SEL-2505 Remote I/O Module Instruction Manual

Features, Benefits, and Applications

The SEL-2505 is a remote I/O module that has eight input contacts and eight output contacts. The status of these inputs and outputs is communicated between the SEL-2505 and a host device by using MIRRORED BITS® communications over a dedicated fiber-optic or copper serial port. Each input contact controls one of the eight MIRRORED BITS transmit bits, while each of the eight received MIRRORED BITS controls a contact output. Use the transmitted input contact status for control indication of a remote device.

- **Communications Flexibility** helps you simplify and improve existing or new installations.
  - Add simple pilot communications to existing two- or three-terminal line applications.
  - Isolate relay and breaker dc supplies for breaker-failure-trip distribution schemes.
  - Annunciate the status of remote contacts.
- **Compact Size** permits panel-mount replacement of existing auxiliary relays.
- **Self-Testing** increases reliability of auxiliary relay functions.
- **Simple Status Diagnostics** consist of 22 LEDs that indicate contact input, output, channel, and device status.
- **Improved Reliability** through increased scheme security reliability with channel monitoring and alarm output.
- **Fast Operating Speed** is comparable with high-speed teleprotection equipment.
- **Increased Safety** is provided through fiber-optic isolation.
- **Two Serial Interface Options:** Fiber-optic for superior safety and data integrity, or EIA-232 for convenient connection within the same cabinet.
- **Contact Outputs:** Conventional Form C outputs.
- **Conformal Coating** of the circuit board is standard on all units, providing an extra level of protection in corrosive environments.

Product Overview

Figure 1 shows the functional overview of the SEL-2505.

The SEL-2505 is an excellent teleprotection device and a simple way of expanding the number of I/O points available in a system of relays. It is superior to hardwiring relays together through electromechanical or static auxiliary relays because you can now monitor the performance of the communications channel. In addition, its self-testing ability ensures prompt notification of any device or communications channel problem.

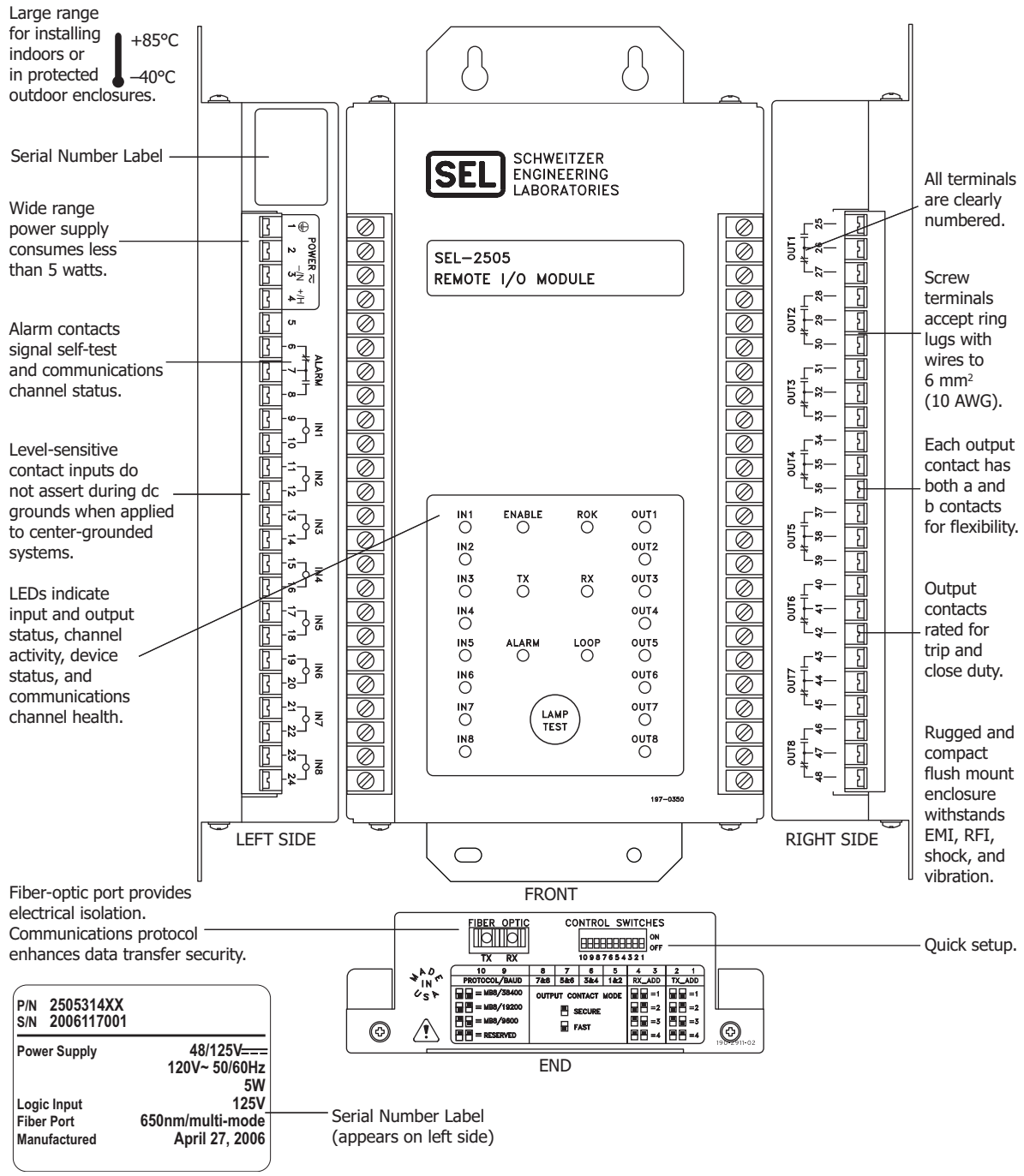


Figure 1 SEL-2505 Functional Overview (Part Number 2505314XX)

Applications

The following application suggestions and examples represent only a few possible uses for the SEL-2505.

- Add communications-assisted tripping to existing relays.
- Add event annunciation to pilot trip schemes.
- Isolate remote tripping via fiber-optic links.
- Cross-trigger event reports.
- Perform auxiliary relay functions while adding self-testing capabilities.

