100 Mbps) D (10/100/1000 Mbps)	4	100 m ^d
100BASE-FX Multimode	SEL-9620-0019	B–F	4	2 km
1000BASE-LX Single-mode	SEL-9620-0020	D	4	10 km
2-Port 1000BASE-SX Multimode fiber and 2-Port 10/100/1000 Mbps copper Ethernet	SEL-9620-0037	D	4	500 m
1000BASE-SX Multimode	SEL-9620-0023	D	4	500 m
100BASE-LX10 Single-mode	SEL-9620-0026	B–F	4	10 km

Module	Part Number ^a	Supported Slots	Number of Ports	Max Cable Distance
2-Port 1000BASE-LX Single-mode fiber and 2-Port 10/100/1000 Mbps copper Ethernet	SEL-9620-0041	D	4	10 km
1-Port 1000BASE-LX Single-mode fiber and 3-Ports 1000BASE-SX Multimode fiber	SEL-9620-0044	D	4	500 m / 10 km
1000BASE-EX Single-mode	SEL-9620-0029	D	4	40 km
10BASE-FL	SEL-9620-0031	B-F	4	2 km

^a Conformal coating option available as a different part number.

^b One is required in Slot A of each SEL-2740S.

^c Supports auto-MDIX, autonegotiation, and full- and half-duplex. There is only one 10/100/1000BASE-T module. The maximum speed of the module is determined by its slot placement.

^d Cat 5 cable.

Ports

You can refer to ports in the SEL-5056 by using the port name (i.e., the combination of module letter and module Port ID), shown in *Figure 6*, or you can refer to the ports by using the device Port ID, shown in *Figure 7*.

Ports can also be aliased in the SEL-5056. These aliases are friendly names that users assign to the port. These aliases can be used in the configuration and for statistical displays in the user interface.

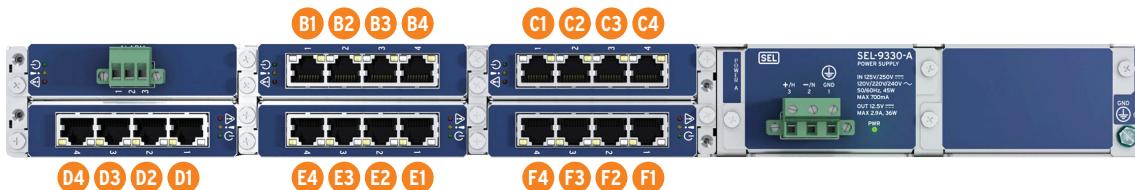


Figure 6 SEL-2740S Port Name



Figure 7 SEL-2740S Port ID

Power Supply

Redundant power supplies provide uninterrupted failover protection. Each power supply may be connected to a separate power source. If one source fails, the other source continues to keep the switch operating. Two power supplies are available: SEL-9330A high-voltage (110–240 Vac and 88–300 Vdc) and SEL-9330C low voltage (24–48 Vdc). The SEL-2740S turns on as soon as it receives the required power. To turn off the SEL-2740S, remove all sources of power.

Follow the wiring instructions in *Table 4* and confirm that the source voltage range is within the tolerance of the SEL-2740S. Power supply inputs are isolated from ground and are polarity-protected.

Table 4 Power Supply Connections

Pin	Description
1	GND
2	—
3	+

Pinhole Reset

A factory-default reset pinhole is located next to the front Ethernet port labeled **ETH F**. Press the pinhole reset button for 5–10 seconds while the device is on and enabled to remove all programmed configurations and return the product to its decommissioned state.

LED Status Indicators and Modes

The SEL-2740S has one LED indicator on the front panel for each power connection, labeled **PWR A** and **PWR B**. *Table 5* lists the power connection LED colors and their descriptions.

Table 5 Power Connection LED

Status	Description
Off	No power applied
Red	Unacceptable power applied
Green	Acceptable power applied

The SEL-2740S has one alarm LED indicator on the front panel, labeled **ALARM**. *Table 6* lists the alarm LED colors and their descriptions.

Table 6 Alarm LED

Status	Description
Off	No alarm conditions
Red	Alarm condition

The SEL-2740S has one enable LED on the front panel, labeled **ENABLED**. *Table 7* lists the enable LED colors and their descriptions.

Table 7 Enable LED

Status	Description
Off	Device is not fully functional
Green	Device is fully functional

The port status LEDs operate in three different modes: Speed and Activity, Link and Activity, and Transmit and Receive. *Table 8*, *Table 9*, and *Table 10* list the different port status LED states and the descriptions for each mode. Change the port status LED modes by pressing and releasing the **LAMP TEST** button on the front of the switch.

Speed and Activity (SPEED/ACT) Mode

Table 8 LED Status Indicators for Speed and Activity (SPEED/ACT) Mode

LED	State	Description
Amber	On	Link at maximum speed for the port
	Blinking	Packet collision has occurred
Green	On	Link Up
	Off	Link down
	Blinking	Port is transmitting and/or receiving data

Link and Activity (LINK/ACT) Mode

Table 9 LED Status Indicators for Link and Activity (LINK/ACT) Mode

LED	State	Description
Amber	Off	No link
	On	Link
Green	Off	No data transmitted or received
	Blinking	Port is transmitting and/or receiving data

Transmit and Receive (TX/RX) Mode

Table 10 LED Status Indicators for Transmit and Receive (TX/RX) Mode

LED	State	Description
Amber	Off	No data transmitted
	Blinking	Port is transmitting data
Green	Off	No data received
	Blinking	Port is receiving data

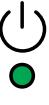
Module LEDs

Each module has three LEDs to indicate the state of the module and if it is ready for use, as shown in *Figure 8*. *Table 11* describes the behavior of each LED. See *LED Status Indicators and Modes on page 8* for the behavior of the Ethernet module port LEDs.



Figure 8 Ethernet Interface Module LEDs

Table 11 Module Status LEDs

LED		State	Description
Power		Off	Module not inserted, inserted but not active, or failed
		On	Active and ready for operation
		Blinking	Module activating or deactivating, or upgrading firmware
Attention		Off	Module operating correctly
		On	Communications failure between module and main board or failure of module itself
Alarm		Off	Normal operation
		On	Module booting, failure in triggering the alarm, or module successfully ejected and ready to be removed

During normal operation, the Power LED is in the On state and the Attention and Alarm LEDs are in the Off state.

Inserting and Removing Interface Modules

The interface modules may be inserted or removed while the SEL-2740S is on or off; however, the modules should be ejected using the SEL-5056 web interface before physically removing the module. The SEL-2740S cycles power if a module is ejected improperly.

To add a module while the SEL-2740S is on or off, simply insert the module. After the module has been turned on, the SEL-2740S automatically configures and accepts the module. The SEL-2740S configures the ports on the inserted module with the preconfigured settings or the default if there are no preconfigured settings.

To remove a module while the SEL-2740S is off, remove the module. Once the module LEDs are all off, it is safe to remove the module.

Alarm Contact Output

One Form C output mechanical relay contact is provided on the flow processor module, which is inserted in Slot A of the SEL-2740S. To indicate a minor alarm, the alarm contact pulses for a configurable amount of time. The minor alarm duration is set to 1 s by default, but this duration can be configured for as long as 30 s. This allows the system to capture the status of the alarm before it is cleared. Major alarms latch the contact and operate until the source of the alarm is cleared or the alarm is manually cleared. Alarm contacts are divided into specific categories. You can configure a different severity for each category. Alarms with a severity of Emergency, Alert, and Critical are major alarms. Other severities are minor alarms.

Table 12 Alarm Contact Pinout

Pin	Description
C1	Normally open
C2	Common
C3	Normally closed

Table 13 Alarm Contact Ratings

Maximum voltage	250 Vdc
Contact protection	270 Vdc, 23 J MOV protected
Maximum current	6 A
Pickup time	≤8 ms typical
Dropout time	≤8 ms typical

The alarm contact is configurable for three event severities. In Log Services, you can set the severity at which the alarm contact will be pulsed. This can be configured under All Categories or under each specific category for more specific control. For Link Up and Link Down events, you can configure the switch to pulse the alarm contact or to latch on state change (as well as whether a latched alarm will self-clear or require manual clearing).

Labels and Markings

Two stickers are attached to the SEL-2740S chassis: a serial number sticker common to SEL devices and a Datapath ID sticker unique to the SEL-2740S. The Datapath ID number printed on the sticker uniquely identifies the SEL-2740S during adoption and is specific to the SEL-2740S chassis. The Datapath ID has the form 0000XXXXXXXXXXXX, where the Xs represent the in-band management Ethernet MAC address.

Battery Change Instructions

The battery in the SEL-2740S maintains power to the real-time clock so that it retains the time through power cycles. The battery is rated to last more than 10 years, but if you need to change the battery, use the following steps:

- Step 1. Disconnect power from the SEL-2740S.
- Step 2. Remove all cables from the SEL-2740S and remove it from service.
- Step 3. Ground yourself, your workstation, and the SEL-2740S to the same ground.
- Step 4. Remove the top lid of the unit by removing the screws on the top and bottom front panels. The battery is located on the main board.
- Step 5. Replace the battery.
- Step 6. Reassemble the device and return it to service.

Installation and Configuration

The SEL-2740S is ideally suited for use as an Ethernet switch for industrial applications that have 19" rack-mount, panel-mount, or surface-mount installations, and it provides industry-leading network performance, cybersecurity, and centralized easy-to-use configuration and network management. It is specifically designed for systems that require exceptional reliability in industrial environments, relying on the revolutionary network advances of SDN technology. These advances include reduced complexity,

improved performance, and centralized control and monitoring of entire networks. Combined with the SEL-5056, the system allows centralized management and makes it possible to monitor the operational counters that provide health and diagnostics information about the network.

Installation

The SEL-2740S is a 1U device and comes with 19" rack mount ears, and panel mount ears or surface mount ears are available for order. The operation of the device is not dependent on the orientation of the mount but does require 1U of space above and below the installation on the rack for ambient heat dissipation to meet all specifications.

Commissioning and Adoption

By default, the SEL-2740S publishes an OpenFlow discovery packet every few seconds out of all ports. OpenFlow discovery packets are Link Layer Discovery Protocol (LLDP) in structure, so they are Layer 2 packets that stay within the subnet. This packet announces the presence of a new SDN switch and provides the default IP address to communicate with the switch. The out-of-band port, **ETH F**, has a default IP address in the 169.254.x.x subnet. The in-band management ports, Ports 1 through 20, have a default IP address in the 192.168.x.x subnet. The last two octets are random and will change on every factory-default reset action. Commission the IP address, subnet, time, certificates, and the flow controller IP address of the switch by using the representational state transfer (REST) interface. The switch listens for incoming connections to this REST interface on Port 443. Once commissioned, the switch attempts to communicate with the configured flow controller by using OpenFlow with a destination port of 6653. The term adoption is used when the switch and the flow controller are successfully bound and communicating on the OpenFlow and REST interfaces. When you use the SEL-5056, the adoption process is automated for simple one-touch commissioning.

The SEL-2740S can be commissioned and adopted out-of-band or in-band before or after deployment. Special attention must be made when using in-band management to configure all the flows in the switches between the flow controller and the destination switch. The SEL-2740S communicates with one flow controller and once commissioned stops publishing the OpenFlow discovery packet. To adopt the switch to a different flow controller, the switch must be factory-default reset either through the current flow controller settings or through the pinhole reset button on the front of the switch.

