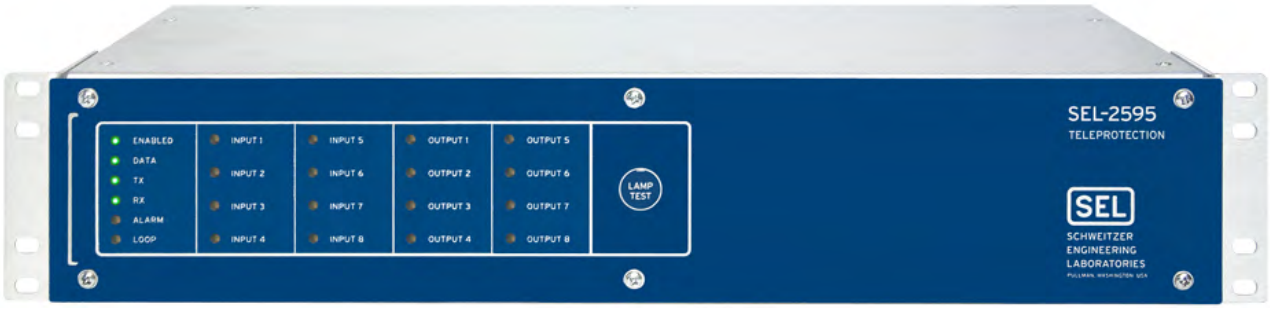
SEL-2595 Teleprotection Terminal Instruction Manual



Features, Benefits, and Applications

The SEL-2595 is a two-rack unit teleprotection terminal that has eight contact inputs and eight contact outputs. The status of these inputs and outputs is communicated between SEL-2595 terminals by using IEEE C37.94 compliant fiber-optic channels. The high operating speed, high security against misoperation caused by noise, and high dependability in the presence of noise of the SEL-2595 terminal make this product an ideal teleprotection device.

- **Simple Pilot Protection** improves existing or new installations. Add low-cost pilot communications to existing line protection applications.
- **Compact Rack Mount** reduces installation to a two-rack unit chassis.
- **Self-Testing** increases reliability of auxiliary relay functions.
- **Simple Diagnostics** consist of 22 LEDs that indicate contact input, output, channel, and device status.
- **Fiber Optics and Channel Monitoring** increases scheme security and provides freedom from interference.
- **User Configurable Labels** allow clear indication of system function and status.
- **Fast Operating Speed** compares with high-speed teleprotection equipment.
- **Connectorized® Terminal Blocks** offer ease of service.
- **Increased Safety** results from fiber-optic isolation and location of all electrical connections behind the panel.

Product Overview

Figure 1 shows the functional overview of the SEL-2595.

The SEL-2595 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 hard-wiring 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.

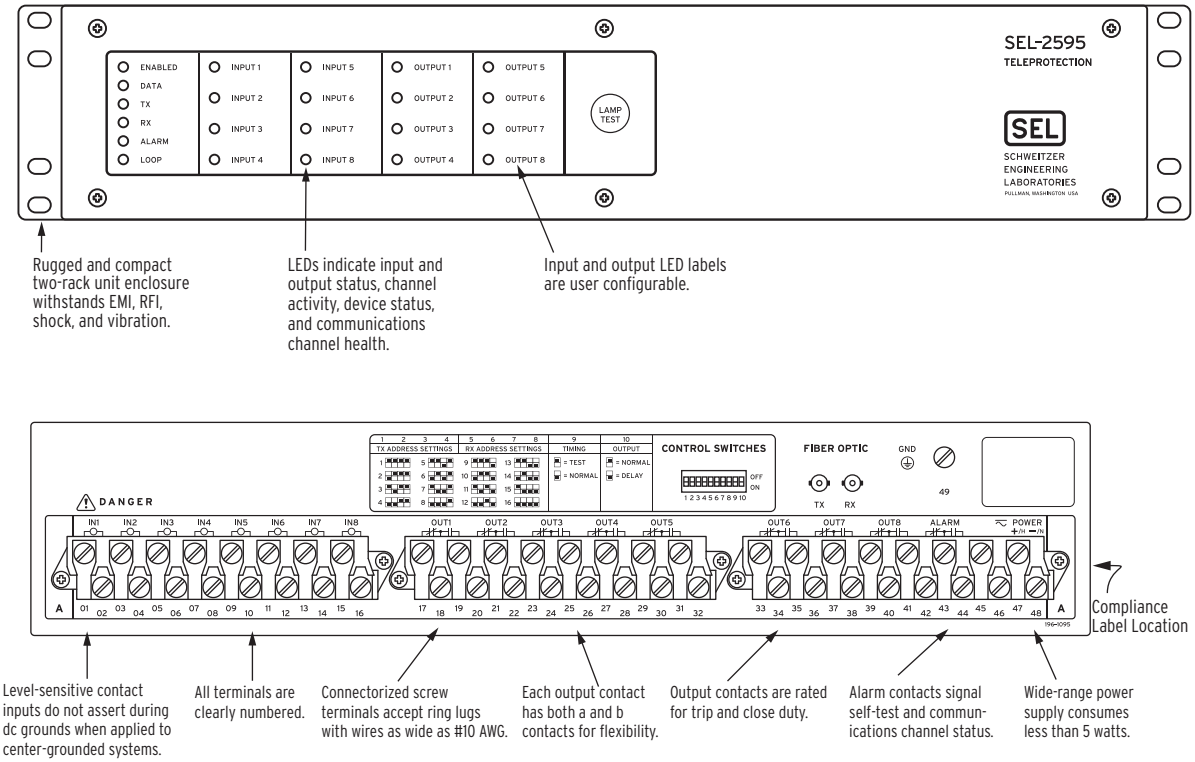


Figure 1 Functional Overview (SEL-2595 With Standard Output Contacts)

Applications

Protection

High-speed protective relay systems rely on teleprotection equipment to send and receive transfer tripping commands between substations. Modern utility grade digital multiplexers include teleprotection channel cards that provide this function by using one or more of the multiplexer time slots. Often the multiplexer is collocated with the communications equipment in the substation, however, the communications equipment and protective relays can be physically located in separate buildings. The physical equipment separation requires long control cable runs between devices, increasing susceptibility to problems associated with metallic control wiring. The SEL-2595 provides a contact interface between the protective relay and IEEE C37.94 compliant multiplexer equipment via a short-haul fiber interface.

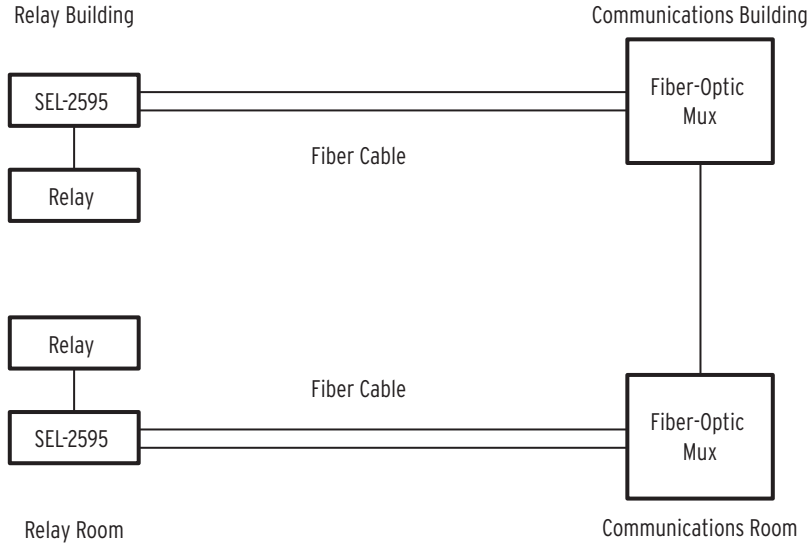


Figure 2 The SEL-2595 Is a Low-Cost Teleprotection System for Use With IEEE C37.94 Compliant Digital Multiplexers

SCADA

Use the SEL-2595 to extend the reach of SCADA Remote Terminal Units (RTU). Communicate control and alarm points between remote circuit breakers/circuit switchers and RTUs via the SEL-2595.