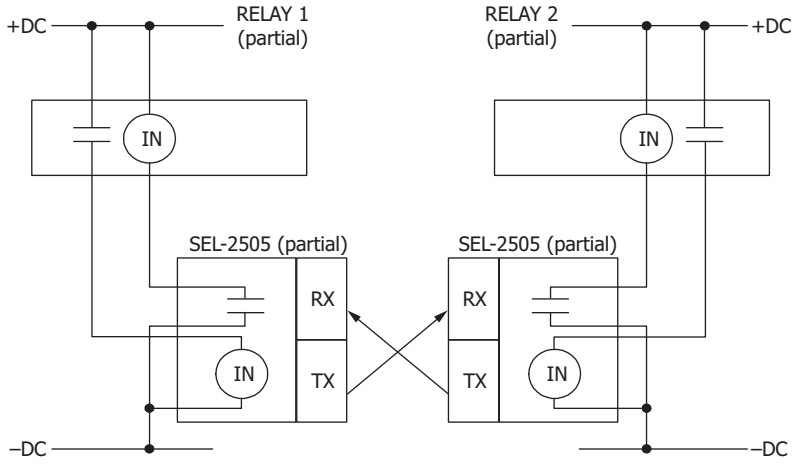


Figure 2 Channel Interface I/O for Relays Without MIRRORED BITS Protocol

- Create bus protection by using existing protective relays for simple buses.
- Include an SEL-2100 Logic Processor for bus protection of larger buses.
- Add direct transfer trip to existing cogeneration interconnections.

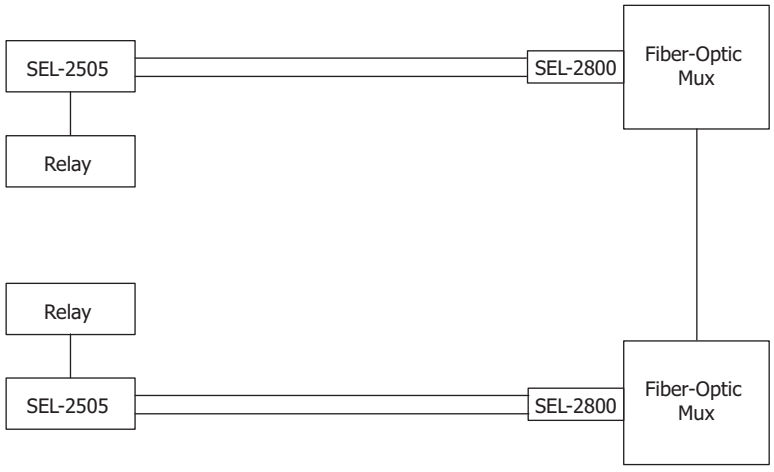


Figure 3 Provide Communications-Assisted Tripping Over Existing Digital Communications Networks

- Provide low-cost teleprotection over digital multiplexers.
- Provide a migration path from electromechanical relays to MIRRORED BITS relays.

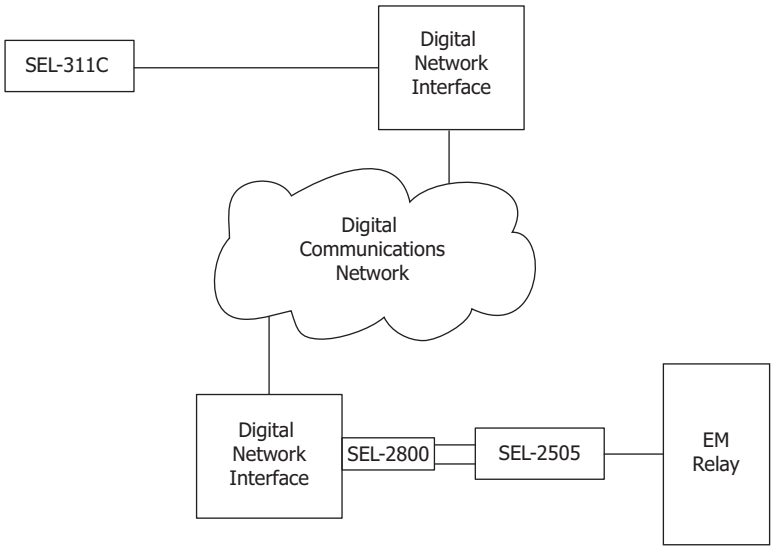


Figure 4 Interface Relays With MIRRORED BITS to Relays Without MIRRORED BITS

- Eliminate hard wiring from control room to breaker or motor-operated disconnect switch.
- Reduce dc ground exposure.
- Add trip/close path continuity monitoring.
- Expand I/O capability of relays with MIRRORED BITS communications protocol.

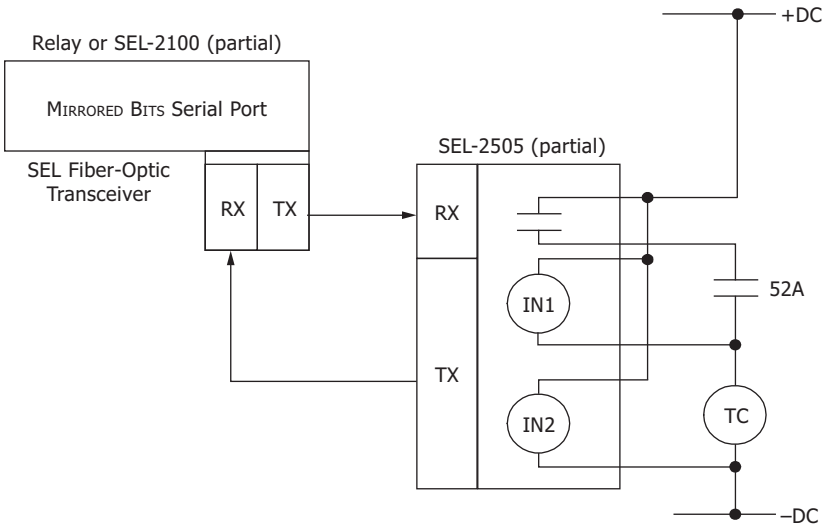


Figure 5 Reduce Wiring From Control House to Outdoor Cabinets

Example Distribution Bus Protection: Radial Feeders

Figure 6 shows an SEL-2505 application that uses existing distribution relays and an SEL-2100 Logic Processor to provide bus and line protection for the radial system. When the overcurrent elements of the transformer low-side relay pick up and the overcurrent elements in the feeder relays do not, the detected fault must be located on the bus. Using relay overcurrent element status transmitted by the SEL-2505 devices, the SEL-2100 uses SELOGIC®

control equations to issue a bus trip via a MIRRORED BITS message to the protective relays through the SEL-2505 modules. Unlike conventional schemes, there is no switchboard wiring between relays. Eliminating this wiring reduces dc ground exposure, and replacing this wiring with SEL-2505 remote I/O modules adds self-testing and automatic communications-path checking.