Time Synchronization

The SEL-2740S supports synchronizing the local time with ACTS or NTP. The switch time is set at adoption to synchronize with the SEL-5056 time. When ACTS or NTP are enabled, those services maintain time synchronization with their respective time sources. The SEL-2740S can be configured with as many as three NTP servers. The switch will attempt to synchronize to the configured time servers in priority order of when each time server was entered into the configuration. ACTS provides ongoing time synchronization in which the SEL-5056 synchronizes the switch time with its own time source every time the flow controller checks synchronization on the switch. The configuration of time synchronization for the SEL-2740S is performed in the SEL-5056. Specific settings are detailed in the *SEL-5056 SDN Flow Controller Instruction Manual*.

Managing Precision Time Protocol

The SEL-2740S is an IEEE C37.238-2017 Power Profile peer-to-peer (P2P) transparent clock (TC) with synchronization support. The SEL-2740S can also be used in an IEEE C37.238-2011 and IEEE 1588 Default P2P network to update Precision Time Protocol (PTP) event messages. The SEL-2740S does not use PTP to set system time. PTP is disabled by default but can be enabled in the SEL-2740S configuration node settings. The SEL-2740S has the fixed PTP settings shown in *Table 14*.

Table 14 Fixed PTP Settings

Setting	Value
P2P Delay Request Interval	1 (in seconds)
Domain	0
VID	None (all PTP messages sourced from the SEL-2740S are untagged)

To meet the performance requirements of IEEE C37.238-2017 or -2011 Power Profile, the user must configure the network and end devices correctly, including ensuring the following:

- The PTP domain of the master(s) must be 0 for the SEL-2740S to synthesize.
- The modules used for passing PTP messages through the SEL-2740S must be 100BASE-T, 1000BASE-T, 100BASE-FX, 1000BASE-SX, 100BASE-LX, or 1000BASE-LX.
- All equipment between the PTP master and the SEL-2740S must meet Power Profile requirements.
- The following flows must be present on each SEL-2740S between the PTP master and clients:
 - Send P2P messages to the local port to enable the P2P delay mechanism.
 - Forward Sync and Announce messages between PTP masters and between each PTP master and client.

Interruptions to the PTP flow or adding or removing modules interrupts synchronization. The SEL-2740S continuously sends untagged P2P delay requests outside of the OpenFlow pipeline at the P2P delay request interval. The local port on the SEL-2740S accepts both single-tagged and untagged packets.

Logging

The SEL-2740S logs events through Syslog and stores 4096 local events. The SEL-5056 also collects the logs from each switch and, if configured to, also sends Syslog log messages to any configured log server and records them to the Windows event log files.

Syslog is configured in the SEL-2740S through the logging settings in the SEL-5056. The SEL-2740S supports UDP (RFC 3164) and TLS Syslog (RFC 5424 over RFC 5425) protocols.

The Syslog delivery failure message, "Log delivery was not confirmed to behavior {behavior type} for event with id {Id},," appears once for each message if that message cannot be sent to at least one Syslog server with the TLS transport method type because the TLS connection is not present from the SEL-2740S to the Syslog server or the acknowledgment of the TCP delivery is not received.

OpenFlow changes can happen rapidly and the logs from the SEL-2740S will have combined many of the OpenFlow actions to a single log. The Syslog message "OpenFlow changes ({numberOfChanges}): {Change Description}" reports the number of changes and a list of as many as 50 of the changes in 10-second intervals. The list is comma-separated and includes an abbreviation and number. All numbers are in hexadecimal format.

Table 15 describes the meaning of the abbreviation and what the number represents.

Table 15 OpenFlow Changes Event Description

Abbreviation	Description	Number (in Hexadecimal Format)
Fa	Flow entry added	Flow ID
Fd	Flow Entry deleted	Flow ID
Fm	Flow entry modified	Flow ID
Fr	Flow replaced	Flow ID
Fto	Flow entry deleted because of time-out	Flow ID
Ga	Group entry added	Group ID
Gd	Group entry deleted	Group ID
Gm	Group entry modified	Group ID
Ma	Meter entry added	Meter ID
Md	Meter entry deleted	Meter ID
Mm	Meter entry modified	Meter ID
Pa	OpenFlow port added	Port ID
Pd	OpenFlow port deleted	Port ID
Pm	OpenFlow port modified	Port ID

Centrally Manage and Monitor With SEL-5056

All configuration and monitoring of the SEL-2740S happens through the SEL-5056. Refer to the *SEL-5056 SDN Flow Controller Instruction Manual* for all configuration and monitoring options of the SEL-2740S.

SNMP

The SEL SDN switches support SNMP for read-only status monitoring. SNMPv2c and SNMPv3 are supported. SNMP is disabled by default and either or both can be enabled. When you use SNMPv2c you can set the community string. If no string is supplied, the string defaults to "public". When you use SNMPv3, refer to the SEL-5056 manual under the SNMP Configuration section for details.

The SEL SDN switch supports the following MIBs:

- ▶ If-MIB
- ▶ Entity-MIB for the entPhysicalTable
- ▶ System-MIB for Description, Name, Location, Object Identifier, and System Up Time
- ▶ SEL-274XS-Alarm-Contact-MIB
- ▶ SEL-274XS-Module-MIB
- ▶ SEL-274XS-Power-Supply-MIB
- ▶ SEL-274XS-Switch-Configuration-MIB
- ▶ SEL-Definitions-MIB
- ▶ SEL-Products-MIB

Table 16 If-MIB Table

Interface	If-Index	Description
ethb-1	2	
ethb-2	3	
ethb-3	4	
ethb-4	5	
ethc-1	6	
ethc-2	7	
ethc-3	8	
ethc-4	9	
ethd-1	10	
ethd-2	11	
ethd-3	12	
ethd-4	13	
ethe-1	14	
ethe-2	15	
ethe-3	16	
ethe-4	17	
ethf-1	18	
ethf-2	19	
ethf-3	20	
ethf-4	21	
eth0	22	Front Ethernet Port

You can download the MIBs and read their details at the SEL-2740S product page (selinc.com/SEL-2740S).

SEL-2740S Switch Device View, Local Logs, and Alarms

Device View

The Device View page contains chassis, module, and port information and diagnostics of the SEL SDN switch. Device view is accessed through the SEL-5056. Refer to the *SEL-5056 SDN Flow Controller Instruction Manual* on how to access the switch device view.

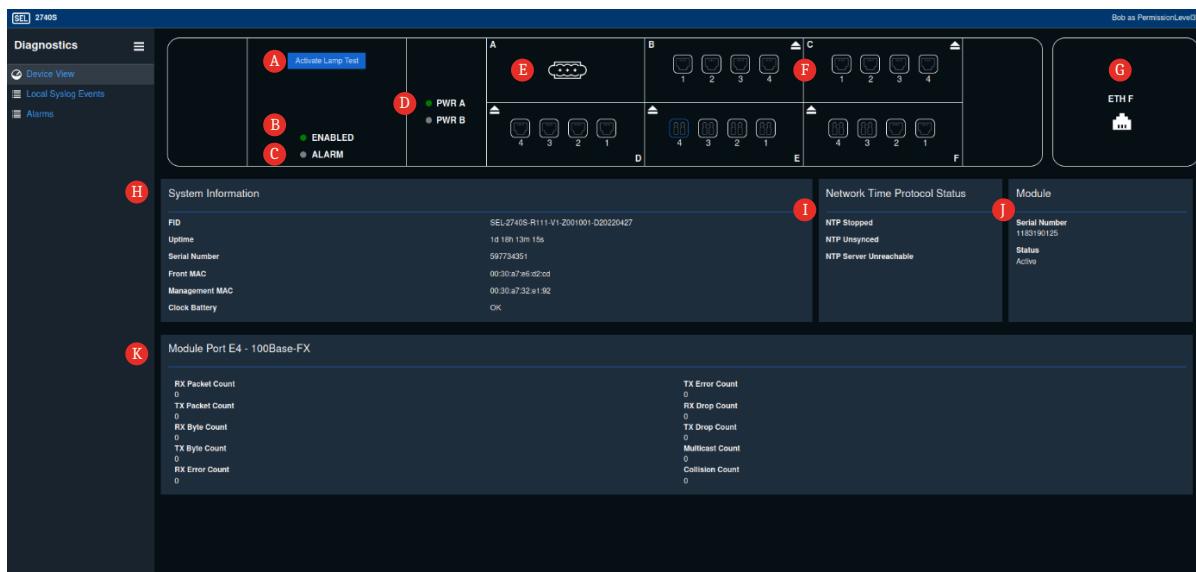


Figure 9 Device View Page

- (A) **Activate Lamp Test:** Illuminates all LEDs in sequence, validating that they operate properly.
- (B) **Enabled LED Status:** Matches front-panel **ENABLED** LED.
- (C) **Alarm LED Status:** Matches front-panel **ALARM** LED.
- (D) **Power LED Status:** Status of Power Supply A and B.
- (E) **Alarm Contact:** Select the image to show the Module (J) information.
- (F) **Eject Button:** Select to eject the corresponding module.
- (G) **Front Port:** Select to show front-port diagnostics.
- (H) **System Information:** Provides chassis information.
- (I) **Network Time Protocol Status:** Status of NTP on the SEL-2740S.
- (J) **Module Status:** Provides serial number and status for the selected module.
- (K) **Module Port Diagnostics and Type:** Provides diagnostics and type of selected port.

NOTE

Fiber module types manufactured after April 2020 will display the module fiber type. Any module manufactured prior to April 2020 will display that it is a fiber module but not the fiber type.

Port States and Media Types

Table 17 Port Status Images

Port Status	Image
Up	
Down or Disabled	

Table 18 Media Images

Media Type	Image
Copper	
Fiber	

Local Syslog Events

The Local Syslog Events page lists the stored events on the switch.

The screenshot shows a table of log entries with the following columns: ID, Timestamp, Tag, Severity, and Message. The table includes a header row with filters for Tags, Severity, and a search bar for the message text. At the top right are buttons for 'Acknowledge All' (B) and 'Export as CSV' (C). Below the table are navigation controls for pages and records per page, with labels E and F pointing to them. Red circles with letters A through F point to specific UI elements: A points to the Tag filter; B points to the Acknowledge All button; C points to the Export as CSV button; D points to the Acknowledge button for the first entry; E points to the page number '1 of 4'; and F points to the 'Records Per Page' dropdown.

ID	Timestamp	Tag	Severity	Message
34	12/24/2018 12:50AM +00:00	System	Notice	Port ethd-3 changed link state to up.
33	12/24/2018 12:50AM +00:00	System	Notice	Port ethd-3 changed link state to down.
32	12/24/2018 12:48AM +00:00	Openflow	Informational	OpenFlow changes (4): Pd 4,Pd 3,Pd 2,Pd 1
31	12/24/2018 12:48AM +00:00	Hardware Module Manager	Warning	Slot B: Module powered down.
30	12/24/2018 12:48AM +00:00	System	Notice	Port ethb-2 changed link state to down.
29	12/24/2018 12:48AM +00:00	System	Notice	Port ethb-1 changed link state to down.
28	12/24/2018 12:48AM +00:00	DataBroker	Informational	User admin with role Administrator and module RestBroker executed unbound action DeactivateModule from IP address 172.16.100.8
27	12/24/2018 12:48AM +00:00	System	Notice	Port ethb-2 changed link state to up.
26	12/24/2018 12:48AM +00:00	System	Notice	Port ethb-1 changed link state to up.
25	12/24/2018 12:48AM +00:00	System	Notice	Port ethb-2 changed link state to down.