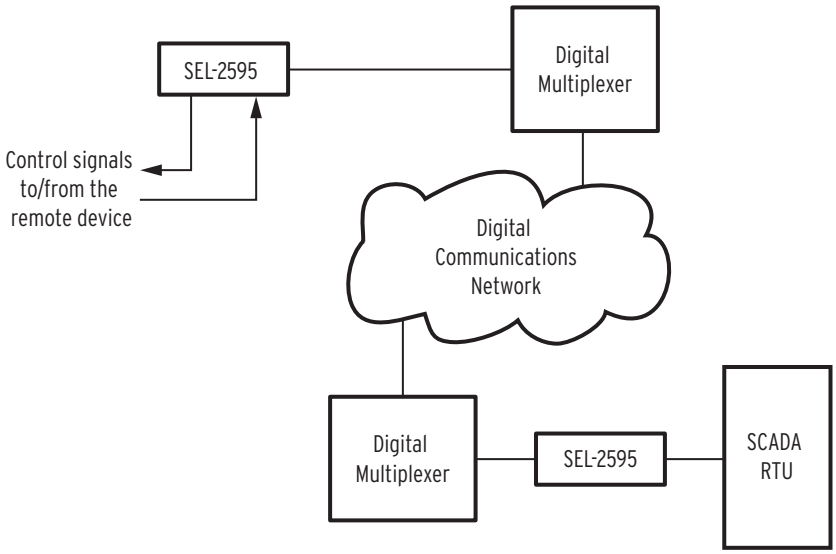


Figure 3 Use the SEL-2595 to Extend RTU Status and Control to Other Locations

Functional Description

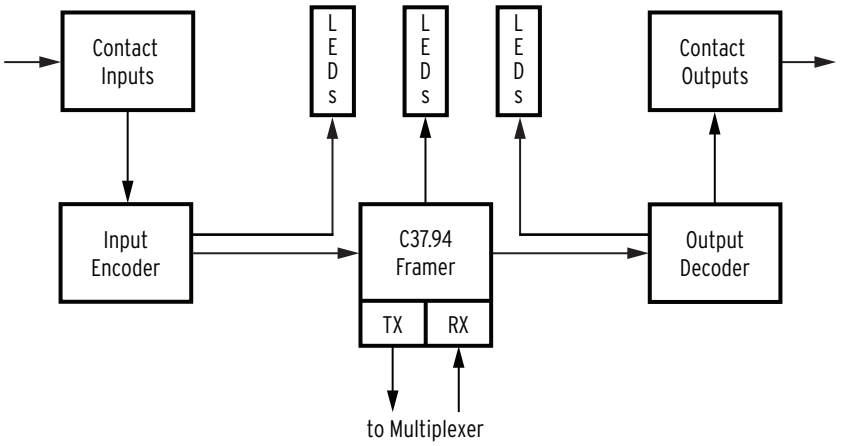


Figure 4 SEL-2595 Functional Block Diagram

Transmit Section

The contact input information is passed through an input encoder, where the contact status is encoded into a 64-kilobit-per-second data packet. This "payload" packet includes the status bits for the eight contact inputs, error detection bits, and transmit address bits per switch setting 1–4. The completed transmit payload packet is sent to the C37.94 framer section. The C37.94 framer section formats the payload data into a transport frame that is used between the SEL-2595 and the multiplexer channel card. This frame is transmitted at 2.048 megabits per second and includes header and overhead bits, per IEEE Standard C37.94.

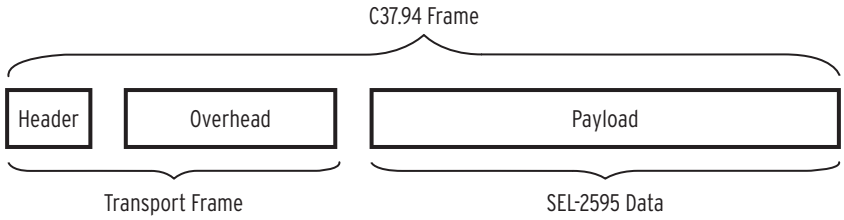


Figure 5 Frame Structure

The Multiplexer

The transport frame is stripped off at the multiplexer channel card and the payload data are included as a DS0 channel in the multiplexer payload. At the remote multiplexer, the DS0 data are decoded and inserted into a new transport C37.94 frame and sent to the remote SEL-2595.

Receive Section

The SEL-2595 receives a data frame from the multiplexer channel card. In the framer section the payload data are separated from the transport frame and sent to the output decoder section. The RX LED lights if the C37.94 transport frame is valid. In the output decoder, error detection bits are checked. If errors are detected, the DATA LED extinguishes, the contact outputs de-energize, and the packet is discarded. If the error detection check passes, the address information is decoded and compared to the receive address setting on switches 5–8. If the address is different than expected, the DATA LED extinguishes and the output contacts de-energize.

Installation and Maintenance

⚠CAUTION
To ensure proper safety and operation, the equipment ratings, installation instructions, and operating instructions must be checked before commissioning or maintenance of the equipment. The integrity of any protective conductor connection must be checked before carrying out any other actions. It is the responsibility of the user to ensure that the equipment is installed, operated, and used for its intended function in the manner specified in this manual. If misused, any safety protection provided by the equipment may be impaired.

The first steps in applying the SEL-2595 Teleprotection Terminal are installing and connecting the device. This section describes common installation features and requirements. To install and connect the device safely and effectively, you must be familiar with device configuration features and options. Carefully plan unit placement, cable connections, and communication during initial design.

Device Placement

Mount the SEL-2595 in a sheltered indoor environment (a building or an enclosed cabinet) that does not exceed the temperature and humidity ratings for the device (see *Specifications on page 20*). The unit is rated Installation/Overvoltage Category II and Pollution Degree 2. This rating allows mounting of the unit indoors or in an outdoor (extended) enclosure where the unit is protected against exposure to direct sunlight, precipitation, and full wind pressure, but temperature and humidity are not controlled.

The SEL-2595 is deigned to be fixed in a standard 19" equipment rack. Refer to *Mechanical Drawing on page 18* for space requirements.

Fiber-Optic Port

The SEL-2595 uses a fiber-optic transmitter. 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.
- During installation, maintenance, or testing of the optical ports, use only test equipment qualified for Class 1 laser products.
- Incorporated components, such as transceivers and laser emitters, are not user serviceable. Return units to SEL for repair or replacement.

Fast Hybrid (Fast High-Current Interrupting) Control Outputs

NOTE: You can use ac or dc circuits with Fast Hybrid (fast high-current-interrupting) outputs.

The Fast Hybrid (fast high-current interrupting) control outputs offer a way to close contacts in microseconds and interrupt large levels of current giving you the best of high-speed tripping and current interruption. These control outputs have a resistive load pickup time of 10 μs (microseconds), which is much faster than the 4–5 ms pickup time of the Standard control outputs. The Fast Hybrid control outputs drop out in a maximum time of 9 ms. The maximum voltage rating is 250 Vac/330 Vdc.