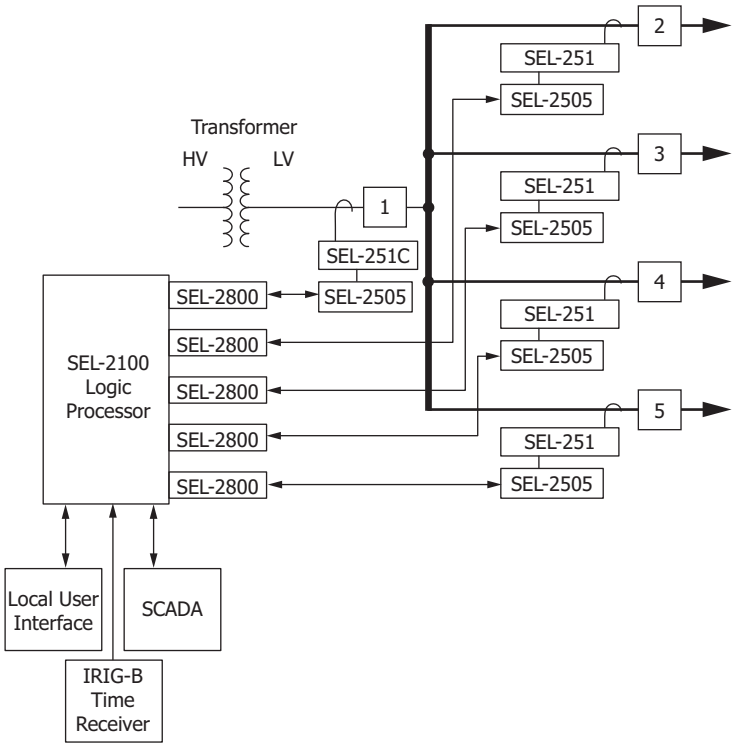


Figure 6 Distribution Bus Protection Application Example

Functional Description

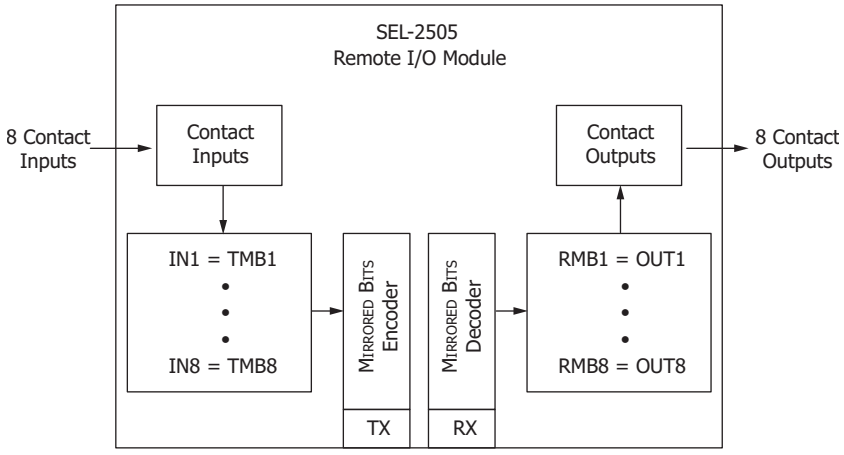
MIRRORED BITS Decoder/Encoder and I/O Control

Figure 7 shows the functional block diagram of the SEL-2505. There is a MIRRORED BIT decoder associated with the receive (**RX**) port and an encoder for the transmit (**TX**) port. The decoder receives MIRRORED BIT messages, checks whether the receive address matches the receive address set by SW3–4, checks for data message errors, and then decodes each message. If a Receive MIRRORED BIT (RMB) is a logical 1 for the number of message frames set by SW5–8, the SEL-2505 asserts the corresponding output contact.

If an RMB is a logical 0 for the number of message frames set by SW5–8, the SEL-2505 deasserts the corresponding output contact. If the communications channel is faulty or power is removed from the device, the output contacts are deasserted.

The decoder also monitors the received data and channel integrity. Detected errors include data errors, resynchronization, data over- and under-run, parity, and framing errors. When it detects an error, the SEL-2505 turns off the **ROK** LED and de-energizes the ALARM relay (closing the alarm contact). If the SEL-2505 detects two errors in a row, it begins resynchronizing with the remote device. Once the remote device receives this resynchronize message, it also deasserts its ROK message to indicate a problem with the communications path.

The encoder converts the eight input contacts into the MIRRORED BIT protocol and outputs these data to the transmit fiber or serial port. This protocol is designed to the security requirements outlined by IEC 834-1.



TMB*n* = Transmit MIRRORED BIT *n*, RMB*n* = Receive MIRRORED BIT *n*

Figure 7 SEL-2505 Functional Block Diagram

Safety Information

Dangers, Warnings, and Cautions

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

⚠DANGER
Indicates an imminently 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.

General Safety Marks

⚠CAUTION Use supply wires suitable for 9°C (16°F) above ambient.	**⚠ATTENTION** Utilisez des fils d'alimentation appropriés pour 9°C (16°F) au-dessus ambiante.