Figure 10 Local Syslog Events Page

- (A) **Filter Settings:** Filter what events are shown by tag, severity, or partial or complete message.
- (B) **Acknowledge All Button:** Acknowledge all unacknowledged events.
- (C) **Export as CSV:** Export all events in CSV format.
- (D) **Acknowledge Button:** Acknowledge a single event.
- (E) **Page Number:** Move to the previous or next page.
- (F) **Records Per Page:** Change the number of events displayed per page.

Alarms View

The Alarms page (shown in *Figure 11*) lists major alarms that are active and allows you to acknowledge those alarms.

The screenshot shows a table with three columns: Alarm Message, Time Alarm Triggered, and Actions. The first row contains the following information: 'Firmware upgrade from SEL-2740S-X191-V0-Z001001-D20181220 to ? failed at step 2 of 8.' under 'Alarm Message', '12/24/2018 02:37AM +00:00' under 'Time Alarm Triggered', and an 'Acknowledge' button under 'Actions'. A red circle with letter A points to the alarm message, and another red circle with letter B points to the 'Acknowledge' button.

Alarm Message	Time Alarm Triggered	Actions
Firmware upgrade from SEL-2740S-X191-V0-Z001001-D20181220 to ? failed at step 2 of 8.	12/24/2018 02:37AM +00:00	Acknowledge B

Figure 11 Alarms Page

- (A) **Alarm Table:** Lists present major alarms.
- (B) **Acknowledge Button:** Clears the alarm.

OpenFlow

This section provides a reference for the parts of OpenFlow 1.3 that are supported by the SEL-2740S SDN Switch. The SEL-2740S is OpenFlow-compatible and does not have legacy control plane technology such as spanning tree. This allows OpenFlow to be the underlay control plane on the network, resulting in significant performance, cybersecurity, and situational awareness advantages. For detailed information on OpenFlow version 1.3, refer to the standard at www.opennetworking.org.

The SEL-2740S supports out-of-band and in-band management. When using out-of-band management, SEL-5056 communicates with the SEL-2740S through the **ETH F** port. When using in-band management, SEL-5056 communicates with the SEL-2740S through any port except **ETH F**.

Flow entries are the building blocks necessary for traffic engineering the network. Traffic engineering allows proactive configuration of how all packets travel through the network under normal or faulted conditions.

The SEL-2740S uses the capabilities defined in the OpenFlow standard, not legacy switch behaviors (such as Spanning Tree Protocol [STP] and dynamic MAC learning) to forward packets through the switch. As an OpenFlow switch, the SEL-2740S can be divided into the following seven separate OpenFlow components (each of these components is discussed in this section):

- ▶ Counters
- ▶ Ports and queues
- ▶ General settings
- ▶ Match fields
- ▶ Instructions and actions
- ▶ Groups and action buckets
- ▶ Meters and meter bands

Table 19 shows the OpenFlow resources available in the SEL-2740S.

Table 19 Complete List of Supported OpenFlow Parameters

Parameter	Supported
Priority Queues Per Port	4
Flow Tables	4
Flow Entries Per Table	2,048
Group Entries	256
Action Buckets Per Group	30
Unique Action Buckets	128
Meter Entries	64
Meter Bands Per Meter Entry	1

Counters and Parameters

Table 20 Complete List of Supported Counters

Type of Counter	Name	Description
Port	Received Packets	Packet count received per port
	Transmitted Packets	Packet count transmitted per port
	Received Bytes	Byte count received per port
	Transmitted Bytes	Byte count transmitted per port
Flow Table	Active Count	Number of flow entries in the flow table
Flow Entry	Received Packets	Packet count applied to the flow entry
	Received Bytes	Byte count applied to the flow entry
	Duration	Elapsed time from when the flow entry was programmed or last modified (in milliseconds)
Group Entry	Packet Count	Packet count applied to the group entry
	Byte Count	Byte count applied to the group entry
	Reference Count	Number of flow entries referencing the group entry
	Duration	Elapsed time from when the group entry was programmed or last modified (in milliseconds)
Meter Entry	Input Packet Count	Packet count applied to the meter entry
	Input Byte Count	Byte count applied to the meter entry
	Reference Count	Number of flow entries referencing the meter entry
	Duration	Elapsed time from when the meter was programmed or last modified (in milliseconds)
Meter Band	In-Band Packet Count	Packet count applied to the meter band
	In-Band Byte Count	Byte count applied to the meter band

Ports

Table 21 SEL-2740S Port Types

Ports	Description	Value	Friendly Name	Port Diagnostics	Valid InPort	Valid OutPort	Valid Watch Port
Physical	20 rear ports ^a	1–20	XY ^b	Yes	Yes	Yes	Yes
Ingress ^c	Alias for physical ingress port	0xffffffff8	Ingress	No	No	Yes	No
All	Forwards to all standard ports except the ingress port	0xffffffffc	All	No	No	Yes	No
Controller	Forwards packets to the SEL-5056	0xffffffffd	Controller	No	Yes	Yes	No
Local	Forwards to the management interface for in-band management	0xffffffffe	Local	Yes	Yes	Yes	No

Ports	Description	Value	Friendly Name	Port Diagnostics	Valid InPort	Valid OutPort	Valid Watch Port
Any	The watch port used when there is no port liveness	0xffffffff	Any	No	No	No	Yes

^a Data ports may be referenced in OpenFlow entries, even if the Ethernet module is not present.

^b X is B-F, and Y is 1-4. See Ports on page 7.

^c The Ingress port is an alias for the physical ingress port and must be used to send a packet out the ingress port. For example, if a packet comes in on Port 5, to send the packet back out Port 5, the OutPort must be Ingress and not 5. When capitalized, Ingress refers to the OpenFlow Ingress port. Otherwise, it refers to the ingress physical port.

The SEL-2740S has four priority queues per port. The queues are serviced according to an 8:4:2:1 WRR schedule.

Table 22 Priority Queue Precedence

Priority Queue	Precedence
4	Highest
3	Higher
2	Default
1	Lowest

The SEL-2740S sets the priority queue with the SetQueue OpenFlow action, and if no SetQueue action is in the flow entry, the default priority is 2. The SEL-2740S does not act on the VLAN priority tag data. Egress priority can be set without a VLAN tag by including the instruction in the flow entry.

The SEL-2740S supports the administrative settings listed in *Table 23* for a physical port. Each of these settings may be True or False. These settings cannot be modified for a port that is inactive, and settings are reset to the default value if the SEL-2740S is reset.

Table 23 Port Settings

Setting	Default Value (if Supported ^a)	Supported (1000/100/10)
Disable Port	False	Yes
Disable Receiving	False	Yes
Disable Transmitting	False	Yes
Disable Packet In Messages	False	Yes
Auto-Negotiation	True	Yes
Pause	Not supported	N/A
Asymmetric Pause	Not supported	N/A
10 Mbps Full-Duplex	True	Yes
10 Mbps Half-Duplex	True	Yes
100 Mbps Full-Duplex	True	Yes
100 Mbps Half-Duplex	True	Yes
1 Gbps Full-Duplex	True	Yes ^b
1 Gbps Half-Duplex	True	Yes ^b

^a If not supported, the default value is false.

^b Only for ports in a Slot D module.

Flow entries are critical to the OpenFlow system. Control how packets are forwarded through their match fields and instructions. The SEL-2740S uses match fields to match packets to a flow entry and then executes the instructions in the Flow entry.

Flow entries have the following four parts:

- ▶ General settings
- ▶ Match fields
- ▶ Instructions
- ▶ Counters

The primary purposes of flow entries are to identify all the packets that belong to a conversation between the source and destination and apply uniform instructions to all packets of that conversation. Therefore, a flow entry can be divided into two functions: an ingress function of matching a packet, and an egress function of controlling what to do with that matched packet. Match fields control the behavior of packets on ingress and instructions control the behavior of packets on egress.

General Settings

Table 24 Flow Entry General Settings

Setting	Values	Description
Alias	User-defined string	Friendly name used to identify the flow when looking at the table and counters. Local to the SEL-5056 only.
Flow ID	Set by the controller	ID of the flow entry.
Table ID	0 to 3	Table ID to which the flow entry is programmed.
Priority	0 to 65535 ^a	Setting used for selecting a flow entry when a packet matches multiple flow entries; in this case, the SEL-2740S selects the flow entry with the highest value.
Idle Timeout	0 to 65535	The flow entry is deleted if the set number of seconds has elapsed from when a packet was last applied to the flow entry; a value of 0 disables the time-out.
Hard Timeout	0 to 65535	The flow entry is deleted after the specified number of seconds; a value of 0 disables the timeout.
Check Overlap	True or False	If true, the SEL-2740S prohibits flow entries that have the same priority and may match the same packet in the same flow table; the SEL-5056 sets this to True for every flow entry; this is always enforced when using the SEL-5056.

^a 1000 to 60000 is recommended to prevent conflict with the SEL-5056 auto-generated default flow entries.

The Flow ID setting serves as a reference to a particular flow entry. The SEL-5056 sets this value after you have submitted a new flow entry. This value also serves to reference a flow entry in the list of flow entry counters. If both time-outs are set and either time-out expires, the SEL-2740S deletes the flow. Modifying a flow entry resets the counters.

Supported Match Fields

Table 25 Match Fields

Name	Valid Values	Maskable	Prerequisites		Description
			Type	Value	
ArpOp	0 to 255	No	EthType	0x806	Address Resolution Protocol (ARP) Opcode
ArpSpa	Any valid IPv4 address	Yes	EthType	0x806	ARP source IPv4 address
ArpTpa	Any valid IPv4 address	Yes	EthType	0x806	ARP destination IPv4 address
Cst Match	Any name of a CST	No			Imports the match fields from the CST if not already present in the match fields list
EthDst	Any valid MAC address	Yes			Ethernet destination address
EthSrc	Any valid MAC address	Yes			Ethernet source address
EthType	0 to 65535	No			Ethernet type
InPort	Any valid InPort port listed in <i>Table 21</i>	No			Switch input port
IpProto	0 to 255	No	EthType	0x800	IP Protocol
Ipv4Dst	Any valid IPv4 address	Yes	EthType	0x800	IPv4 destination address
Ipv4Src	Any valid IPv4 address	Yes	EthType	0x800	IPv4 source address
TcpDst	0 to 65535	No	IpProto	6	IPv4 TCP destination port
TcpSrc	0 to 65535	No	IpProto	6	IPv4 TCP source port
UdpDst	0 to 65535	No	IpProto	17	IPv4 UDP destination port
UdpSrc	0 to 65535	No	IpProto	17	IPv4 UDP source port
VlanPcp	0 to 7	No	See VlanVid		VLAN PCP
VlanVid	None, Present, 1 to 4094; Present and 0 to 4095 for mask	Yes			VLAN ID

If the match fields represent the *if*, the instructions (and the possible included actions) represent the *then*. If a packet matches a flow entry, the SEL-2740S applies the instructions of the flow entry to the packet. *Table 26* lists the supported instructions on the SEL-2740S, in order of instruction application.

Table 26 Supported Instructions in Order of Applied Priority

Instruction	Value	Description
Meter	Any valid Meter ID	Directs the packet to a meter
Clear-Actions	None	Removes all of the actions from the action set
Write-Actions	Zero or more of the actions listed in <i>Table 27</i>	Merges the specified action(s) into the action set
Goto-Table	1–3 (value must be higher than the Table ID of the Flow entry)	Sends the packet to the designated table to look for the next match

The Meter instruction sends the flow to the specified meter. If the meter drops the packet, packet processing for that packet stops. Write-Actions instruction actions are not applied to the packet immediately, but they are added to the action set of the packet. The action set is only applied to the packet when packet processing stops, so it does not affect any further matching against the packet.