Figure 6 shows a representative connection for a Form A Fast Hybrid control output.

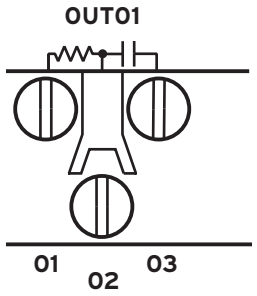


Figure 6 Fast Hybrid Control Output Connection

The Fast Hybrid control output uses three terminal positions, instead of two terminal on standard contacts. The third terminal of each Fast Hybrid control output is connected to precharge resistors that can be used to mitigate transient inrush current conditions, as explained below.

Short transient inrush current can flow at the closing of an external switch in series with open Fast Hybrid contacts. This transient will not energize the circuits in typical relay-coil control applications (trip coils and close coils), and standard auxiliary relays will not pick up. However, an extremely sensitive digital input or light-duty, high-speed auxiliary relay can pick up for this condition. This false pickup transient occurs when the capacitance of the Fast Hybrid output circuitry charges (creating a momentary short circuit that a fast, sensitive device sees as a contact closure). A third terminal (03 in *Figure 7*) provides an internal path for precharging the Fast Hybrid output circuit capacitance when the circuit is open.

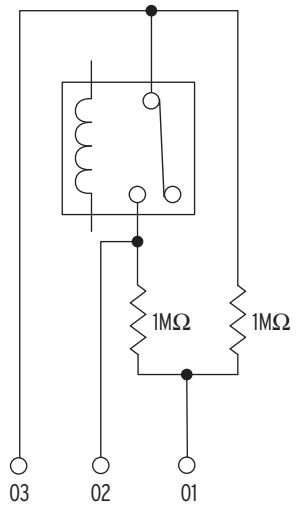


Figure 7 Fast Hybrid Control Output Typical Terminals

Figure 8 shows some possible connections for this third terminal that will eliminate the false pickup transients when closing an external switch. In general, you must connect the third terminal to the dc rail (positive or negative) that is on the same side as the open external switch condition. If an open switch exists on either side of the output contact, then you can accommodate only one condition because two open switches (one on each side of the contact) defeat the precharge circuit.

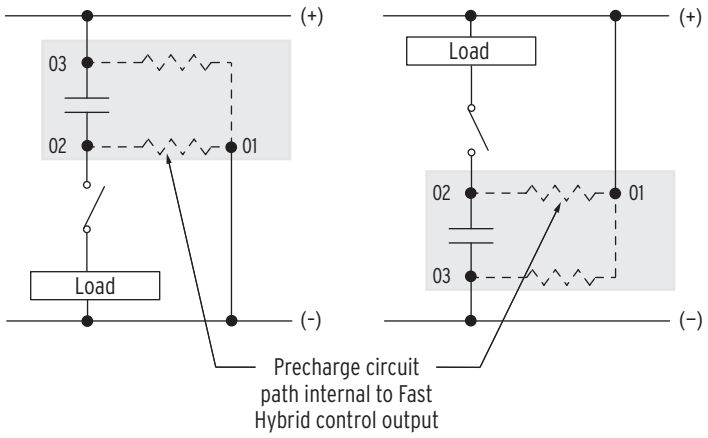


Figure 8 Precharging Internal Capacitance of Fast Hybrid Output Contacts

For wiring convenience, precharge resistors shown in *Figure 7* are built-in to the I/O board, and connected to a third terminal.

Rear-Panel Symbols

There are important safety symbols on the rear of the SEL-2595 as shown in *Figure 9*.

Observe proper safety precautions when you connect the SEL-2595 at terminals marked by these symbols. In particular, the danger symbol located on the rear panel corresponds to the following:

> **Contact with instrument terminals may cause electrical shock that can result in injury or death.**

Be careful to limit access to these terminals.

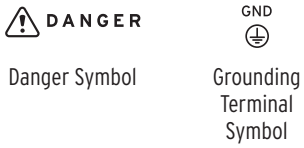


Figure 9 Rear-Panel Safety Symbols

Power Supply

DANGER
Contact with instrument terminals may cause electrical shock which can result in injury or death.

CAUTION
Capacitors should be safely discharged before service or repair.

You can order the SEL-2595 with one of two power supply voltages listed in the *Specifications on page 20*. The serial number label on the back of the device lists the power supply voltage. The SEL-2595 power supply ceases operation when the input voltage is too low to maintain reliable operation, and all output contacts return to the deasserted state. Applying the rated input voltage returns the SEL-2595 to proper operation.

Use 16 AWG (1.5 mm^2) wire (or heavier) to connect to the **POWER** terminals, shown in *Figure 10*. When you use a dc power source, you must connect the source with the proper polarity, as indicated by the **+** (Terminal **47**) and **–**(Terminal **48**) symbols on the power terminals. Upon connecting power, you will see the **ENABLED** LED illuminate.

IMPORTANT: Do not connect power to the SEL-2595 until you have completed these procedures.

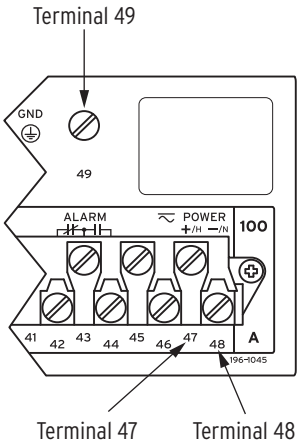


Figure 10 SEL-2595 Rear-Panel Power and Ground Connections

When decommissioning equipment, allow 60 seconds after power removal before handling the equipment to ensure all internal capacitors discharge to safe levels.

Disconnect Device

For installations requiring CE compliance, place an external circuit breaker no more than 3.0 m (9.8 ft) from the equipment. The circuit breaker must comply with IEC 60947-1 and IEC 60947-3 or an equivalent approved disconnect device appropriate for the country of installation 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 SEL-2595. Operational power is internally fused. This fuse is not user replaceable. Should failure occur, return the unit to the factory for repair.

Screw Terminal Connectors

Terminate connections to the SEL-2595 screw terminal connectors with ring-type crimp lugs. Use a #8 ring lug with a maximum width of 9.1 mm (0.360 in). The screws in the rear-panel screw terminal connectors are #8-32 binding head, slotted, nickel-plated brass screws. Tightening torque for the terminal connector screws is 2.0 Nm (18 in-lb). Minimum wire size is 18 AWG with a minimum temperature rating of 105°C.

Grounding

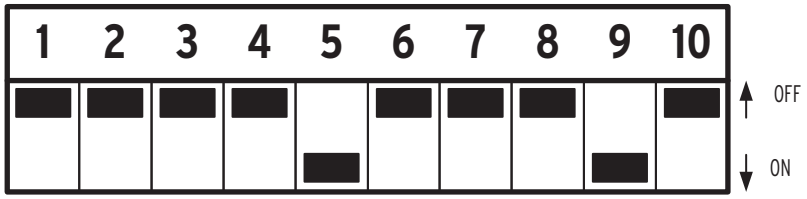
Connect the grounding terminal (**49**) labeled **GND** on the rear panel to a rack frame ground or main station ground for proper safety and performance. Use 12 AWG (4 mm^2) or heavier wire less than 2 m (6.6 ft) in length for this connection. The ground connection should be made before the power connections.

Cleaning

Use care when cleaning the SEL-2595. 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.