Other Safety Marks (Sheet 1 of 2)

⚠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 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 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.
⚠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 During installation, maintenance, or testing of the optical ports, use only test equipment qualified for Class 1 laser products.	**⚠AVERTISSEMENT** Durant l'installation, la maintenance ou le test des ports optiques, utilisez exclusivement des équipements de test homologués comme produits de type laser de Classe 1.
⚠WARNING For UL compliance, install this product only in restricted-access locations (for example, dedicated equipment rooms, equipment closets, or similar). This directive is in accordance with Articles 110.26, 110.27, and 110.18 of the National Electrical Code, ANSI/NFPA 70 (2005).	**⚠AVERTISSEMENT** Pour être conforme aux normes "UL", installer cet équipement uniquement dans des espaces à accès limité (chambres dédiées aux équipements, cabinets pour équipements ou équivalent). Cette directive est conforme aux articles 110.26, 110.27 et 110.18 du Code National de l'Électricité, ANSI/NFPA 70 (2005).
⚠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-décelables 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.

Other Safety Marks (Sheet 2 of 2)

⚠CAUTION Class 1 LASER Product. This product uses visible or invisible LASERs based on model option. Looking into optical connections, fiber ends, or bulkhead connections can result in hazardous radiation exposure.	**⚠ATTENTION** Produit LASER de Classe 1. Ce produit utilise des LASERS visibles ou invisibles dépendant des options du modèle. Regarder vers les connecteurs optiques, les extrémités des fibres ou les connecteurs de cloison peut entraîner une exposition à des rayonnements dangereux.
⚠CAUTION Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.	**⚠ATTENTION** L'utilisation de commandes ou de réglages, ou l'application de tests de fonctionnement différents de ceux décrits ci-après peuvent entraîner l'exposition à des radiations dangereuses.

Installation and Maintenance

IMPORTANT: This equipment must be used in the manner specified in this instruction manual; failure to do so might impair the protection provided by the equipment.

IMPORTANT: Do not connect power to the SEL-2505 until you have completed the installation procedures.

Follow these installation and maintenance instructions for years of reliable, trouble-free service from the SEL-2505.

Mounting

Mount the SEL-2505 in a protected environment such as an outdoor weatherproof cabinet or inside a building. Refer to *Figure 14* for mounting hole locations. Use dimension B to place mounting hole at X whenever possible. This helps prevent interference between fiber-optic cables/connectors and mounting tools.

⚠WARNING
For UL compliance, install this product only in restricted-access locations (for example, dedicated equipment rooms, equipment closets, or similar). This directive is in accordance with Articles 110.26, 110.27, and 110.18 of the National Electrical Code, ANSI/NFPA 70 (2005).

As a safety measure, restrict access to the module and the exposed terminal strips. This is a requirement for a UL-compliant installation.

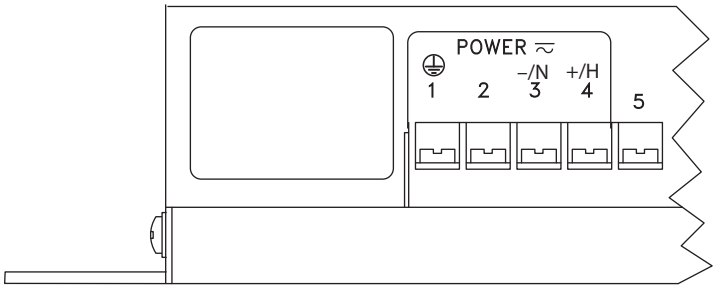


Figure 8 SEL-2505 Power and Ground Connections

Side-Panel Symbols

There are important safety symbols on the side of the SEL-2505.

Observe proper safety precautions when you connect the SEL-2505 at terminals marked by these symbols. In particular, the danger symbol located on the side panel corresponds to the following: **Contact with instrument terminals can cause electrical shock that can result in injury or death.** Be careful to limit access to these terminals.

Figure 9 Safety Symbols

Grounding

Connect the grounding terminal (1) labeled ⏚ to a rack frame ground or main station ground for proper safety and performance. Use 12 AWG (4 mm^2) or heavier wire less than 2 m (6.6 ft) in length for this connection. Make the ground connection before making the power connections.

Power Connections

You can order the SEL-2505 with one of three power supply voltages listed in *Specifications on page 16*. The serial number label on the back of the device lists the power supply voltage.

Use 16 AWG (1.5 mm^2) wire (or heavier) to connect to the **POWER** terminals. When you use a dc power source, you must connect the source with the proper polarity, as indicated by the **+/H** (Terminal **4**) and **–**/N (Terminal **3**) symbols on the power terminals. Upon connecting power, you will see the **ENABLE** LED illuminate.

⚠DANGER
Contact with instrument terminals can cause electrical shock that can result in injury or death.

Place an external switch, circuit breaker, or overcurrent device in the **POWER** leads for the SEL-2505; this device must interrupt both the hot (**H**) and neutral (**N**) power leads. The circuit breaker (or an equivalent approved disconnect device appropriate for the country of installation) must comply with EN 60947-1 and EN 60947-3, and be identified as the disconnect device for this equipment.

The maximum current rating for the power disconnect circuit breaker or overcurrent device must be 20 A. Be sure to locate this device within 3.0 m (9.8 ft) of the relay. Operational power is internally fused. This fuse is not user replaceable. Should failure occur, return the unit to the factory for repair.

Terminal Connections

Terminate connections to the SEL-2505 screw terminals with ring-type crimp lugs. Use a #6 ring lug with a maximum width of 8.2 mm (0.325 in.). Tightening torque for the screws is 1.4 Nm (12 in-lb) maximum. Minimum wire size is 0.75 mm^2 (18 AWG) with a minimum temperature rating of 105°C (221°F).

I/O interfaces are isolated for a maximum 2500-FEPC transient rating, consistent with a maximum Overvoltage Category III environment, with a maximum working voltage of 250 Vac rms.

Cleaning

Use care when cleaning the SEL-2505. Use a mild soap or detergent solution and a damp cloth to clean the chassis. Be careful cleaning the front and rear panels because a permanent plastic sheet covers each panel; do not use abrasive materials, polishing compounds, or harsh chemical solvents (such as xylene or acetone) on any surface.