Table 27 lists the supported actions of the Write-Actions instruction in the order the SEL-2740S executes the actions. The Clear-Actions instruction clears the action set of actions added in previous flow tables. The Goto-Table instruction forwards the packet to another flow table for further matching. The specified table must have a higher Table ID than the Table ID of the present flow entry. Therefore, flow entries in Flow Table 3 cannot have Goto-Table instructions, and flow entries in Flow Table 2 can only have a Goto-Table instruction for Flow Table 3.

Table 27 Supported Write-Actions (in Order of Applied Priority)

Action	Value	Description
PopVlan	None	Pops a VLAN header
PushVlan	0x8100	Pushes a VLAN header
SetVlanId	0 to 4095 ^a	Sets the VLAN ID of the outermost VLAN header
SetVlanPcp	0 to 7	Sets the VLAN PCP value
SetQueue	1 to 4	Sets the priority queue
Group by Alias or Group by Value	Any valid Group ID or alias	Sends the packet to the group represented by the Group ID or alias
Output by Alias or Output by Value	Any valid port number or the alias of an adopted port	Sends the packet out of the port represented by the port name or alias

^a The value 0 indicates a priority-tagged packet. The value 4095 is reserved by IEEE 802.1Q.

The Output action sends the packet to the specified port, referred to as the OutPort. This OutPort can be any of the valid OutPorts listed in *Table 21*. The Output action is required for egress packets coming from the SEL-2740S. If an OutPort action is never executed against a packet, the packet is dropped. This Output action may be present in the Group action instead of directly in the flow entry. The Group action sends the packet to the specified group. The group can be any of the presently programmed groups on the SEL-2740S. When adding a new VLAN header, the SEL-2740S copies the VLAN ID and VLAN PCP fields from the previous VLAN tag to the new VLAN tag, if present, or sets them at 0, if not present. Use the SetVlanId and SetVlanPcp actions when using the pushVLAN action to set the fields in the header. To set the VLAN ID or VLAN PCP, a VLAN header must be present. This requires that either the VlanVid match fields be present with a value of Present or of 0 to 4095, or that the PushVlan action also be present.

You can add flow entries to a flow table if you do not exceed the limit of 2,048 flow entries per table. This limit includes the default flows.

Modifying or deleting a flow entry may disrupt packets that are applied to that flow entry, including packet loss. If you delete a Group or Meter entry, all flow entries that reference that group or meter are also deleted. Flow entries with timeouts are deleted when the SEL-2740S resets or cycles power.

You can only program one flow entry with the same match fields and priority for each flow table.

Additionally, you cannot program flow entries on the same flow table with different match fields and the same priority that match the same packets.

The SEL-2740S supports all four OpenFlow group types and supports as many as the allowed amount in *Table 28*.

Table 28 SEL-2740S Supported Group Use

Parameter	Supported Number
Groups	256
Action Buckets Per Group	30
Unique Action Buckets	128

Table 29 lists the general settings supported by the SEL-2740S.

Table 29 Group Entry General Settings

Setting	Values	Description
Group ID	0 to 4294967040	ID of the Group Entry
Group Type	Indirect, All, Select, Fast Failover	Type of the Group

The Group ID setting is used to reference the group in a Group action and for counters. Table 30 lists the supported attributes in each group.

Table 30 Group Type Parameters

Group Type	Number of Group Chaining	Packet Duplication	Liveness	Relationship
Indirect	2	No	No	Aliasing
All	2	Yes	No	Duplication
Select ^a	0	No	No	Aggregation
Fast Failover	2	No	Yes	Redundancy

^a One Select group can be used per switch.

The SEL-2740S supports the following action bucket configurations. Table 31 lists all of the parameters per group type for Watch port and Watch group, supported actions, and the maximum number of action buckets.

The SEL-2740S treats each set of actions in an action bucket as its own action. A group with no action buckets drops the packet. Because the action set of a packet through the flow tables is applied before the packet is sent to a group entry, action bucket actions are applied after the SEL-2740S has applied all of the Write-Actions instruction actions to the packet. If an action bucket forwards a packet to another group, the SEL-2740S applies the actions of the second action bucket to the packet after applying the actions of the first action bucket and the action of the Write-Actions instruction of the Flow entry. There are no prerequisites for action bucket actions. If the action bucket contains a PopVlan, SetVlanId, or SetVlanPcp action without a PushVlan action and the packet did not have a VLAN tag when sent to the group (for example, if the Write-Actions Instruction action set contains a PopVlan action), the SEL-2740S discards the packet. The SEL-2740S supports 128 unique action buckets per switch. An action bucket is unique if the Watch port, Watch group, and actions are unique. If more than one action bucket has the same Watch port, Watch group, and actions, these action buckets still only count as one action bucket toward the limit of 128.

Table 31 Group Type Configuration Options

Group Type	Action Buckets Supported	Valid Watch Port	Valid Watch Group	Supported Actions
Indirect	1	Any	Any	Output, Group
All	30	Any	Any	Output, Group, PushVlan, PopVlan, SetQueue, SetVlanVid, SetVlanPcp
Select	30	Any ^a	Any	Output
Fast Failover	30	Any Watch port listed in <i>Table 21</i>	Group ID of a Fast Failover group on the switch or Any	Output, Group, PushVlan, PopVlan, SetQueue, SetVlanVid, SetVlanPcp

^a Although the watch port must be Any, action buckets with a downed OutPort are automatically skipped.

^b Either the watch port or watch group may be Any, but not both.

Meters provide simple QoS rate limiting. The SEL-2740S supports 64 meters. Each meter must have exactly one meter band. A meter band may have only a rate, or it may have both a rate and a burst size (if Set Burst Size is True). The rate and burst size may be in packets per second (PPS) or Kbps. *Table 32* lists the SEL-2740S meter settings.

Table 32 SEL-2740S Supported Meter Use

Setting	Valid Values	Description
Meter ID	1 to 64	ID of the Meter entry
Measurement Type	Kbps or PPS	Defines the unit of measurement for the Rate and Burst Size Meter Band settings
Set Burst Size	True or False	If True, the meter band burst size is user-defined; if False, the minimum value is used

The Rate and Burst Size settings are listed in *Table 33* and depend on the Measurement Type setting of the meter band. The Burst Size setting defines the size of the meter, and the range of accepted values depends on the Meter Rate setting. If no burst size is set, or if it is set to a value below the minimum, Burst Size defaults to a minimum value as determined by the equation shown in *Table 33*. Using this minimum value with traffic in bursts may cause traffic loss even though the traffic rate is much lower than the meter rate. Burst Size is in bytes if the Rate setting is in Kbps, and in packets if the Rate setting is in PPS.

Table 33 Meter Rate and Burst Size Setting Ranges

Setting	Measurement Type	Minimum Value	Maximum Value
Meter Rate	Kbps	1	110000
	Pps	1	624999
Burst Size	Kbps	$1632 / 1 - ([\text{Rate} / 125,000,000])$	$16,777,215 / (1 - [\text{Rate} / 125,000,000])$
	Pps	$256 / (1 - [\text{Rate} / 625,000])$	$16,777,215 / (1 - [\text{Rate} / 625,000])$

If you modify or delete a meter entry, all flow entries referencing that meter entry are also deleted.

For explanations on OpenFlow, refer to the *SEL-5056 SDN Flow Controller Instruction Manual* and the OpenFlow standard at OpenNetworking.org.

Dimensions

RACK MOUNT CHASSIS

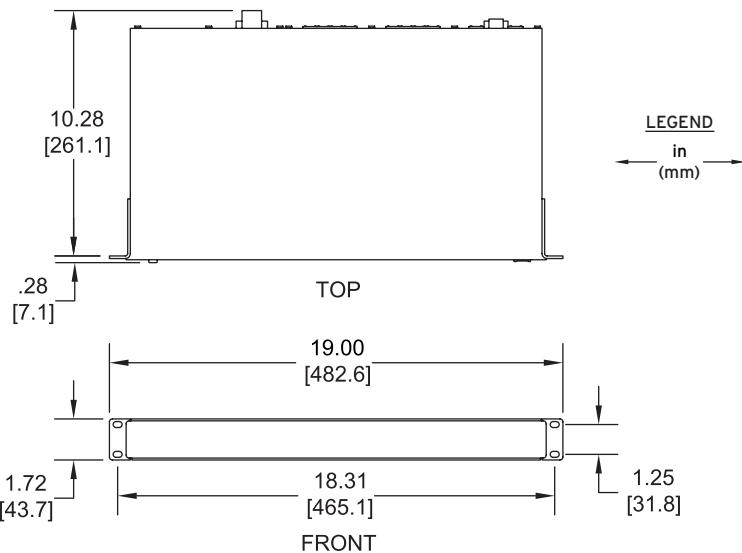


Figure 12 SEL-2740S Rack Mount Dimensions

The dimensions for the panel mount option are shown in *Figure 13*.

PANEL MOUNT CHASSIS

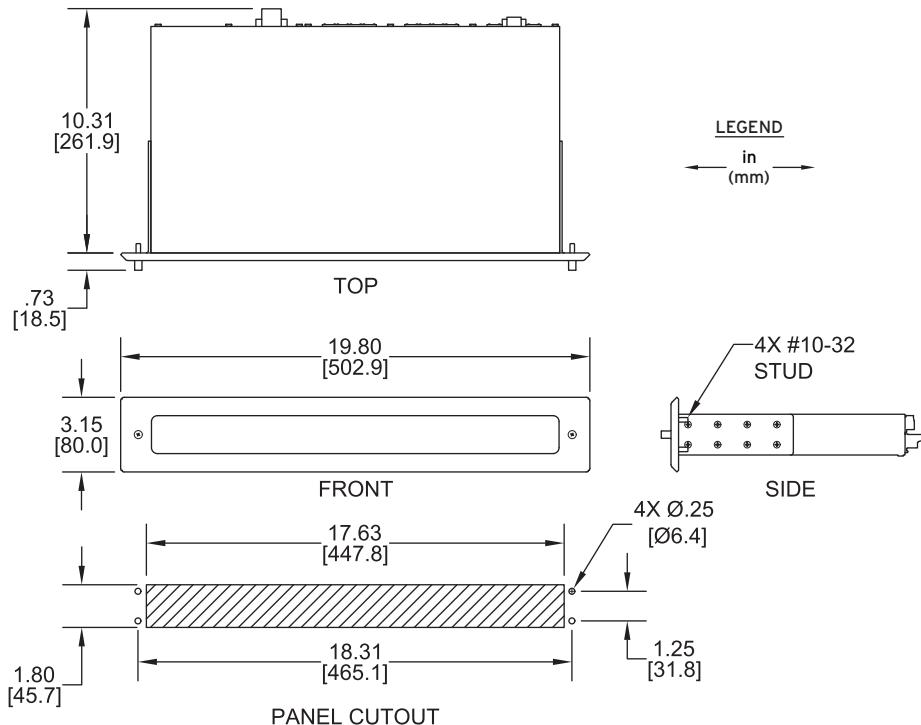


Figure 13 SEL-2740S Panel Mount Dimensions

The dimensions for the optional surface mount kit, part number 915900533, are shown in *Figure 14*.