Configuring the SEL-2595 With Standard Output Contacts

The SEL-2595 has a 16-position control (DIP) switch to set the transmit address, receive address, and timing mode as shown in *Figure 11*. The High-Speed High-Current Output Contact option is different than the standard output contact option. The number of control (DIP) switches, operate times, and logic are different. This section is only for SEL-2595 units with standard output contacts. If the SEL-2595 has high-speed high-current contacts, proceed to the next section for configuration.



Switch No.	Function
1–4	Transmit Address (TX)
5–8	Receive Address (RX)
9	Timing Mode
10	OUTPUT Delay

Figure 11 SEL-2595 Control Switch Position Identifications

Setting the Transmit and Receive Addresses

Set the transmit (TX) address of each local SEL-2595 to match the receive (RX) address of the remote SEL-2595. The RX and TX addresses of each device should always be set to different numbers. The SEL-2595 detects a loopback condition when it receives the same address as the TX address setting. When the SEL-2595 detects loop back, it illuminates the LOOP LED and extinguishes the DATA LED. The SEL-2595 disables the contact outputs to prevent acting on its own message during loop back.

The SEL-2595 provides 16 transmit and receive address choices. *Table 1* lists the switch positions for the 16 addresses.

Table 1 Transmit and Receive Address Settings Sheet (Sheet 1 of 2)

	Switch	Switch	Switch	Switch	Address
TX RX	1 5	2 6	3 7	4 8	
	OFF	OFF	OFF	OFF	1
	ON	OFF	OFF	OFF	2
	OFF	ON	OFF	OFF	3
	ON	ON	OFF	OFF	4
	OFF	OFF	ON	OFF	5
	ON	OFF	ON	OFF	6
	OFF	ON	ON	OFF	7
	ON	ON	ON	OFF	8
	OFF	OFF	OFF	ON	9
	ON	OFF	OFF	ON	10
	OFF	ON	OFF	ON	11

Table 1 Transmit and Receive Address Settings Sheet (Sheet 2 of 2)

	Switch	Switch	Switch	Switch	Address
TX RX	1 5	2 6	3 7	4 8	
	ON	ON	OFF	ON	12
	OFF	OFF	ON	ON	13
	ON	OFF	ON	ON	14
	OFF	ON	ON	ON	15
	ON	ON	ON	ON	16

Setting the Timing Mode

Switch **9** sets the timing mode for the SEL-2595. For normal operation set this switch to ON. In this mode, timing is recovered from the host multiplexer. When testing SEL-2595 devices without a multiplexer, connect the fiber directly between two SEL-2595 modules and set Switch **9** to the test position on only one SEL-2595.

When connecting two SEL-2595 modules back-to-back, set one timing mode switch to OFF. With the timing mode switch set to OFF, the SEL-2595 provides a timing source for both of the SEL-2595 modules.

Setting the OUTPUT Delay

Switch **10** controls the output contact response time. When the switch is set to the OFF position, the **ALARM** contact will assert with a 100 ms delay when an alarm condition is detected.

When Switch **10** is set to the ON position, a 2-second delay is added to the assertion time of the **ALARM** contact. A 100 ms hold time is also added to the 8 output contacts.

Refer to *Figure 12* for information on setting control (DIP) switch **10**.

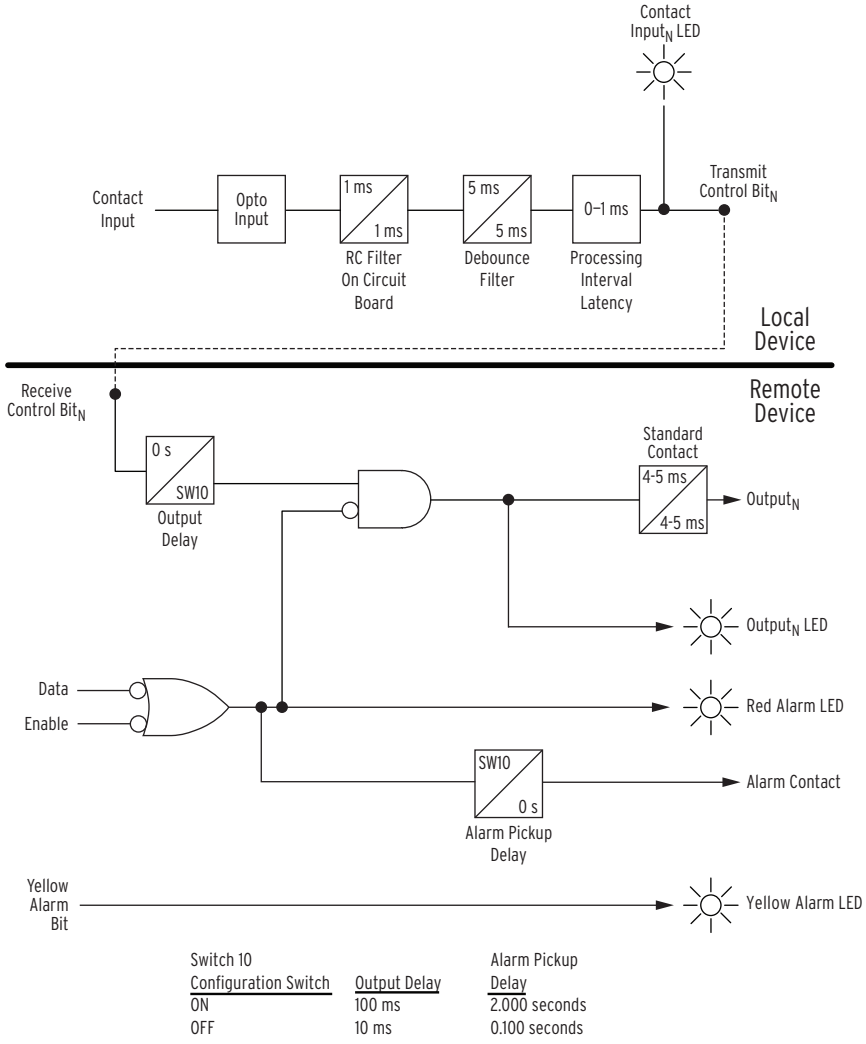


Figure 12 I/O Logic

Connecting the SEL-2595 to a Multiplexer

Use a duplex fiber-optic patch cord to connect the SEL-2595 to an IEEE C37.94 compliant channel card. Connect the **TX** ST® connector on the SEL-2595 to the **RX** ST connector on the multiplexer channel card, and connect the **RX** ST connector on the SEL-2595 to the **TX** ST connector on the multiplexer channel card, as shown in *Figure 13*.

The LEDs are not user serviceable. Return the device to the factory for repair or replacement.

⚠CAUTION
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

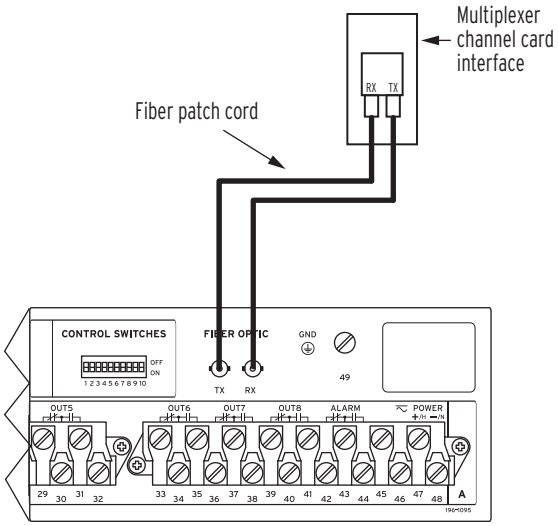
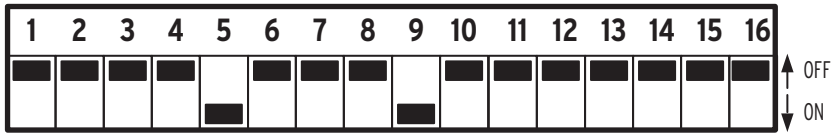


Figure 13 Fiber-Optic Connections

Configuring the SEL-2595 With High-Speed High-Current Output Contacts

The SEL-2595 has a 16-position control (DIP) switch to set the transmit address, receive address, and timing mode as shown in *Figure 14*. This section is for SEL-2595 models that have the high-speed high-current output contacts. If the SEL-2595 came with standard output contacts refer to the previous section on configuration.