Fiber-Optic Port

The SEL-2505 uses a fiber-optic transmitter unless ordered with the EAI-232 option. See *Specifications* for details about use of a 91560 attenuator on some shorter fiber links. When working with this device, observe the following safety precautions:

- Do not look into the fiber (laser) ports/connectors.
- Do not look into the end of an optical cable connected to an optical output.
- Do not perform any procedures or adjustments that this instruction manual does not describe.
- Do not use controls or adjustments, or perform procedures other than those specified in this instruction manual; these actions might result in hazardous radiation exposure.
- Incorporated components, such as transceivers and laser emitters, are not user serviceable. Return units to SEL for repair or replacement.

Serial Port (Optional)

The SEL-2505 uses a DB-9 connector when ordered with EIA-232 communications option. The serial cable should be kept as short as possible and used within the same cabinet space or local area. If longer distances are required or isolation is needed then the fiber-optic options are better for safety and data integrity.

Figure 10 shows the EIA-232 serial port DB-9 connector pin numbering for the SEL-2505.

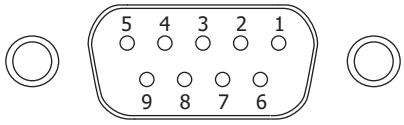


Figure 10 EIA-232 DB-9 Connector Pin Numbers

Table 1 shows the pin functions for the EIA-232 serial port.

Table 1 Serial Port Pin Functions

Pin	Port EIA-232
1	+5Vdc[a]
2	RXD
3	TXD
4	N/C
5	GND
6	N/C
7	RTS
8	CTS
9	GND

[a] If jumper JMP1 is installed.

Figure 11 displays the cable diagram for connecting the EIA-232 serial communications port to other SEL devices for a MIRRORED BITS link. This cable and others are available from SEL.

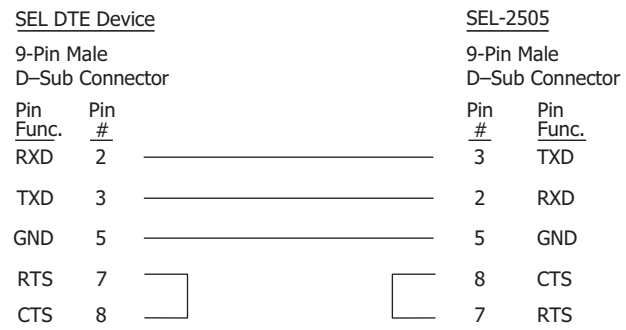


Figure 11 SEL-C272A Cable

Power Jumper Selection

Figure 12 shows the major components of the communication card ordered with the EIA-232 serial port. The jumper labeled JMP1 is located behind the DB-9 port. This jumper enables +5 Vdc on the DB-9 port on Pin 1 (see *Table 2*). The product is shipped default with the +5 Vdc off.

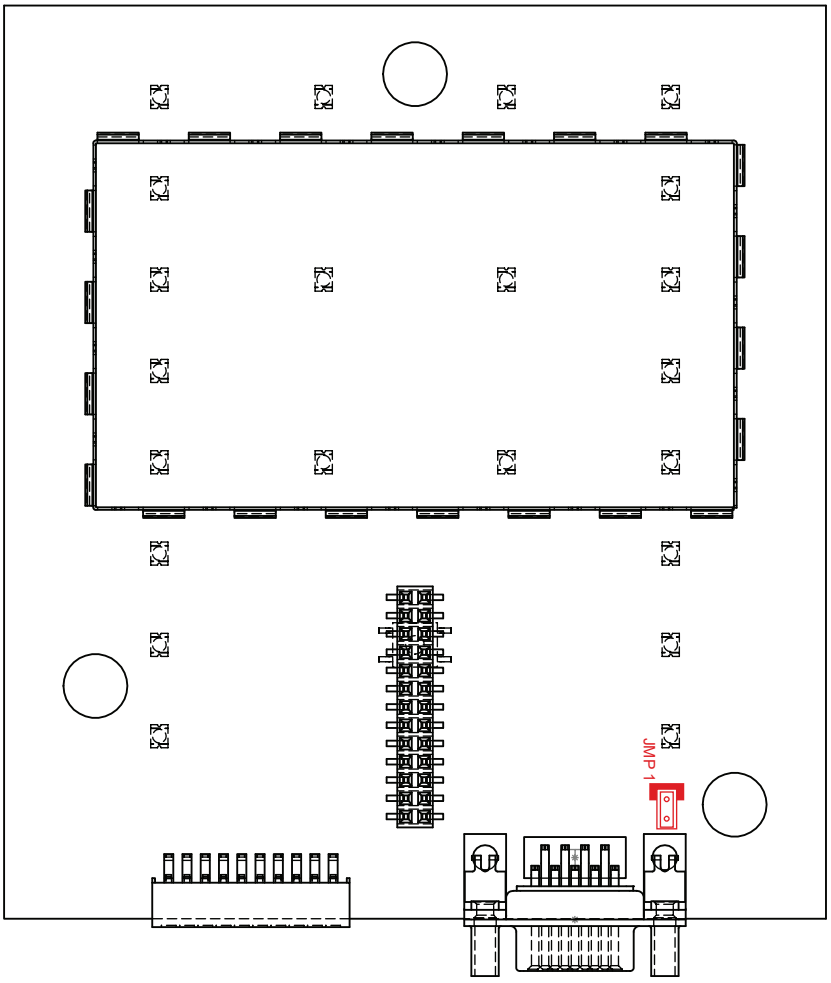


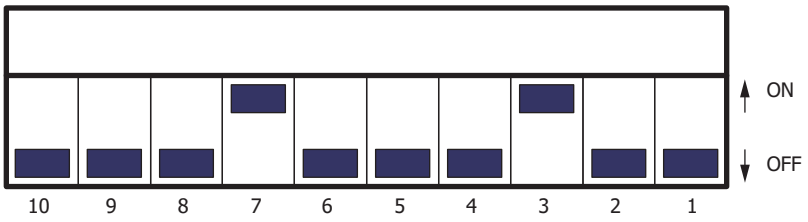
Figure 12 +5 Vdc Jumper Location on Communications Board

Table 2 +5 Vdc Jumper Position

DB-9 Pin 1 +5 Vdc	Jumper Positions
Jumper Removed (Default) With the jumper removed Pin 1 of the DB-9 connector is not connected.	
Jumper Installed Installing the jumper across JMP1 will enable +5 Vdc on Pin 1 of the DB-9 connector.	