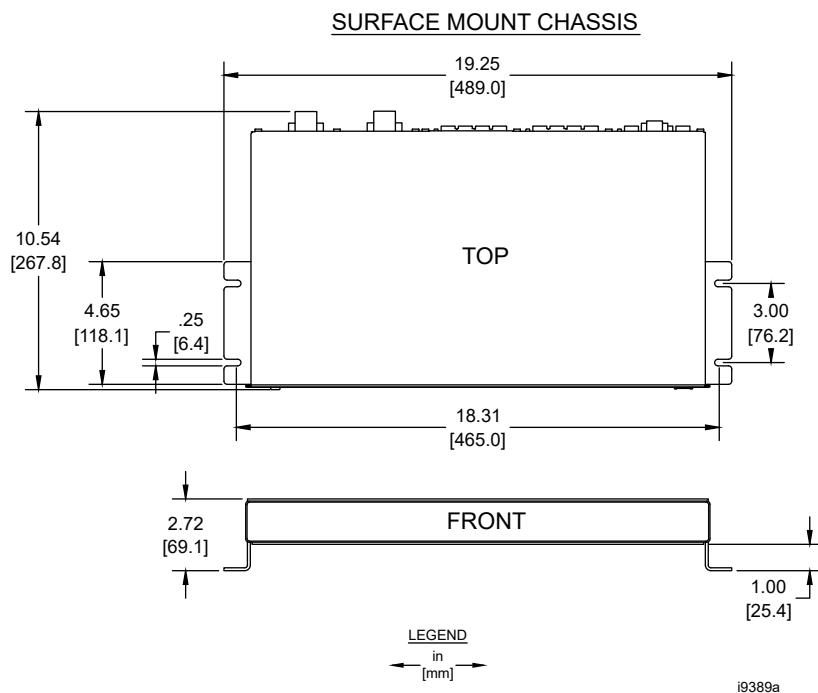


Figure 14 SEL-2740S Surface Mount Dimensions

Front and Rear Panels

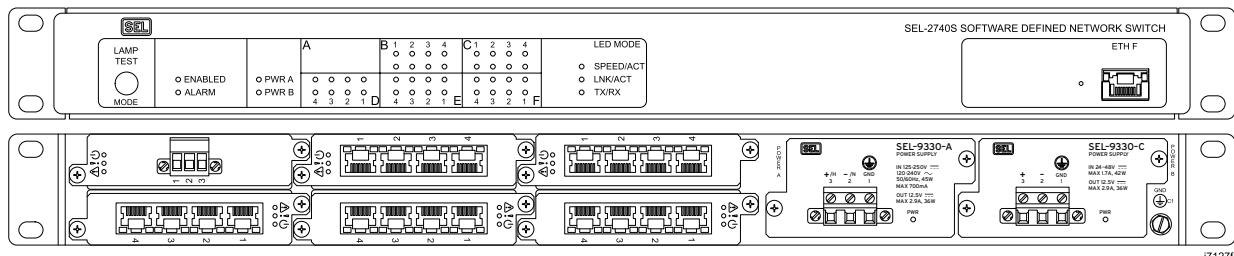


Figure 15 SEL-2740S Front and Rear Panels

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

UL recognized to U.S. and Canadian safety standards
(File E220228, NRAQ/NRAQ7)

47 CFR 15B, Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

FIPS 140-2 Level 1 Validated

CE Mark
UKCA Mark
RCM Mark
Green Product
Compliant with the European Union's RoHS directive

General

Switching Properties

Switching Method:	Store and forward
Switch Fabric Throughput:	5.6 Gbps
Priority Queues:	4
Priority Queue Method:	8:4:2:1 weighted round-robin (WRR)
Flow Entries:	8,192
Flow Tables:	4
Maximum Transmission Unit (MTU):	1632

Warranty

10 years

Network Management

SNMP v2c, v3

OpenFlow 1.3

Group Entries:	256
Action Buckets Per Group Entry:	30
Group Types:	All, Select, Indirect, Fast Failover
Instructions:	Write-Actions, Meter, Clear-Actions, Goto-Table
Actions:	Output, Group, Push Vlan, Pop Vlan, Set Queue, Set VID, Set PCP

Secure Communication

TLS with the OpenFlow controller

X.509 certificate to establish TLS connection to the OpenFlow controller

Logging and Diagnostics

Syslog

UDP and TLS

OpenFlow 1.3

SNMP v2c, v3

Precision Time Protocol

Profile

IEEE C37.238-2017 (Power Profile)

Transparent Clock (100BASE-TX, 1000BASE-T, 100BASE-FX, 1000BASE-SX, 100BASE-LX, or 1000BASE-LX)

Network Time Inaccuracy (NTI): 49 ns

Communications Ports**Ethernet Ports**

Ports: 20 rear
1 front

Data Rate

Slots B, C, E, F:	10 or 100 Mbps
Slot D:	10, 100, or 1000 Mbps
Front Connector:	RJ45 female
Rear Connectors:	RJ45 female or LC fiber (single-mode or multimode)
Standard:	IEEE 802.3

Fiber-Optic Ports**10BASE-FL Multimode Option (to 2 km)**

Maximum TX Power:	-12 dBm
Minimum TX Power:	-19 dBm
Maximum RX Power:	-12 dBm
RX Sensitivity:	-32 dBm
System Gain:	13 dB
Source:	VCSEL
Wavelength:	850 nm
Connector Type:	LC (IEC 61754-20)

100BASE-FX Multimode Option (to 2 km)

Maximum TX Power:	-14 dBm
Minimum TX Power:	-19 dBm
Maximum RX Power:	-14 dBm
RX Sensitivity:	-31 dBm
System Gain:	12 dB
Source:	FP laser
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)

100BASE-LX Single-Mode Option (to 10 km)

Maximum TX Power:	-8 dBm
Minimum TX Power:	-15 dBm
Maximum RX Power:	-8 dBm
RX Sensitivity:	-25 dBm
System Gain:	10 dBm
Source:	FP laser
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)

1000BASE-LX Single-Mode Option (to 10 km)

Maximum TX Power:	-3 dBm
Minimum TX Power:	-11.5 dBm
Maximum RX Power:	-3 dBm
RX Sensitivity:	-19 dBm

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System Gain:	7.5 dB
Source:	FP laser
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)
1000BASE-SX Multimode Option (to 500 m)	
Maximum TX Power:	0 dBm
Minimum TX Power:	-9.5 dBm
Maximum RX Power:	0 dBm
RX Sensitivity:	-17 dBm
System Gain:	7.5 dB
Source:	VCSEL
Wavelength:	850 nm
Connector Type:	LC (IEC 61754-20)
1000BASE-EX Single-Mode Option (to 40 km)	
Maximum TX Power:	0 dBm
Minimum TX Power:	-4.5 dBm
Maximum RX Power:	-3 dBm
RX Sensitivity:	-22.5 dBm
System Gain:	18 dB
Source:	FP laser
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)

Note: If connecting with a short fiber-optic cable, a minimum of 3 dB attenuation is required for proper operation.

Ethernet

IEEE 802.3

IEEE 802.3ac

Power Supply

125–250 Volt Power Supply (SEL-9330-A)

Rated Voltage Range:	125–250 Vdc 120–240 Vac, 50/60 Hz
Min/Max Voltage:	88–300 Vdc 85–264 Vac

Maximum Burden

AC:	<70 VA
DC:	<45 W
Input Voltage Interruptions:	50 ms @ 125 Vac/Vdc 100 ms @ 250 Vac/Vdc

24–48 Volt Power Supply (SEL-9330-C)

Rated Voltage Range:	24–48 Vdc
Min/Max Voltage:	19.2–60.0 Vdc
Maximum Burden:	<42 W
Input Voltage Interruptions:	50 ms @ 48 Vdc 10 ms @ 24 Vdc

Power Supply Fuse Ratings

SEL-9330-A:	2.5 A, 250 Vdc/300 Vac time-lag T, 250 Vac/1500 A break rating
SEL-9330-C:	4.0 A, 150 Vdc time-lag T, 250 Vac/1500 A break rating

Note: Fuses are not user-serviceable.

Recommended External Overcurrent Protection

Breaker Type:	Standard
Breaker Rating:	15 A at 250 Vdc

Alarm Contact Output

Output Type:	Relay, Form C, break-before-make	
Power Supply Burden:	<1 W maximum	
Mechanical Life:	2,000,000 operations	
Operational Voltage:	250 Vac/Vdc	
Make:	30 A at 250 Vdc	
Carry:	6 A continuous at 70°C	
1 s Rating:	50 A	
MOV Protection:	270 Vac, 23 J	
Insulation Voltage:	300 Vdc	
Pickup Time:	<8 ms	
Dropout Time:	<8 ms	
Breaking Capacity (10,000 Operations):		
24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

Cyclic Capacity (2.5 Cycles/Second):

24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

Terminal Connections

Compression Screw Terminals

Power Wiring

Insulation:	300 V minimum
Size:	12–18 AWG
Tightening Torque Min/Max:	0.6–0.8 Nm (5–7 in-lb)

Note: Crimp ferrule is recommended.

Alarm Wiring

Insulation:	300 V minimum
Size:	16–24 AWG
Tightening Torque Min/Max:	0.5–0.6 Nm (4–5 in-lb)

Note: Crimp ferrule is recommended.

Grounding Screw

Ground Wiring

Insulation:	300 V minimum
Size:	12 AWG
Length:	<3 m
Tightening Torque Min/Max:	0.9–1.4 Nm (8–12 in-lb)

Note: Ring terminal is recommended.

Mounting

Mounting Ear Tightening Torque Min/ 2–4 Nm (18–35 in-lb)
Max:

Dimensions

1U Rack Mount

Height:	43.7 mm (1.72 in)
Depth:	261.1 mm (10.28 in)
Width:	482.6 mm (19 in)

1U Panel Mount

Height:	80.0 mm (3.15 in)
Depth:	261.9 mm (10.31 in)
Width:	502.9 mm (19.80 in)

1U Surface Mount

Height:	69.1 mm (2.72 in)
Depth:	267.8 mm (9.74 in)
Width:	489.0 mm (19.25 in)

Weight

1.96 kg (4.3 lb)

Environmental

Operating Temperature

–40° to +85°C (–40° to +185°F)

Relative Humidity

0% to 95% noncondensing

Altitude

2000 m

Atmospheric Pressure

80–210 kPa

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Insulation Class:	I

Enclosure Protection

IEC 60529:2001 + A2:2014
Severity Level: IP20

Type Tests

Communications Product Testing

IEC 61850-3:2013, Performance Class 1

IEEE 1613, Class 1

IEEE 1613-2009, Class 1* KEMA certified

IEC 61850-3:2013 KEMA certified

IEC 61850-90-4 KEMA certified

* With SEL-C627-R or equivalent cables.