Switch No.	Function
1–4	Transmit Address (TX)
5–8	Receive Address (RX)
9	Timing Mode
10	Alarm Output Delay
11	Output Hold Delay
12	Receive Input Delay
13	Pretrip Delay
14, 15	Not used
16	Loopback

Figure 14 SEL-2595 Control Switch Position Identifications

Setting the Transmit and Receive Addresses

Set the transmit (**TX**) address of each local SEL-2595 to match the receive (**RX**) address of the remote SEL-2595. The **RX** and **TX** addresses of each device should always be set to different numbers. The SEL-2595 detects a loopback condition when it receives the same address as the **TX** address setting. When the SEL-2595 detects loop back, it illuminates the **LOOP** LED and extinguishes the **DATA** LED. The SEL-2595 disables the contact outputs to prevent acting on its own message during loop back.

The SEL-2595 provides 16 transmit and receive address choices. *Table 2* lists the switch positions for the 16 addresses.

Table 2 Transmit and Receive Address Settings Sheet

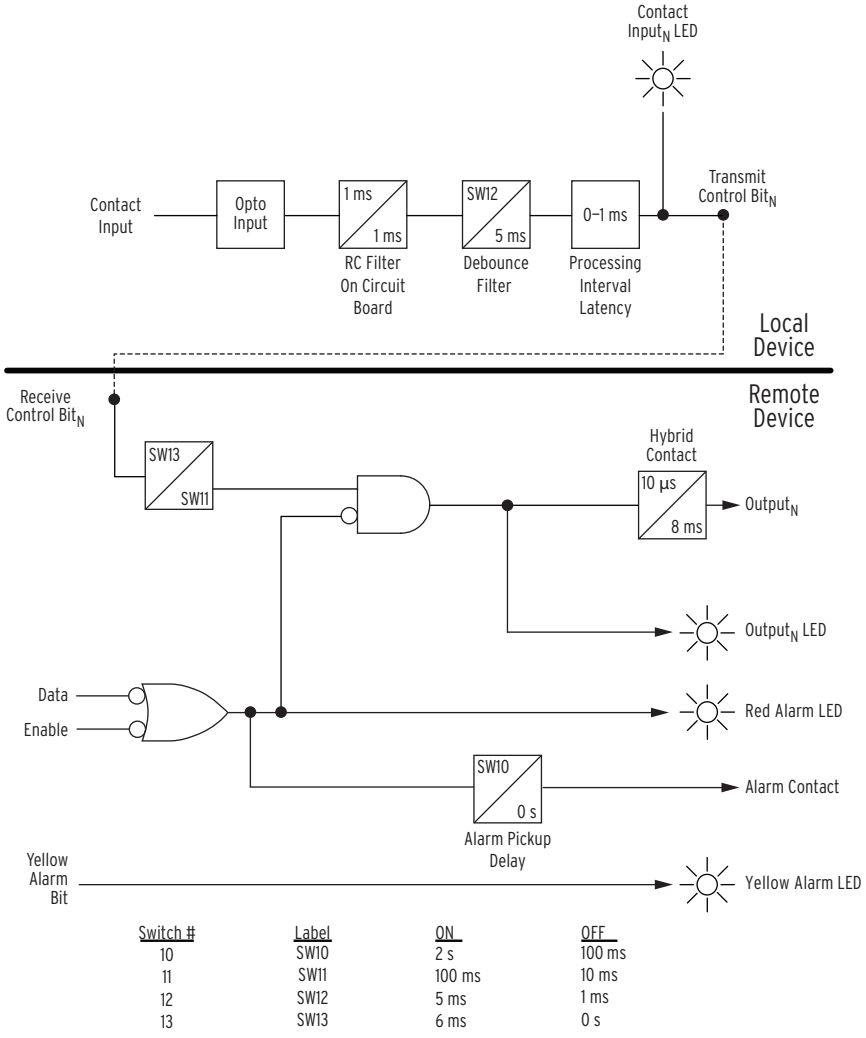
	Switch	Switch	Switch	Switch	Address
TX RX	1 5	2 6	3 7	4 8	
	OFF	OFF	OFF	OFF	1
	ON	OFF	OFF	OFF	2
	OFF	ON	OFF	OFF	3
	ON	ON	OFF	OFF	4
	OFF	OFF	ON	OFF	5
	ON	OFF	ON	OFF	6
	OFF	ON	ON	OFF	7
	ON	ON	ON	OFF	8
	OFF	OFF	OFF	ON	9
	ON	OFF	OFF	ON	10
	OFF	ON	OFF	ON	11
	ON	ON	OFF	ON	12
	OFF	OFF	ON	ON	13
	ON	OFF	ON	ON	14
	OFF	ON	ON	ON	15
	ON	ON	ON	ON	16

Setting the Timing Mode

Switch **9** sets the timing mode for the SEL-2595. For normal operation set this switch to ON. In this mode, timing is recovered from the host multiplexer. When testing SEL-2595 devices without a multiplexer, connect the fiber directly between two SEL-2595 modules and set Switch **9** to the test position on only one SEL-2595.

When connecting two SEL-2595 modules back-to-back, set one timing mode switch to OFF. With the timing mode switch set to OFF, the SEL-2595 provides a timing source for both of the SEL-2595 modules.

Refer to *Figure 15* for information on setting control (DIP) switches **10**-**13**.



Switch #	Label	ON	OFF
10	SW10	2 s	100 ms
11	SW11	100 ms	10 ms
12	SW12	5 ms	1 ms
13	SW13	6 ms	0 s

Figure 15 I/O Logic

Setting the Alarm OUTPUT Delay

Switch **10** controls the alarm output contact response time. When the switch is set to the OFF position, the **ALARM** contact will assert with a 100 ms delay when an alarm condition is detected.

When Switch **10** is set to the ON position, a 2-second delay is added to the assertion time of the **ALARM** contact. Refer to *Figure 15* for information on setting control (DIP) switch **10**.

Setting the Output Hold Delay

Switch **11** controls how long the output contact shall remain closed on the remote device upon receiving a valid control command assertion from the transmit end. When the switch is in the OFF position and a valid control close command is issued the SEL-2595 will hold the contact closed for a minimum of 10 ms. If the switch is in the ON position the SEL-2595 will hold the contact closed for 100 ms.

Setting the Input Delay

Switch **12** controls the amount of time the contact input on the local device needs to delay to consider the input a valid assertion. If the switch is in the ON position the input must be asserted for an additional 5 ms for the SEL-2595 to consider it a valid signal. In the OFF position it will delay 1 ms. For faster assertion times set the switch to OFF. Set the switch to ON to increase the security of the input asserting.