Settings

The SEL-2505 uses a 10-position control (DIP: dual-in-line) switch to set the TX and RX addresses, to determine the number of received correct consecutive messages for control, and to program the baud rate of the MIRRORED BITS communications (see *Table 5*). The contact consecutive messages feature is intended to increase the system security for applications requiring higher security, such as direct transfer tripping.



Switch No.	Function
1, 2	Transmit Address (TX)
3, 4	Receive Address (RX)
5	OUT1, OUT2 Output Contact Mode
6	OUT3, OUT4 Output Contact Mode
7	OUT5, OUT6 Output Contact Mode
8	OUT7, OUT8 Output Contact Mode
9, 10	Baud Rate Setting

Figure 13 SEL-2505 Control-Switch Position Identifications

Setting the Transmit and Receive Addresses

You must set the TX address of each local SEL-2505 to match the receive address of the remote device. Further, the TX and RX addresses of each device should not be set to the same number. The SEL-2505 detects a loopback condition when it receives its own transmit address in the MIRRORED BITS message. When the SEL-2505 detects loopback, it illuminates the **LOOP** LED and extinguishes the **ROK** LED. The SEL-2505 disables the output contacts to prevent acting on its own message during loopback (i.e., output contacts go to their de-energized state). *Table 3* lists the address settings.

Table 3 Transmit and Receive Address Settings

Switch 4	Switch 3	RX Address	Switch 2	Switch 1	TX Address
OFF	OFF	1	OFF	OFF	1
OFF	ON	2	OFF	ON	2
ON	OFF	3	ON	OFF	3
ON	ON	4	ON	ON	4

Setting Output Contact Mode for Received Data

Table 4 lists the output contact mode (data-security-count) settings. When the data-security switch is set to FAST (OFF), the output contact follows its associated RMB logical status with no intentional delay. When the data-security switch is set to SECURE (ON), the SEL-2505 requires two consecutive RMB messages of the same logical state to assert/deassert the associated output contact. Note that each setting switch controls an adjacent pair of output contacts.

Table 4 Output Contact Mode Settings

Switch	Message 1	Message 2
Switch 5 (OUT1, OUT2)	FAST (OFF)	SECURE (ON)
Switch 6 (OUT3, OUT4)	FAST (OFF)	SECURE (ON)
Switch 7 (OUT5, OUT6)	FAST (OFF)	SECURE (ON)
Switch 8 (OUT7, OUT8)	FAST (OFF)	SECURE (ON)

For example, when output switch 7 is set to SECURE (ON) the SEL-2505 requires two consecutive confirmed messages before asserting and/or deasserting output **OUT5** and output **OUT6**. With output switches set to FAST (OFF), the SEL-2505 requires only one confirmed message.

Setting the Baud Rate

Table 5 lists the settings for the three baud rate options. For applications that use fiber connections between SEL devices, baud rate 38400 is recommended. This recommendation is based on operating time. For applications where a multiplexer or other communications device is between the two MIRRORED BITS devices, baud rates 19200 or 9600 are recommended. If the channel is operating intermittently, lowering the baud rate will provide more stable performance in most cases.

Table 5 Protocol/Baud Rate Settings

Switch 10	Switch 9	Protocol/Rate
OFF	OFF	MB8 Protocol @ 38400 Baud
OFF	ON	MB8 Protocol @ 19200 Baud
ON	OFF	MB8 Protocol @ 9600 Baud
ON	ON	Reserved

Connecting the SEL-2505 to Other SEL Devices

The SEL-2505 uses the MB8 MIRRORED BITS protocol, transmits and receives data at the baud rate set by switches 9 and 10.

The following examples show how to configure several SEL devices to operate with the SEL-2505. Only the minimum settings required are shown. Consult the appropriate instruction manual to ensure proper settings for your particular MIRRORED BITS application.

For fiber-optic ports, connect a fiber-optic cable to a compatible transceiver or built-in fiber-optic port on the other device (see *Fiber-Optic Port on page 9*). For the EIA-232 option, connect to the other device by using a copper cable within the same cabinet as the SEL-2505.

SEL-2505/SEL-2506

TX_ADD = 1 (Switch 1 and 2 = OFF)
RX_ADD = 2 (Switch 3 = ON, Switch 4 = OFF)
PROTO/SPEED = 38400 (Switch 9 = OFF, Switch 10 = OFF)

SEL Relays Except SEL-321 and SEL-400 Series

PROTO = MB8A*
SPEED = 38400
RXID = 1 TXID = 2

* = MB8A or MB8B may be used

SEL-321

PROTO= MB8
SPEED = 38400
TX_ID = 2 RX_ID = 1

SEL-2100

PROTO = MB8
SPEED = 38400
TXID = 2 RXID = 1

SEL-400 Series Relays

PROTO= MBA*
SPEED = 38400
STOPBIT = 2
TX_ID = 2 RX_ID = 1
TX MODE = P

* = MBA or MBB may be used

Testing

Testing an SEL-2505 requires another communicating device. Examples include an SEL-2505, SEL-2506, SEL-2100, SEL-3530 RTAC, or a relay with MIRRORED BITS protocol and the appropriate fiber-optic transceiver. The following test procedure assumes you are using another SEL-2505 as the remote communicating device. The test procedure for other communicating devices is similar.

Step 1. Check the SEL-2505 control (DIP) switch configuration settings.

Make certain the transmit address matches the receive address of the remote device and that the baud rate is identical.

Step 2. Connect the chassis ground terminal of the SEL-2505 to ground (Terminal **1**).

Step 3. Connect and apply rated voltage to the power supply inputs of the SEL-2505 (positive to Terminal **4**, negative to Terminal **3**).

The **ENABLE** LED should illuminate. The b form of the ALARM contact should remain closed and the **ALARM** LED should illuminate because there is no communication.

Step 4. Press the **LAMP TEST** pushbutton.

All LEDs should illuminate. When you release the pushbutton, the LEDs should extinguish.