Electromagnetic Compatibility Emissions

Generic Emissions: 47 CFR:2008 Part 15.107 & 109

EN 60255-26:2013

IEC 60255-26:2013

EN 61850-3:2014

IEC 61850-3:2013

EN 55011:2009 + A1:2010

EN 55022:2010 + AC:2011

EN 55032:2012 + AC:2013

EN 55016 (Series)

CISPR 11:2009 + A1:2010

CISPR 22:2008

Canada ICES-001 (A) / NMB-001 (A)

ANSI C63.4:2014

Severity Level: Class A

Electromagnetic Compatibility Immunity

Conducted RF Immunity: IEC 60255-26:2013

Severity Level: 10 Vrms

IEC 61000-4-6:2008

Severity Level: 10 Vrms

Radiated RF Immunity: IEEE C37.90.2-2004

Severity Level: 20 V/m unmodulated
80 MHz–1 GHz

IEEE 1613-2003 Class 1

IEC 60255-26:2013

Severity Level: 10 V/m unmodulated
80 MHz–1 GHz, 1.4–2.7 GHz

Conducted Common-Mode Disturbance (CCMD): IEC 61000-4-16:2009

Severity Level: 4

Profile Level: 4

Electrostatic Discharge Immunity: IEC 60255-26:2013

Severity Level: 2, 4, 6, 8 kV contact;
2, 4, 8, 15 kV air

IEC 61000-4-2:2008

Severity Level: 2, 4, 6, 8 kV contact;
2, 4, 8, 15 kV air

IEEE 1613-2003 Class 1

IEEE C37.90.3-2001

Severity Level: 2, 4, 8 kV contact;
4, 8, 15 kV air

Fast Transient/Burst Immunity: IEC 60255-26:2013

IEC 61000-4-4:2012

Severity Level: Zone A

IEEE 1613-2003 Class 1

Magnetic Field Immunity: IEC 61000-4-8:2009

IEC 61000-4-10:2000

Severity Level: 100 A/m
(100 kHz and 1 MHz)

IEC 60255-26:2013

Severity Level: 100 A/m for 60 seconds;
1000 A/m for 3 seconds

IEC 61000-4-9:2001

Severity Level: 1000 A/m

34 Specifications

Power Frequency Immunity:	IEC 60255-26:2013 IEC 61000-4-16:2009 IEC 61000-4-16:2011 Severity Level: Zone A 150 Vrms
Power Supply Immunity:	IEC 60255-26:2013 IEC 61000-4-11:2004 IEC 61000-4-29:2000
Power Supply Ripple:	IEC 60255-26:2013 IEC 61000-4-17:2008 IEEE 1613-2003 Class 1
Power Supply Gradual Shutdown and Startup:	IEC 60255-26:2013 Severity: shutdown ramp 60 seconds, power off 5 minutes, startup 60 seconds
Power Supply Discharge Capacitors:	IEC 60255-27:2013
Power Supply Reverse Polarity and Slow Ramp:	IEC 60255-27:2013
Surge Immunity:	IEC 60255-26:2013 Clause 7.2.7 IEC 61000-4-5:2005 Severity Level: Zone A
Surge Withstand Capability:	IEC 60255-26:2013 IEC 61000-4-18:2010 IEC Surge Withstand Capability Severity Level: 1 MHz common mode, 2.5 kV on power and I/O, 1 kV on communications ports Severity Level: 1 MHz differential mode, 1 kV on power and I/O IEEE C37.90.1-2012 Severity Level Oscillatory: ±2.5 kV, 1 MHz common and differential mode Severity Level Fast Transient: ±4 kV, 2.5 kHz common and differential mode IEEE 1613-2003 Class 1

Environmental

Cold:	IEC 60068-2-1:2007 Severity Level: 16 hours at -40°C IEC 60255-27:2013 IEEE 1613-2003 Class 1
Damp Heat, Cyclic:	IEC 60068-2-30:2005 Severity Level: 25°C Relative Humidity: 93% Duration: 6 cycles IEC 60255-27:2013
Dry Heat:	IEC 60068-2-2:2007 Severity Level: 16 hours at +85°C IEC 60255-27:2013 IEEE 1613-2003 Class 1
Damp Heat, Steady State:	IEC 60068-2-78:2012 Severity Level: 40°C at 90% for 10 days IEC 60255-27:2013 IEEE 1613-2003 Class 1
Vibration:	IEC 60255-21-1:1988 Severity Level: Class 1 endurance, Class 2 response IEC 60255-21-2:1998 Severity Level: Class 1 shock withstand, bump, and Class 2 shock response IEC 60255-21-3:1993 Severity Level: Class 2 (quake response) IEC 60255-27:2013 IEEE 1613-2003 Class 1

Safety

Dielectric Strength:	IEC 60255-27:2013 IEEE 1613-2003 Class 1 IEEE C37.90-2005 3100 Vdc on power supply and alarm contact 2100 Vdc on Ethernet ports Type tested for 1 minute
Impulse:	IEC 60255-27:2013 IEEE 1613-2003 Class 1 IEEE C37.90-2005 Severity Level: Common Mode: 5 kV power supply, alarm contact 2 kV Ethernet ports Common Mode, Port to Port: 5 kV power supply, alarm contact zero-rated, Ethernet ports
Protective Bonding Resistance:	IEC 60255-27:2013 IEEE C37.90-2005

Appendix A: Firmware and Manual Versions

Firmware

Determining the Firmware Version

The firmware version can be determined by navigating to the Device View dashboard and reading the firmware identification number.

The firmware version number is after the R, and the date code is after the D. For example, the following is firmware version number R100, date code November 4, 2016.

FID=SEL-2740S-R100-V3-Z001001-D20161104

Revision History

Table 34 lists the SEL-2740S firmware versions, revision descriptions, and corresponding instruction manual date codes. The most recent firmware version is listed first.

Starting with revisions published after March 1, 2022, changes that address security vulnerabilities are marked with "[Cybersecurity]". Other improvements to cybersecurity functionality that should be evaluated for potential cybersecurity importance are marked with "[Cybersecurity Enhancement]".

Table 34 SEL-2740S Firmware Revision History

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2740S-R113-V1-Z001001-D20240501	Includes all the functions of SEL-2740S-R113-V0-Z001001-D20231218 with the following addition: ► [Cybersecurity] Addressed a denial-of-service vulnerability in a third-party software component that could allow a malicious client to temporarily affect the availability of the web server.	20240501
SEL-2740S-R113-V0-Z001001-D20231218	► Added SNMP support to report the power supply status.	20231218

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Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2740S-R112-V3-Z001001-D20230919	<p>Includes all the functions of SEL-2740S-R112-V2-Z001001-D20230313 with the following addition:</p> <ul style="list-style-type: none"> ▶ [Cybersecurity] Addressed an issue in previous releases where tampering with TLS negotiation could result in weakening the key strength for OpenFlow and Syslog/TLS. 	20230919
SEL-2740S-R112-V2-Z001001-D20230313	<p>Includes all the functions of SEL-2740S-R112-V1-Z001001-D20230106 with the following addition:</p> <ul style="list-style-type: none"> ▶ Addressed an issue present in previous releases where the PTP transparent clock process could restart under certain conditions resulting in increased network time inaccuracy values for two minutes. 	20230313
SEL-2740S-R112-V1-Z001001-D20230106	<p>Includes all the functions of SEL-2740S-R112-V0-Z001001-D2022111 with the following addition:</p> <ul style="list-style-type: none"> ▶ Addressed an issue present in previous releases that caused the switch to lose all flow configurations after a power cycle on switches configured with IGMP IP protocol match value (2) in a flow entry. 	20230106
SEL-2740S-R112-V0-Z001001-D20221110	<ul style="list-style-type: none"> ▶ Added a feature to block downgrade of firmware prior to R112 to prevent compatibility issues with updated hardware. ▶ Enhanced single event upset protections. ▶ Addressed an issue in previous releases where the major alarms did not persist through power cycles. 	20221110
SEL-2740S-R111-V1-Z001001-D20220427	<p>Includes all the functions of SEL-2740S-R111-V0-Z001001-D20220401 with the following additions:</p> <ul style="list-style-type: none"> ▶ Addressed an issue present in previous releases where multicast destinations did not receive packets in mesh topologies. ▶ Added support to display fiber port type in the switch device view. 	20220427
SEL-2740S-R111-V0-Z001001-D20220401	<ul style="list-style-type: none"> ▶ [Cybersecurity] Addressed a security vulnerability allowing Transport Layer Security (TLS) authentication bypass. 	20220401
Note: Firmware version R110-V0 did not release.		
SEL-2740S-R109-V1-Z001001-D20220304	<p>Includes all the functions of SEL-2740S-R109-V0-Z001001-D20211105 with the following addition:</p> <ul style="list-style-type: none"> ▶ Addressed an issue present in previous releases that may cause the switch to lose flows after a power cycle. 	20220304
SEL-2740S-R109-V0-Z001001-D20211105	<ul style="list-style-type: none"> ▶ Added support for Authenticated Controller Time Synchronization (ACTS). ▶ Added support for a configurable alarm contact. ▶ Addressed a PTP issue where in previous releases the switch could set its advertised network time inaccuracy to a value larger than the actual inaccuracy. ▶ Addressed an issue present in previous releases in which an OpenFlow group could become fixed and unable to be changed or deleted. 	20211105
SEL-2740S-R108-V0-Z001001-D20210805	<ul style="list-style-type: none"> ▶ Added support for fast link detect to support microsecond networking healing on Gigabit Ethernet copper ports. ▶ Updated multiple third-party packages to the latest versions. ▶ Addressed an issue in previous releases where flows could be lost on reboots when using PTP. ▶ Addressed an issue in previous releases where ports that are oversubscribed would not consistently manage the priority queues. ▶ Added support for the Lamp Test feature to be initiated through the Device View interface. 	20210805

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2740S-R107-V2-Z001001-D20210402	<p>Includes all the functions of SEL-2740S-R107-V0-Z001001-D20210312 with the following additions:</p> <ul style="list-style-type: none"> ➤ Added support for new mixed fiber and copper gigabit modules. ➤ Addressed an issue in R107 where SNMPv3 credentials are not saved. 	20210402
Note: Firmware version R107-V1 did not release.		
SEL-2740S-R107-V0-Z001001-D20210312	<ul style="list-style-type: none"> ➤ Achieved compliance to FIPS 140-2 Level 1. 	20210312
SEL-2740S-R106-V0-Z001001-D20210122	<ul style="list-style-type: none"> ➤ Added support for SNMPv3. ➤ Added the Entity, Alarm contact, SEL-2740S Module, Power Supply, and Switch Alias MIBs. ➤ Improved internal packet handling and flow configuration timing on boot. ➤ Increased flow table size to support 8,192 flows. 	20210122
SEL-2740S-R105-V0-Z001001-D20200630	<ul style="list-style-type: none"> ➤ Updated multiple third-party packages to latest versions. ➤ Improved handling of dates beyond January 19th, 2038. ➤ Enhanced in-band adoption, allowing adoption on any port. 	20200630
SEL-2740S-R104-V1-Z001001-D20190503	<p>Includes all the functions of SEL-2740S-R104-V0-Z001001-D20190118 with the following additions:</p> <ul style="list-style-type: none"> ➤ Changed the alarm contact behavior for unacknowledged local log storage from latch to pulse. ➤ Improved firmware upgrade handling of unadopted switches, removing the need for an extra factory-default reset. 	20190503
SEL-2740S-R104-V0-Z001001-D20190118	<ul style="list-style-type: none"> ➤ Added support for syslog collection directly from the SEL-2740S. ➤ Enhanced Device View page. ➤ Added support for storing and viewing local events. ➤ Added enable and disable settings for SNMP and PTP. ➤ Added support for importing X.509 trusted certificates. ➤ Added support for as many as three NTP servers. ➤ Updated open-source software components to address the following security vulnerabilities: CVE-2015-8315, CVE-2015-8859, CVE-2016-1834, CVE-2016-7099, CVE-2016-10542, CVE-2017-11499, CVE-2017-16113, CVE-2017-18077, CVE-2018-3750. 	20190118
SEL-2740S-R103-V0-Z001001-D20181012	<ul style="list-style-type: none"> ➤ Added support for 10BASE-FL module. 	20181012
SEL-2740S-R102-V3-Z001001-D20180530	<p>Includes all the functions of SEL-2740S-R102-V2-Z001001-D20180518 with the following addition:</p> <ul style="list-style-type: none"> ➤ Enhanced the manufacturing process. 	20180530
SEL-2740S-R102-V2-Z001001-D20180518	<p>Includes all the functions of SEL-2740S-R102-V1-Z001001-D20180420 with the following addition:</p> <ul style="list-style-type: none"> ➤ Reduced amount of time before an SEL-2740S starts sending out autodiscovery packets. 	20180518
SEL-2740S-R102-V1-Z001001-D20180420	<p>Includes all the functions of SEL-2740S-R102-V0-Z001001-D20180401 with the following addition:</p> <ul style="list-style-type: none"> ➤ Resolved an issue where the fiber link status could be reported incorrectly. 	20180420