Setting the Pretrip Delay

Switch **13** is used to delay the period of time when it receives a control close command on the remote device before issuing a contact closure. If the switch is in the ON position the receive side will not issue a close signal until the control close command has been received for 6 ms. Setting the switch to the OFF position gives no intentional delay and the fastest operate times.

Connecting the SEL-2595 to a Multiplexer

Use a duplex fiber-optic patch cord to connect the SEL-2595 to an IEEE C37.94 compliant channel card. Connect the **TX** ST connector on the SEL-2595 to the **RX** ST connector on the multiplexer channel card, and connect the **RX** ST connector on the SEL-2595 to the **TX** ST connector on the multiplexer channel card, as shown in *Figure 13*.

⚠CAUTION
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

The LEDs are not user serviceable. Return the device to the factory for repair or replacement.

Testing and Troubleshooting

Test the SEL-2595 with either a direct fiber connection to another SEL-2595, or with two SEL-2595 modules connected through a multiplexer.

Step 1. Configure the SEL-2595 control (DIP) switch ID settings.

a. Make sure the **TX** address of the local SEL-2595 matches the **RX** address of the remote SEL-2595.

b. If the connection between the SEL-2595 modules is direct fiber, set the timing control Switch **9** to OFF (test) on one SEL-2595.

c. If the test setup includes multiplexers, set Switch **9** to ON (normal) on both SEL-2595 modules.

Step 2. Connect the chassis ground terminal of the SEL-2595 to ground (terminal **49**).

Step 3. Connect and apply rated voltage to the power supply inputs of the SEL-2595 (positive to terminal **47**, negative to terminal **48**).

The **ENABLED** LED should illuminate. The Form B ALARM contact will remain closed and the **ALARM** LED will illuminate (red) because of no communication.

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

All LEDs should illuminate. When you release the button, the contact input and output LEDs should extinguish and the remainder will return to indicating the current communication status.

Step 5. Make the fiber-optic connections between SEL-2595 modules either directly or through a multiplexer by connecting the transmit (**TX**) fiber on one unit to the receive fiber (**RX**) on the other.

The **DATA**, **TX**, and **RX** LEDs on both devices should illuminate. In addition the Form B ALARM contact should open, and the **ALARM** LED should extinguish.

Step 6. Apply rated voltage to **IN1** on one device. The **INPUT 1** LED should illuminate on this device. On the other SEL-2595, the **OUT1** contact should close and the **OUTPUT 1** LED should illuminate.

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

Step 8. To test the loopback feature:

- ➢ **for the SEL-2595 with standard output contacts**, set Switch **9** to test, connect a single fiber between the **TX** and **RX** on the same device. The **LOOP** LED should illuminate and the **DATA** LED should extinguish.
- ➢ **for the** SEL-2595 **with high-speed high-current output contacts**, set Switch **16** to ON and the transmit and receive fiber must be jumpered together and the **TX** and **RX** address switches must be set to the same address.

Alarm Conditions

Figure 16 illustrates the operation of the yellow alarm bit and LED.

A yellow alarm is a remote receive alarm communicated from the local channel card to the local SEL-2595 via a predefined alarm bit in the frame. A yellow alarm is declared when the local multiplexer channel card is not receiving data from the local SEL-2595. The channel card sets the yellow alarm bit in the transport frame header in the transmit direction back to the SEL-2595. If the SEL-2595 is still receiving data from the channel card, the yellow alarm bit is decoded and the **ALARM** LED is illuminated yellow.

When valid transport frames are received but the payload data are invalid, the **ALARM** LED will be red, the **DATA** LED will turn off, and the **RX** LED will remain lit.