Step 5. Install the fiber-optic or EIA-232 connections between the SEL-2505 modules: transmit (**TX**) on one device to receive (**RX**) on the other.

The **ROK**, **TX**, and **RX** LEDs on both devices should illuminate. In addition, the b contacts of the **ALARM** contact should open and the **ALARM** LED should extinguish.

⚠CAUTION
Class 1 LASER Product. This product uses visible or invisible LASERs based on model option. Looking into optical connections, fiber ends, or bulkhead connections can result in hazardous radiation exposure. The LASERs are not user serviceable. Return to the factory for repair or replacement.

Step 6. Apply rated voltage to input **IN1** on one device.

The input **IN1** LED should illuminate on this device. On the other SEL-2505, the output **OUT1** contact should close and **OUT1** LED should illuminate.

Step 7. Repeat *Step 6* for the remaining contacts.

Step 8. To test the loopback feature, connect a single fiber between the **TX** to **RX** on the same device. The **LOOP** LED should illuminate and the **ROK** LED should extinguish. Energize each input. No output contact should assert.

Mechanical Diagram

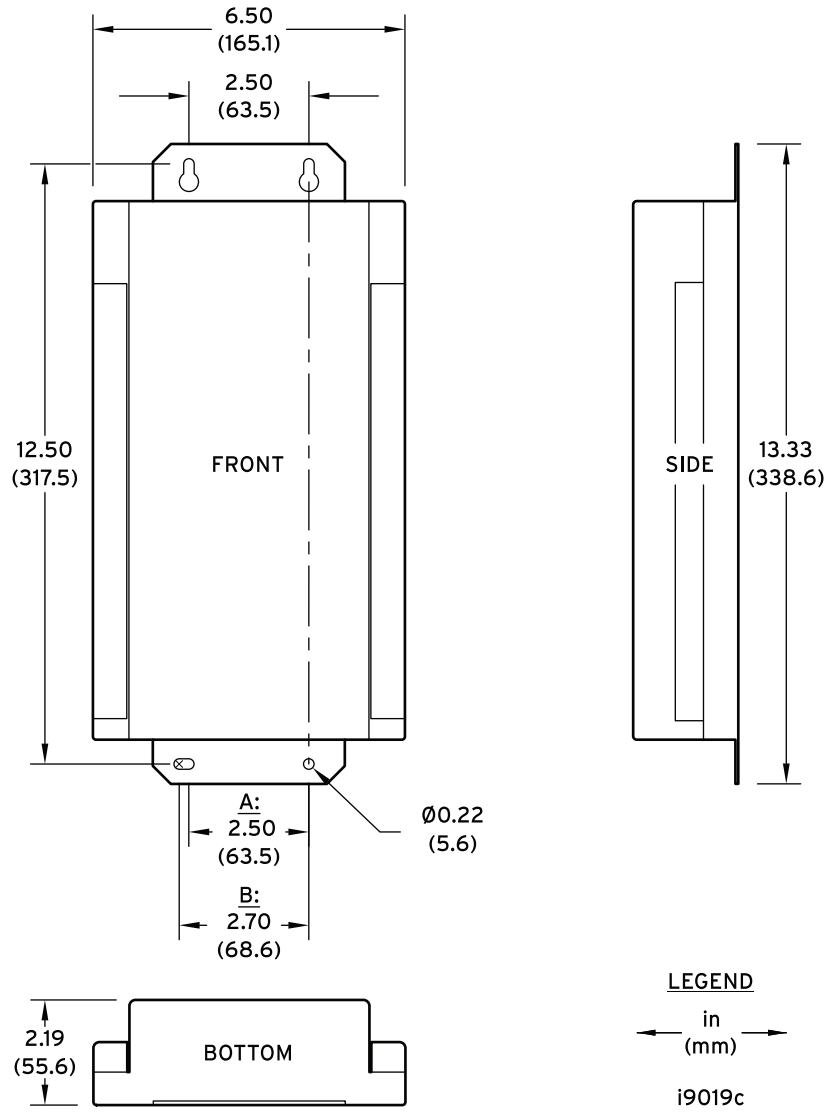


Figure 14 SEL-2505 Dimensions and Drill Diagram

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

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.

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

Tightening Torque

I/O and Power Connectors:	1.0–1.4 Nm (9–12 in-lb)
Serial Ports:	0.6–0.8 Nm (5–7 in-lb)

Terminal Connections

Terminals or stranded copper wire. Ring terminals are recommended. Minimum temperature rating of 105°C (221°F).

Alarm and Output Contacts

IEEE C37.90 Tripping Output Performance

Make:	30 A
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
MOV Protection:	270 Vac rms 360 Vdc continuous

Breaking Capacity (10,000 Operations):

48 Vdc	0.5 A	L/R = 40 ms
125 Vdc	0.3 A	L/R = 40 ms
250 Vdc	0.2 A	L/R = 20 ms

AC Output Ratings

Rated Operational Voltage:	110–240 Vac
Rated Voltage Range:	19.2–264 Vac
Rated Insulation Voltage:	270 Vac
Rated Frequency:	50/60 ± 5 Hz
Utilization Category:	AC-15 (control of electromagnetic loads >72 VA)
Contact Rating Designation:	B300 (B = 5 A, 300 = rated insulation voltage)
Contact Protection:	270 Vac, 40 J
Continuous Carry:	6 A @ 70°C; 4 A @ 85°C
Operating Time (Coil Energization to Contact Closure):	Pickup/Dropout Time: ≤8 ms
Electrical Durability Make VA Rating:	3600 VA, cosϕ = 0.3
Electrical Durability Break VA Rating:	360 VA, cosϕ = 0.3

Optoisolated Inputs

250 Vdc:	Pickup 210–300 Vdc Dropout <150 Vdc
220 Vdc	Pickup 176–264 Vdc Dropout <132 Vdc
125 Vdc:	Pickup 105–150 Vdc Dropout <75 Vdc
110 Vdc:	Pickup 88–132 Vdc Dropout <66 Vdc
48 Vdc:	Pickup 38.4–60 Vdc Dropout <28.8 Vdc
24 Vdc:	Pickup 15–30 Vdc
12 Vdc:	Pickup 9.6–15 Vdc Dropout < 6 Vdc

Note: 12, 24, 48, and 125 Vdc optoisolated inputs draw approximately 4 mA of current; 110 Vdc inputs draw approximately 7 mA of current; and the 220 and 250 Vdc inputs draw approximately 5 mA of current. All current ratings are at nominal input voltages.