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2740S-R102-V0-Z001001-D20180401	<ul style="list-style-type: none"> ► Added IEEE C37.238 Power Profile PTP transparent clock support. ► Added SNMP v2c IF-MIB. ► Added VLAN Group bucket actions. 	20180401
SEL-2740S-R101-V0-Z001001-D20170421	<ul style="list-style-type: none"> ► Added support for fiber-optic Ethernet modules. 	20170412
SEL-2740S-R100-V5-Z001001-D20161223	<p>Includes all the functions of SEL-2740S-R100-V4-Z001001-D20161122 with the following addition:</p> <ul style="list-style-type: none"> ► Resolved an issue where the device does not load product identifier values from memory. 	20161223
SEL-2740S-R100-V4-Z001001-D20161122	<p>Includes all the functions of SEL-2740S-R100-V3-Z001001-D20161104 with the following addition:</p> <ul style="list-style-type: none"> ► Resolved an issue where device boot times could be inconsistent. 	20161122
SEL-2740S-R100-V3-Z001001-D20161104	<ul style="list-style-type: none"> ► Initial version. 	20161104

Instruction Manual

The date code at the bottom of each page of this manual reflects the creation or revision date.

Table 35 lists the instruction manual versions and revision descriptions. The most recent instruction manual version is listed first.

Table 35 Manual Revision History^a

Date Code	Summary of Revisions
20240501	<ul style="list-style-type: none"> ► [Cybersecurity] Updated for firmware version R113-V1.
20231218	<ul style="list-style-type: none"> ► Updated for firmware version R113-V0.
20230919	<ul style="list-style-type: none"> ► Updated <i>Table 3: Interface Modules</i>. ► Updated for firmware version R112-V3.
20230313	<ul style="list-style-type: none"> ► Updated for firmware version R112-V2.
20230111	<ul style="list-style-type: none"> ► Updated description of firmware version R109-V0.
20230106	<ul style="list-style-type: none"> ► Updated for firmware version R112-V1.
20221110	<ul style="list-style-type: none"> ► Updated for firmware version R112-V0.
20221027	<ul style="list-style-type: none"> ► Added UKCA Mark in <i>Specifications</i>.
20220906	<ul style="list-style-type: none"> ► Changed <i>SEL-2740S Firmware and SEL-5056 Software Compatibility</i> to <i>SEL-2740S Firmware and Hardware Compatibility</i> in <i>Appendix B</i> and replaced the text in that section.
20220427	<ul style="list-style-type: none"> ► Updated <i>Figure 9: Device View Page</i>. ► Updated for firmware version R111-V1.
20220401	<ul style="list-style-type: none"> ► Updated for firmware version R111-V0.
20220304	<ul style="list-style-type: none"> ► Updated for firmware version R109-V1.
20211227	<ul style="list-style-type: none"> ► Updated <i>Figure 1: SEL-2740S Front Panel</i>, <i>Figure 3: SEL-2740S Rear Panel</i>, <i>Figure 4: Rear-Panel Module Identifiers</i>, <i>Figure 6: SEL-2740S Port Name</i>, <i>Figure 7: SEL-2740S Port ID</i>, and <i>Figure 15: SEL-2740S Front and Rear Panels</i>. ► Updated <i>Specifications</i>.

Date Code	Summary of Revisions
20211105	<ul style="list-style-type: none"> ► Updated <i>Features and Benefits</i>. ► Updated <i>Alarm Contact Output</i> in <i>LED Status Indicators and Nodes</i>. ► Updated <i>Time Synchronization</i>. ► Updated <i>Figure 9: Device View Page</i>. ► Updated for firmware version R109-V0.
20210805	<ul style="list-style-type: none"> ► Updated <i>Introduction and Hardware Specifications</i>. ► Added <i>Figure 13: SEL-2740S Panel Mount Dimensions</i>. ► Added <i>1U Panel Mount under Dimensions</i> in <i>Specifications</i>. ► Updated <i>Electromagnetic Compatibility Emissions</i> under <i>Type Tests</i> in <i>Specifications</i>.
20210521	<ul style="list-style-type: none"> ► Updated <i>Features and Benefits</i>. ► Updated <i>Table 6: LED Status Indicators for Speed and Activity (SPEED/ACT) Mode</i>. ► Updated <i>Table 17: Complete List of Supported OpenFlow Parameters</i>. ► Updated <i>Specifications</i>.
20210402	<ul style="list-style-type: none"> ► Updated <i>Table 1: Interface Modules</i>.
20210325	<ul style="list-style-type: none"> ► Updated <i>Compliance</i> information in <i>Specifications</i>. ► Added <i>Figure 14: SEL-2740S Front and Rear Panels</i>.
20210312	<ul style="list-style-type: none"> ► Updated <i>Specifications</i>.
20210122	<ul style="list-style-type: none"> ► Added <i>SNMP</i>. ► Updated <i>Table 17: Complete List of Supported OpenFlow Parameters</i>. ► Updated <i>Table 28: Group Type Parameters</i>. ► Updated <i>Specifications</i>. ► Updated <i>Table 38: SEL-2740S Event Logs</i>.
20200930	<ul style="list-style-type: none"> ► Added <i>Figure 13: SEL-2740S Surface Mount Dimensions</i>. ► Revised text throughout to address surface mount option. ► Updated <i>Specifications</i> to include the surface mount option.
20200911	<ul style="list-style-type: none"> ► Updated <i>Table 15: Media Images</i> and <i>Table 23: Supported Instructions in Order of Applied Priority</i>.
20200630	<ul style="list-style-type: none"> ► Initial version.

^a Information about changes to earlier versions of the SEL-2740S instruction manual is available in the SEL-2740S/SEL-5056 instruction manual with the 20191114 date code.

Appendix B: Firmware Upgrade Instructions

Introduction

These instructions guide you through the process of upgrading firmware in the device. Note that these instructions are only intended for upgrading firmware from an older revision to a newer revision. Downgrading firmware—going from a newer to an older revision—should not be attempted. It may result in the loss of MAC addresses and other device configuration information. Contact SEL if you need to downgrade the firmware.

The firmware upgrade will be either a standard release or a point release. A standard release adds new functionality to the firmware beyond the specifications of the existing version. A point release is reserved for modifying firmware functionality to conform to the specifications of the existing version.

A standard release is identified by a change in the R-number of the device firmware identification (FID) number.

Existing firmware:

FID=SEL-2740S-**R100**-V0-Z001001-Dxxxxxxxx

Standard release firmware:

FID=SEL-2740S-**R101**-V0-Z001001-Dxxxxxxxx

A point release is identified by a change in the V-number of the device FID number.

Existing firmware:

FID=SEL-2740S-R100-**V0**-Z001001-Dxxxxxxxx

Point release firmware:

FID=SEL-2740S-R100-**V1**-Z001001-Dxxxxxxxx

The date code is after the D. For example, the following is firmware version number R100, date code November 04, 2016.

FID=SEL-2740S-R100-V0-Z001001-**D20161104**

SEL-2740S Firmware and Hardware Compatibility

Firmware R108 or higher must be used on devices purchased after July 2022. SEL-2740S switches manufactured after November 11, 2022 require firmware version R112 or higher.

Firmware Files

SEL-2740S firmware upgrade files have a tar.gz file name extension. An example firmware filename is the following:

2740S.R100.V4.tar.gz

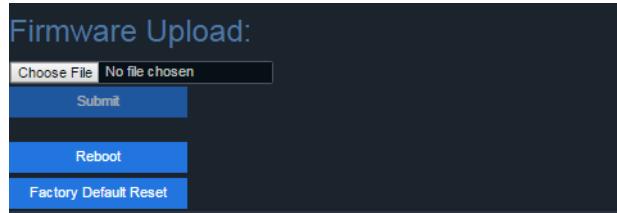
The firmware packages are cryptographically signed to enable the device to recognize official SEL firmware. Any uploaded files that cannot be verified as being produced by SEL will not be processed.

Upgrade Procedure

To perform an upgrade, you will need the appropriate firmware upgrade file and access to the device through SEL-5056 with Permission Level 3 privileges. Upgrade the device firmware by uploading a file from a personal computer to the device via the SEL-5056 web interface. Note that only one firmware upload can be running at a time in firmware versions R103 and lower. All firmware updates are logged. If you are upgrading to R104 from R101–R103, SEL recommends that you first upgrade SEL-5056 to Version 2.0 before upgrading the firmware. Follow these steps to upgrade the SEL-2740S firmware:

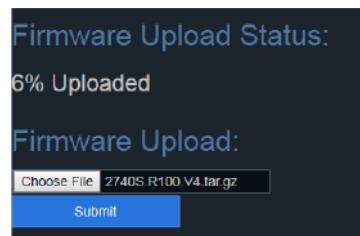
- Step 1. Log in to the SEL-5056 with an authorized user with the role of Permission Level 3.
- Step 2. Navigate to the Topology page under the Configuration menu.
- Step 3. Select the SEL-2740S device that you want to upgrade.

- Step 4. In the configuration pane to the right, select **Choose File** under the Firmware Upload heading and select the firmware file.
- Step 5. Click **Submit** when you have selected the firmware upgrade file.



Status Messages

Firmware upgrades may take as long as ten minutes. The current status of the upload and upgrade appears above the Firmware Upload.



Completion

Once the upgrade process is complete and the switch has restarted, log in and navigate to the **Device View** option in the Configuration pane. You will see the new FID.

Appendix C: Events

The Syslog Protocol is used to convey event notification messages. The SEL-2740S creates Syslog messages as defined in RFC 3164 and RFC 5424 through use of either UDP or TLS. This section also lists the category for each event on the SEL-2740S.

The Syslog message is divided into five parts: priority, timestamp, source, tag, and message. The Syslogs forwarded by SEL-2740S switches are formatted as follows:

<priority> timestamp hostname tag: message

For example:

<131> Jul 19 10:15:54 ROBEMEINNB TopologyManager: Disconnected OperationalLink OpenFlow:00000030A733EEF6:B1(1)_OpenFlow: 00000030A733EEF6:B4(4) has reconnected and is now Adopted

The priority is calculated from the severity and facility of the message by the following equation:

$$\text{Priority} = \text{Facility} \cdot 8 + \text{Severity}$$

Table 36 lists the possible values for severity and facility used by the SEL-2740S.

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Table 36 Syslog Severity Levels

Code	Severity
0	Emergency
1	Alert
2	Critical
3	Error
4	Warning
5	Notice
6	Informational

Table 37 Syslog Facility Levels

Code	Facility
1	User
3	System
4	Security/Authorization

The SEL-2740S sends out Syslogs for the given Syslog severity in the Syslog Server settings, as well as any Syslogs with a higher severity level (which corresponds to a lower severity code). For example, if the user configures a Syslog server with a severity level of Warning (code 4), the SEL-2740S sends out Syslogs with that severity, as well as Syslogs with severity levels of Error, Critical, Alert, and Emergency (Codes 3, 2, 1, and 0, respectively).