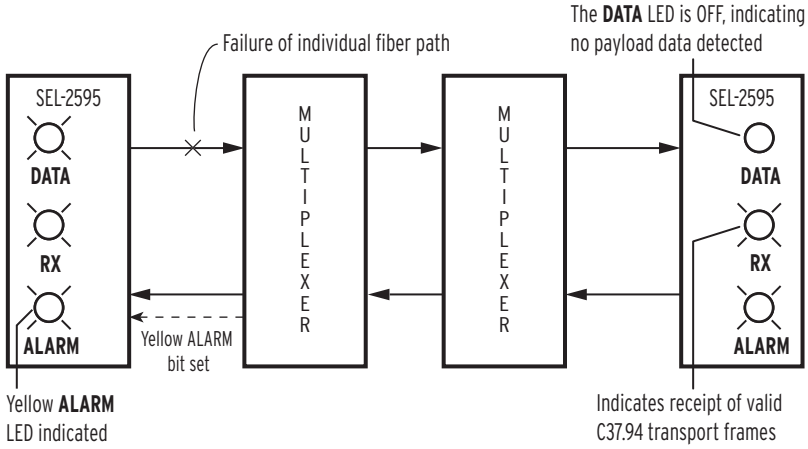


Figure 16 Link Failure and Yellow Alarm Condition

LED Indications

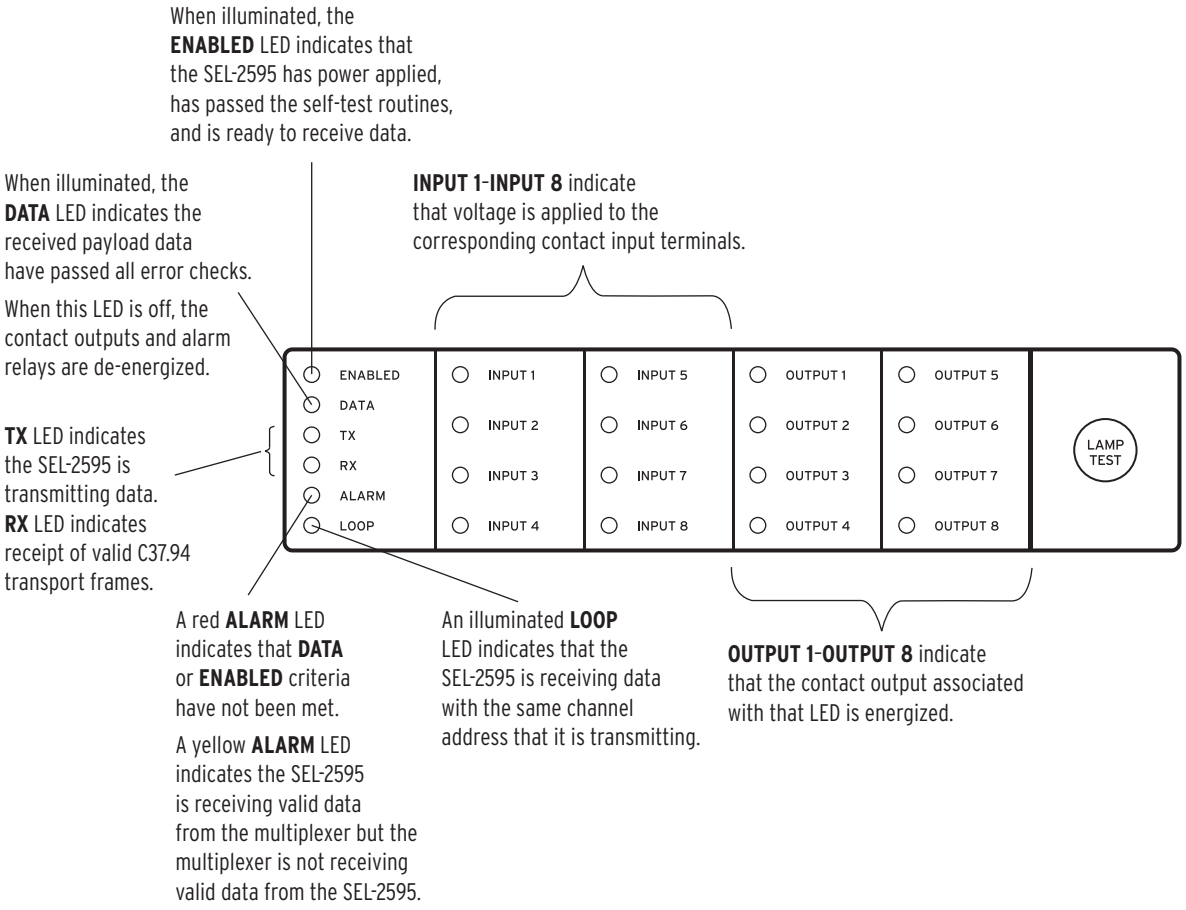


Figure 17 LED Indications

Mechanical Drawing

RACK-MOUNT CHASSIS

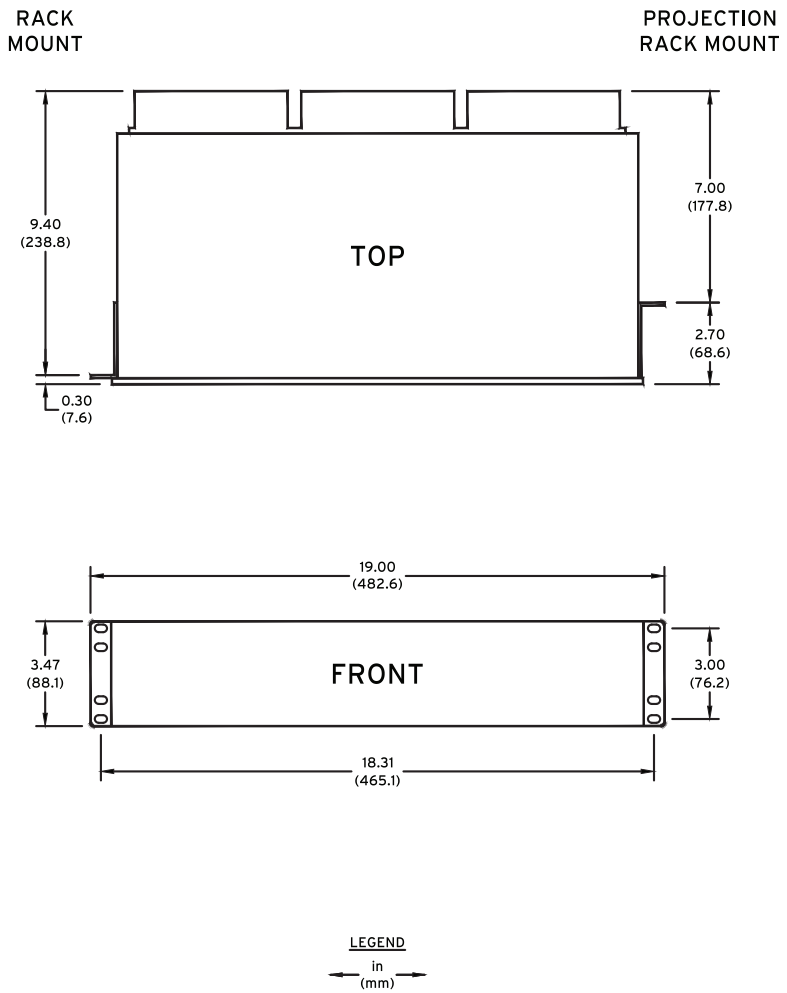


Figure 18 SEL-2595 Dimensions and Drill Diagram

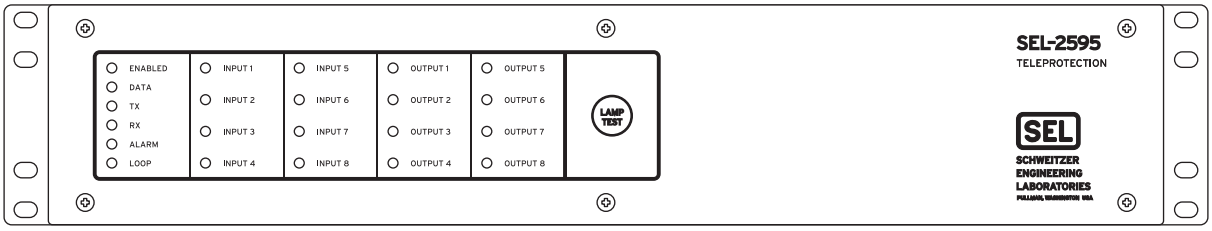


Figure 19 SEL-2595 Front View

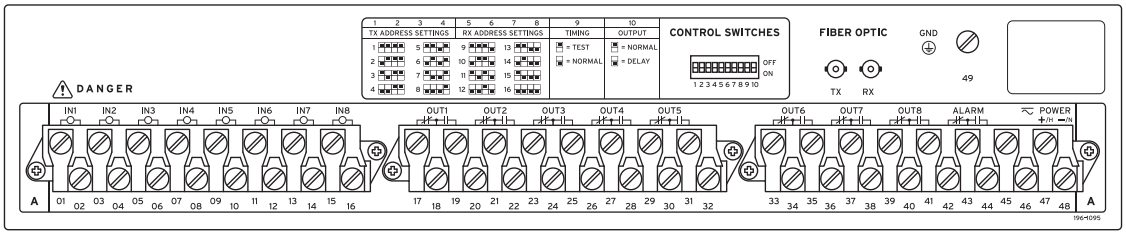


Figure 20 SEL-2595 Rear View With Standard Output Contacts

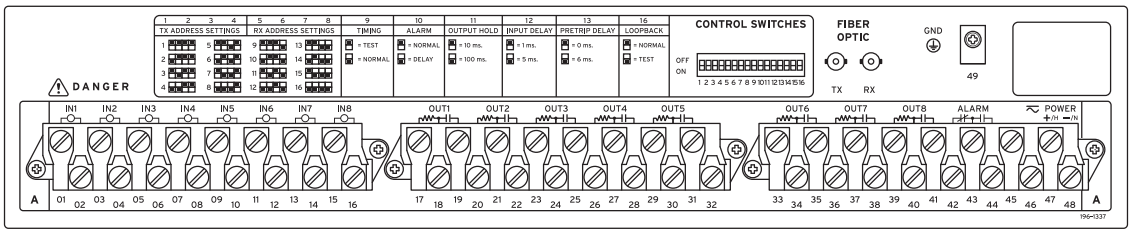


Figure 21 SEL-2595 Rear View With High-Speed High-Current Output Contacts

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

CE Mark:	EMC Directive Low Voltage Directive

Tightening Torque

Minimum:	9 in-lb (1.0 Nm)
Maximum:	18 in-lb (2.0 Nm)

Terminal Connections

Wire Type

Insulation:	300 V min.
Temperature:	105°C min.

Power Wiring

Size:	16 AWG min.

Alarm, Input, and Output Wiring

Size:	18 AWG min.

Ground Wiring

Size:	12 AWG min.
Length:	<2 m

Alarm and Output Contacts

Standard Outputs

Make:	30 A
Carry:	6 A @ 70°C 4 A @ 85°C
1 s Rating:	50 A
MOV:	270 Vac, 360 Vdc, 40 J
Pickup Time:	<5 ms
Dropout Time:	<8 ms, typical
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

Note: Make per IEEE C37.90-1989; Breaking and Cyclic Capacity per IEC 60255-23:1994.