Power Supply

Rating

125/250 Vdc or 120/240 Vac

Range:	85–300 Vdc or 85–264 Vac (50 Hz–60 Hz)
Burden:	< 7 W

48/125 Vdc or 120 Vac

Range:	36–200 Vdc or 85–140 Vac (50 Hz–60 Hz)
Burden:	< 6 W

12/24 Vdc

Range:	9.6–36 Vdc, polarity-dependent
Burden:	<6.2 W
Ripple:	5%

Note: Ripple per IEC 60255-11:1979

Port Speed and Back-to-Back Operate Time

Port Speed (bps)	Avg. Operate Time (ms.)
38400	10
19200	12
9600	18

Mirrored Bits Protocol

MB8 (only)

Fiber Optics

Ordering Options	1	2	3	6
Mode	Multi	Multi	Single	Multi
Wavelength (nm)	650	850	1300	850
Source	LED	LASER	LASER	LASER
Connector type	V-pin	ST	ST	ST
Min TX Pwr. (dBm)	–30	–10	–10	–15.5
Max TX Pwr. (dBm)*	–15	–2	3	–9
RX Sens. (dBm)	–39	–49	–50	–29
Sys. Gain (dB)	9	39	40	16
Compatible Transceiver	SEL-2800	SEL-2815	SEL-2830	SEL-2812, SEL-2814, SEL-9220
91560 Attenuator Required	No	< 2 km	< 16 km	No

* This is a failure mode rating.

Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
EN 60825-1:1994 + A1 + A2

Operating Temperature Range

–40° to +85°C (–40° to +185°F)
UL Rating: –40° to +40°C (–40° to +104°F)

Humidity

0% to 95% Without Condensation

Altitude

2000 m Maximum

Pollution Degree

2

Installation Category

II

Object Penetration

IP10

Overvoltage Category

II

Unit Weight

1.36 kg (3.0 lb)

Dimensions

338.6 mm x 165.1 mm x 55.6 mm
(13.33" H x 6.5" W x 2.19" D)

Input Contact Update Rate

2 ms

Type Tests

Environmental

Cold: IEC 60068-2-1:1990 + A1:1993 + A2:1994 [BS EN 60068-2-1:1993 + REAF:2005] Test Ad: Cold
Severity Level: 16 hours at –40°C

Damp Heat Cyclic: IEC 60068-2-30:1980 + A1:1985 [BS EN 60068-2-30:1999]
Test Db and guidance: Damp heat, cyclic
Severity Level: 25°C to 55°C, 6 cycles, Relative Humidity: 95%

Dry Heat: IEC 60068-2-2:1974 + A1:1993 + A2:1994 [BS EN 60068-2-2:1993 + REAF:2005] Test Bd: Dry heat
Severity Level: 16 hours at + 85°C

Vibration: IEC 60255-21-1:1988 [BS EN 60255-21-1:1996 + A1:1996]
Severity Level: Class 1 Endurance, Class 2 Response
IEC 60255-21-2:1988 [BS EN 60255-21-2:1996 + A1:1996]
Severity Level: Class 1 - Shock withstand, Bump, and Class 2 - Shock Response
IEC 60255-21-3:1993 [BS EN 60255-21-3:1995 + A1:1995]
Severity Level: Class 2 (Quake Response)

Electromagnetic Compatibility

EN 50263:1999 [BS EN 50263:2000]

Electromagnetic Compatibility Emissions

EN 55011:1998 + A1:1999 + A2:2002
IEC 60255-25:2000 [BS EN 60255-25:2000]

Electromagnetic Compatibility Immunity

Conducted RF: IEC 60255-22-6:2001 [BS EN 60255-22-6:2001]
IEC 61000-4-6:2004 [BS EN 61000-4-6:1996 CDRG:2001]
Severity Level: 10 Vrms

Digital Radio Telephone RF Immunity: ENV 50204:1995

Electrostatic Discharge: IEC 60255-22-2:1996 [BS EN 60255-22-2:1997]
IEC 61000-4-2:2001 [BS EN 61000-4-2:1995 + A1:1999 + A2
IEEE C37.90.3-2001
Severity Level: 2, 4, and 8 kV contact; 4, 8 and 15 kV air

Fast Transient Burst Immunity: IEC 60255-22-4:2002 [BS EN 60255-22-4:2002]
IEC 61000-4-4:2004 + CRGD:2006 [BS EN 61000-4-4:2005]
Severity Level: 4 kV at 2.5 kHz and 5 kHz

Power Supply Immunity: IEC 60255-11:1979

Radiated Radio Frequency Immunity: IEC 60255-22-3:2000 [BS EN 60255-22-3:2001]
IEC 61000-4-3:2006 [BS EN 61000-4-3:2006]
Severity Level: 10 V/m

Surge Immunity:	IEC 60255-22-5:2002 [BS EN 60255-22-5:2002] IEC 61000-4-5:2005 [BS EN 61000-4-5:1995 + A1:1996] Severity Level: 1 kV Line-to-Line, 2 kV Line-to-Earth
Surge Withstand Capability Immunity:	IEC 60255-22-1:2005 [BS EN 60255-22-1:2006] Severity Level: 2.5 kV peak common mode, 1.0 kV peak differential IEEE C37.90.1-2002 Severity Level: 2.5 kV oscillatory, 4 kV fast transient waveform

Safety

Dielectric Strength:	IEC 60255-5:2000 Severity Level: 2500 Vac on contact inputs and contact outputs IEEE C37.90-2005 Severity Level: 2500 Vac on contact inputs, contact outputs, and analog inputs. 3100 Vdc on power supply. Type tested for 1 minute.
Impulse:	IEC 60255-5:2000 [BS EN 60255-5:2001] Severity Level: 0.5 Joule, 5 kV

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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