Table 38 SEL-2740S Event Logs

Message	Tag	Severity	Facility	Category
System Time: Recovered and set based on certificate validity	CommissioningInputs	Notice	System	
Commissioning failed	CommissioningManager	Warning	User	Configuration
Commissioning succeeded	CommissioningManager	Informational	User	Configuration
User {user} with role {role} modified configuration object {id} from IP address {ipAddress}	DataBroker	Notice	User	
User {user} with role {role} and module {module} executed action {action} on {id} from IP address {ipAddress}	DataBroker	Notice	User	
User {user} with role {role} and module {module} executed unbound action {action} from IP address {ipAddress}	DataBroker	Notice	User	
User {user} with role {role} and module {module} failed to execute action {action} on {id} from IP address {ipAddress}	DataBroker	Notice	User	
User {user} with role {role} and module {module} failed to execute unbound action {action} from IP address {ipAddress}	DataBroker	Notice	User	
Device factory reset initiated by user {userName} with role {roleName} from IP Address {ipAddress}	DeviceReset	Notice	Security/ Authorization	Configuration
Device reboot initiated by user {userName} with role {roleName} from IP Address {ipAddress}	DeviceReset	Error	User	Configuration
Device reset because of {reason}	DeviceReset	Warning	System	System Integrity

Message	Tag	Severity	Facility	Category
Updated event category {eventCategory}	EventBus	Notice	User	
Log delivery was not confirmed to behavior {behavior- Type} for event with id {monotonicId}	EventBus	Notice	User	
A firmware downgrade is not compatible with the current firmware	FirmwareUpgrade	Error	System	System Integrity
Firmware upgrade from {oldVersion} to {newVersion} failed at step {failedStep} of {failedStepCount}	FirmwareUpgrade	Critical	System	System Integrity
Firmware upgrade from {oldVersion} to {newVersion} succeeded	FirmwareUpgrade	Warning	System	System Integrity
Firmware upgrade was initiated by user {username} with role {role} from IP address {ipaddress}	FirmwareUpgrade	Notice	User	System Integrity
Reverted to fallback firmware version {firmwareVersion}. Previous device settings are in effect. Please contact Schweitzer Engineering Laboratories, Inc. for assistance.	FirmwareUpgrade	Critical	System	System Integrity
The firmware image is corrupted	FirmwareUpgrade	Error	System	System Integrity
Slot {slot_id}: {serial_num} installed	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: {serial_num} removed	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: Module active	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: Module failed	Hardware Module Manager	Critical	System	Chassis and Module
Slot {slot_id}: Module firmware upgrade failed	Hardware Module Manager	Error	System	Chassis and Module
Slot {slot_id}: Module firmware upgraded successfully	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: Module powered down	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: Module restarted	Hardware Module Manager	Warning	System	Chassis and Module
Slot {slot_id}: Unable to power up Module	Hardware Module Manager	Error	System	Chassis and Module
Slot A: Flow Processor Module has failed	Hardware Module Manager	Alert	System	System Integrity
Slot A: No Flow Processor Module installed	Hardware Module Manager	Alert	System	System Integrity
User {userName} with role {roleName} from {ipAddress} acknowledged all local events	LocalEventStore	Notice	User	Configuration
Event storage capacity ({storageCapacity}) exceeded. Oldest {numberRemoved} events removed.	LocalEventStore	Warning	User	System Integrity
Local event storage contains <= 65% unacknowledged events	LocalEventStore	Notice	System	System Integrity
Local event storage contains <= 80% unacknowledged events	LocalEventStore	Notice	System	System Integrity

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Message	Tag	Severity	Facility	Category
Local event storage contains >= 75% unacknowledged events	LocalEventStore	Warning	System	System Integrity
Local event storage contains >= 90% unacknowledged events	LocalEventStore	Warning	System	System Integrity
Device connected to OpenFlow controller at {ip} on port {port}	Openflow	Notice	System	Openflow
Device lost connection to OpenFlow controller at {ip} on port {port}	Openflow	Notice	System	Openflow
OpenFlow changes ({numberOfChanges}): {stringOfChanges}	Openflow	Informational	System	Openflow
Database corruption prevented database upgrade. Please contact SEL for further assistance.	Persistence	Error	System	
Created new database	Persistence	Informational	System	
Database file accessed while locked	Persistence	Error	System	
The database was created by {dbsApp}. It is not compatible with {runningApp}	Persistence	Error	System	
Insufficient disk space for data storage. Free additional disk space.	Persistence	Critical	System	
Denied permission for user {username} in role {role} from module {module} to {permissionsList}	SecurityManager	Warning	Security	
Device initialization completed	System	Notice	System	Chassis and Module
Device reset because of hardware watchdog	System	Critical	System	Chassis and Module
Failure: Power Supply A expected to be installed but absent	System	Alert	System	Chassis and Module
Failure: Power Supply A	System	Alert	System	Chassis and Module
Failure: Power Supply B expected to be installed but absent	System	Alert	System	Chassis and Module
Failure: Power Supply B	System	Alert	System	Chassis and Module
OK: Power Supply A	System	Notice	System	Chassis and Module
OK: Power Supply B	System	Notice	System	Chassis and Module
Certificate with common name {commonName} and thumbprint {thumbprint} internally {revokeState}	TrustAuthority	Informational	User	Configuration
LED Mode: Changed by user at Front Panel	System	Notice	User	Configuration
System Time: lost synchronization to external source	System	Warning	System	Configuration
System Time: synchronized via NTP	System	Notice	System	Configuration
Port {port_num} changed link state to down	System	Notice	System	Link
Port {port_num} changed link state to up	System	Notice	System	Link
Device factory reset initiated through pinhole button	System	Notice	User	System Integrity

Message	Tag	Severity	Facility	Category
Slot {slot_id}: Single Event Upset detected, Module will reset	System	Critical	System	System Integrity
Slot A: Single Event Upset detected, device will reset	System	Alert	System	System Integrity
User {username} failed to import certificate for purpose {purpose}	TrustAuthority	Warning	User	
User {username} revoked certificate {thumbprint}	TrustAuthority	Warning	User	
User {username} uploaded certificate {thumbprint} for {certificatePurpose}	TrustAuthority	Notice	User	

The Syslog message "OpenFlow changes ({numberOfChanges}): {stringOfChanges}" (see *Table 38*) reports the number of changes and a list of as many as 50 of the changes in 10-second intervals. The list is comma-separated and includes an abbreviation and number. All numbers are in hexadecimal format. *Table 39* describes the meaning of the abbreviation and what the number represents.

Table 39 OpenFlow Changes Event Description

Abbreviation	Description	Number (in Hexadecimal Format)
Fa	Flow entry added	Flow ID
Fd	Flow Entry deleted	Flow ID
Fm	Flow entry modified	Flow ID
Fr	Flow replaced	Flow ID
Fto	Flow entry deleted because of time-out	Flow ID
Ga	Group entry added	Group ID
Gd	Group entry deleted	Group ID
Gm	Group entry modified	Group ID
Ma	Meter entry added	Meter ID
Md	Meter entry deleted	Meter ID
Mm	Meter entry modified	Meter ID
Pa	OpenFlow port added	Port ID
Pd	OpenFlow port deleted	Port ID
Pm	OpenFlow port modified	Port ID

Appendix D: Cybersecurity Features

Security features of the SEL-2740S provide secure communications between the SEL-5056 and the SEL-2740S. The SEL-2740S does not provide access for engineers or technicians; all configuration and monitoring happens from the SEL-5056.

Version Information

Device Firmware

The device firmware identification (FID) number can be obtained through the SEL-5056. The SEL-2740S firmware is provided in a single digitally signed file.

Ports and Services

Physical Ports

The SEL-2740S has one front port that is used only for the management of the switch itself. There are 20 rear ports that can be used for management and data plane packet forwarding. All physical ports are always enabled, but the SEL-2740S is a deny-by-default network switch and does not forward packets unless the flows are configured to do so.

Logical Ports

Table 40 Port Numbers

IP Port Default	Network Protocol	Default Port State	Port Configurable	Purpose
3002	UDP	Enabled	No	Only available to commission the switch. Once commissioned, the port is disabled and only can be enabled again in a factory-default reset state.
443	TCP	Enabled	No	HTTPS REST interface for switch settings managed by the SEL-5056
161	SNMP	Disabled	No	SNMP read-only

Access Controls

The SEL-2740S does not have any local user access because all the configuration and monitoring happens from the SEL-5056 and, therefore, does not have any user accounts or passwords. The SEL-2740S supports OpenFlow communications with TLS, providing mutual authentication and encryption between the flow controller and the switch.

X.509 Certificates

The SEL-2740S uses TLS with X.509 certificates to protect communications for OpenFlow and the REST interface.

The default certificate installed on the product is intended to be used for the initial setup only and replaced by a certificate provided by the SEL-5056 once the switch is commissioned. Unique default certificates are generated when the switch is manufactured.

The SEL-2740S supports using SHA-2 for signature generation and supports RSA with a 2048-bit key size.

Physical Access Controls

The SEL-2740S is designed to make it difficult to physically tamper with the device and its connections without disrupting communications and generating a log and alarm.

Alerts and Logging Security Events

The SEL-2740S logs events by using Syslog. The SEL-2740S supports either UDP or TCP TLS Syslog and can send events to as many as three network Syslog servers, as well as activating an alarm contact for certain events. Failure of logging that uses Syslog is itself logged and causes the activation of the alarm contact. See *Appendix C: Events on page 41* for the list of events logged.

Internal Log Storage

The SEL-2740S stores logged events internally. Internal storage can hold as many as 4,096 events. In the event that storage is full, new events replace the oldest events.

Alarm Contact

The SEL-2740S uses an alarm contact, which is configurable to operate on the selected event severity level.

Backup and Restore Saving and Restoring Settings

The SEL-5056 by design saves all configurations of the SEL-2740S. Simple device replacement is supported by the adoption process in the SEL-5056.

Decommissioning Preparing for Recycling or Disposal

It is often desirable to delete settings from the product when it is removed from service.

To delete the SEL-2740S settings, either factory reset the switch through the SEL-5056 or press the pinhole reset button on the front of the switch.

Malware Protection Features Operating System and Firmware

The SEL-2740S is an embedded device that does not allow additional software to be installed. The SEL-2740S only accepts digitally signed firmware upgrades. The SEL-2740S includes a self-test that continually checks running code against the known good baseline version of code in nonvolatile memory. See "The SEL Process for Mitigating Malware Risk to Embedded Devices" at selinc.com/malware_protection for more details.

Revision Management

Appendix A: Firmware and Manual Versions on page 35 contains a description of each firmware update.

See "The SEL Process for Disclosing Security Vulnerabilities" at selinc.com/security_vulnerabilities for details on vulnerability disclosure.

Firmware Update Verification

The SEL-2740S automatically checks the firmware authenticity and integrity and only loads firmware files that have been signed by SEL.

The authenticity and integrity of firmware updates also can be verified by checking the firmware hash. For instructions and firmware hash values, see selinc.com/products/firmware.

Contact SEL

For further questions or concerns about product security, contact SEL Security at:

security@selinc.com or +1.509.332.1890.

Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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This product is covered by the standard SEL 10-year warranty. For warranty details, visit selinc.com or contact your customer service representative.

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