Note: The output contact burden on the supply input is 700 mW.

Fast Hybrid (High-Speed High-Current Interrupting)

Make:	30 A
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
1 s Rating:	50 A
MOV Protection (maximum voltage):	250 Vac/330 Vdc
Pickup Time:	10 µs, resistive load
Dropout Time:	9 ms, resistive load
Breaking Capacity (10,000 Operations):	125 Vdc 10.0 A L/R = 40 ms
Cyclic Capacity (4 Cycles/Second, Followed by 2 Minutes Idle for Thermal Dissipation):	125 Vdc 10.0 A L/R = 40 ms

Note: Make rating per IEEE C37.90-1989.

Optoisolated Inputs

250 Vdc:	Pickup 210–300 Vdc Dropout <50 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

Note: Optoisolated input burden on the supply input is <1mW.

Note: 125 Vdc optoisolated inputs draw approximately 4 mA of current.

Power Supply

125/250 Vdc or 120/230 Vac

Range:	85–350 Vdc or 85–264 Vac (50 Hz or 60 Hz)
Burden:	≤6 W

48/125 Vdc or 120 Vac

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

Fuse Ratings

Power Supply:	1 A, 250 Vdc/250 Vac slow blow 250 Vac/35 A break rating. Fuse is not serviceable

Back-to-Back Operate Time (Without Propagation Delay)

Standard Output Contacts:	11 ms
High-Speed High-Current Output Contacts:	3–17 ms[a]

[a] The operation times vary depending on control (DIP) switch configuration settings.

Protocol

IEEE C37.94

Port Speed (Data Rate)

64 kbps (1 DS0)

Fiber Optics

Ordering Options:

Mode:	Multi	Single
Wavelength (nm):	850	1310
Source:	VCSEL[a]	LED[b]
Connector type:	ST	ST
Min TX Pwr. (dBm):	–19	–30
Max TX Pwr. (dBm):	–11[c]	–17[d]
RX Sens. (dBm):	–32	–35
Sys. Gain (dB):	13	5

[a] 1 Class 1 Laser Product IEC 60825-1:1993 + A1:1997 + A2:2001.
[b] 1 Class 1 LED Product IEC 60825-1:1993 + A1:1997 + A2:2001.
[c] Maximum faulted output (nonoperational) –3 dBm.
[d] Maximum faulted output (nonoperational) –14 dBm.

Operating Temperature Range

–40° to +85°C (–40° to +185°F)

Humidity

0% to 95% without condensation

Altitude

2000 m maximum

Overvoltage Category

Category II

Insulation Class

1

Pollution Degree

2

IP Code

IP20

Green Product

Compliant with the European Union's RoHS directive

Unit Weight

2.94 kg (6.5 lb)

Dimensions

88.1 mm H x 455.1 mm W x 223.5 mm D
(3.47 in. H x 18.31 in. W x 8.80 in. D)

Contact Input Update Rate

1 ms

Product Standards

Measuring Relays and Protection Equipment: IEC 60255-26:2013 [EN 60255-26:2013]; IEC 60255-27:2013 [EN 60255-27:2013]

Type Tests

Electromagnetic Compatibility Emissions

General: CISPR 22:2008; CISPR 11:2009 + A1:2010; FCC CFR47:2008, Part 15, Subpart B, 15.107 & 15-109; EN 55022:2010; EN 55011:2009 + A1:2010

Electromagnetic Compatibility Immunity

Conducted RF Immunity: IEC 61000-4-6:2013 [EN 61000-4-6:2013] Severity Level: 10 Vrms

Electrostatic Discharge Immunity: IEC 61000-4-2:2008 [EN 61000-4-2:2009]; IEEE C37.90.3-2001 Severity Level: 2, 4, 6, and 8 kV contact; 2, 4, 8, and 15 kV air

Fast Transient/Burst Immunity: IEC 61000-4-4:2012 [EN 61000-4-4:2012] Severity Level: 4 kV at 2.5 kHz and 5 kHz

Radiated Radio Frequency Immunity: IEC 61000-4-3:2006 + A1:2007 + A2:2010 [EN 61000-4-3:2006 + A1:2007 + A2:2010] Severity Level: 10 V/m; IEEE C37.90.2-2004 Severity Level: 35 V/m

Surge Immunity: IEC 61000-4-5:2005 [EN 61000-4-5:2006] Severity Level: 1 kV Line-to-Line, 2 kV Line-to-Earth

Surge Withstand Capability Immunity: IEC 61000-4-18:2006 [EN 61000-4-18:2007]; IEEE C37.90.1-2012 Severity Level: 2.5 kV oscillatory, 4 kV fast transient waveform

Magnetic Field Immunity: IEC 61000-4-8:2009 [EN 61000-4-8:2010] Severity Level: 1000 A/m for 3 s; 100 A/m for 60 s.

Power Frequency Immunity: IEC 61000-4-16:1998 + A2:2009 [EN 61000-4-16:1998 + A2:2011]

Power Supply Immunity

Voltage Dips and Interruptions: IEC 61000-4-29:2000 [EN 61000-4-29:2000]; IEC 61000-4-11: 2004 [EN 61000-4-11:2004]

Voltage Ripple: IEC 61000-4-17:1999 + A1:2001 + A2:2008 [EN 61000-4-17:1999 + A1:2004 + A2:2009]

Environmental

Cold: IEC 60068-2-1:2007 [EN 60068-2-1:2007] Test Ad; Severity Level: 16 hours at –40°C

Dry Heat: IEC 60068-2-2:2007 [EN 60068-2-2:2007] Test Bd; Severity Level: 16 hours at +85°C

Damp Heat, Cyclic: IEC 60068-2-30:2005 [EN 60068-2-30:2005] Test Db; Severity Level: 25°C to 55°C, 6 cycles, Relative Humidity: 95%

Damp Heat, Steady State: IEC 60068-2-78:2001 [EN 60068-2-78:2002]

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

Safety

Insulation Coordination:	IEEE C37.90-2005 Severity Level Hi-Pot: 2500 Vac on contact inputs, contact outputs, and analog inputs. 3100 Vdc on power supply. Type tested for 1 minute. Severity Level Impulse: 0.5 joule, 5 kV
Laser (LED) Safety:	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.
Object Penetration:	IEC 60529:1989 + A1:1999 + A2:2013 [EN 60529:1989 + A1:2002 + A2:2013]
Product Safety:	CE Mark

Notes

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

⚠WARNING
Operator safety may be impaired if the device is used in a manner not specified by SEL.

⚠CAUTION
The module contains devices sensitive to Electrostatic Discharge (ESD). When working on the module with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.

⚠CAUTION
Removal of enclosure panels exposes circuitry which may cause electrical shock which can result in injury or death.

⚠CAUTION
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

⚠CAUTION
Capacitors should be safely discharged before service or repair.

⚠DANGER
Tout contact avec les bornes de raccordement de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.

⚠AVERTISSEMENT
La sécurité de l'opérateur peut être compromise si l'appareil est utilisé d'une façon non indiquée par SEL.

⚠ATTENTION
Le module contient des composantes qui sont sensibles aux décharges électrostatiques. Lorsque la face avant du module est retirée, les surfaces et le personnel doivent être mis à la terre convenablement pour éviter de causer des dommages à l'équipement.

⚠ATTENTION
Le retrait des panneaux du boîtier expose le circuit qui peut causer un choc électrique pouvant entraîner des blessures ou la mort.

⚠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.

⚠ATTENTION
Décharger les condensateurs de façon sécuritaire avant d'effectuer des réparations.

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