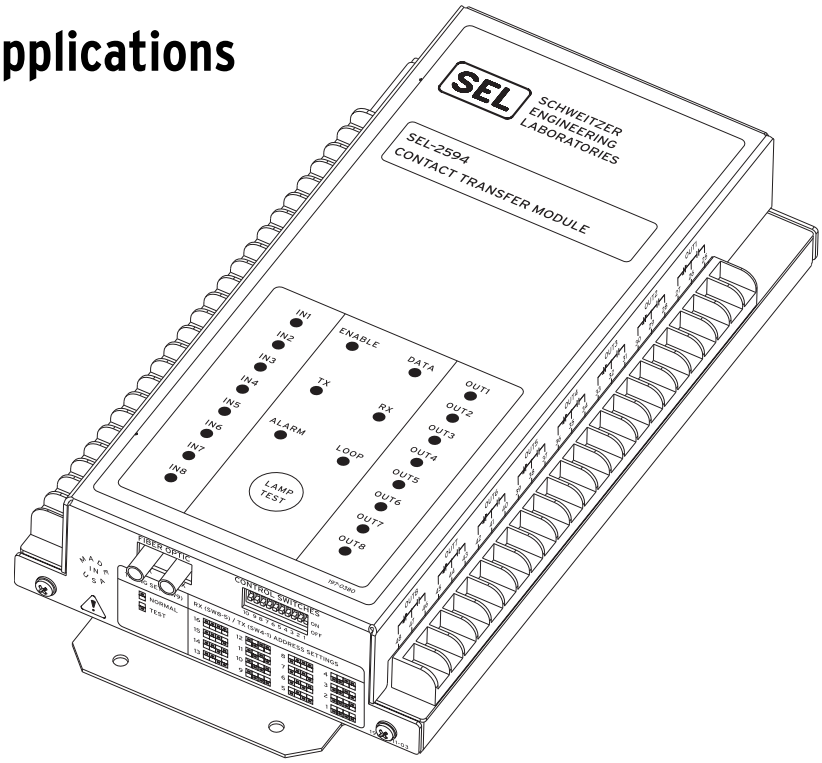
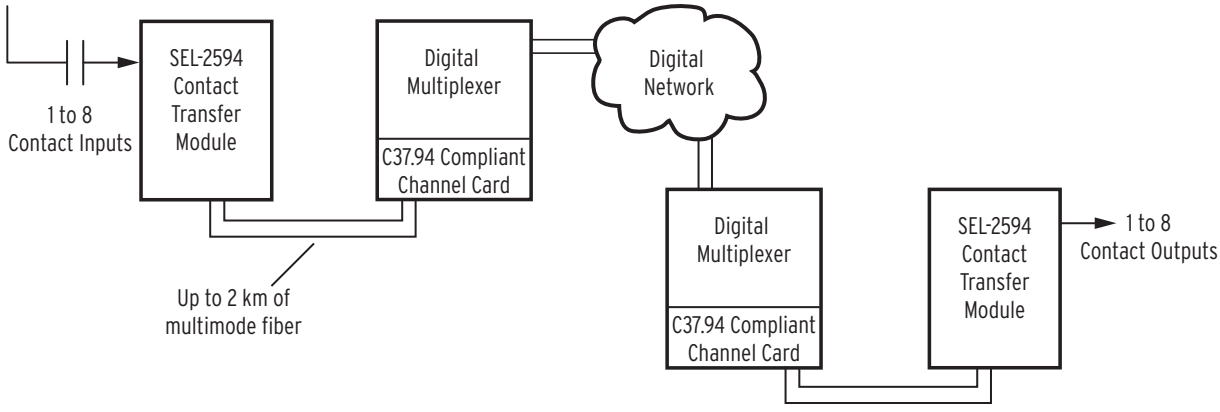
SEL-2594 Contact Transfer Module Instruction Manual

Features, Benefits, and Applications



The SEL-2594 transfers contact status for control, alarm or protective relay transfer trip commands (teleprotection). The SEL-2594 provides eight contact inputs and eight contact outputs. The contact input status of one SEL-2594 is transferred to another SEL-2594 contact output through IEEE C37.94 compliant channels over digital multiplexers. Prior to this interface, connections between teleprotection equipment and multiplexers have been electrical only. Because low energy signal interfaces are susceptible to electromagnetic interference (EMI) and ground loops, the fiber optics interface eliminates data corruption due to these conditions.

- **Isolation** Fiber optic connections provide isolation and prevent ground loops associated with electric communications cables.
- **Immunity** Fiber optics provide immunity to radiated and induced voltages associated with control wiring.
- **Simple** LEDs indicate the state of inputs, contact outputs and channel status. All settings are made with a control switch—PC software is not required.
- **Secure** 16 user selectable addresses for transmit and receive allows up to 240 unique address combinations.
- **High Speed** The SEL-2594 uses one 64-kilobit time slot in a digital multiplexer, and provides 8 millisecond back-to-back operate time.



Product Overview

Figure 1 provides a functional overview of the SEL-2594.

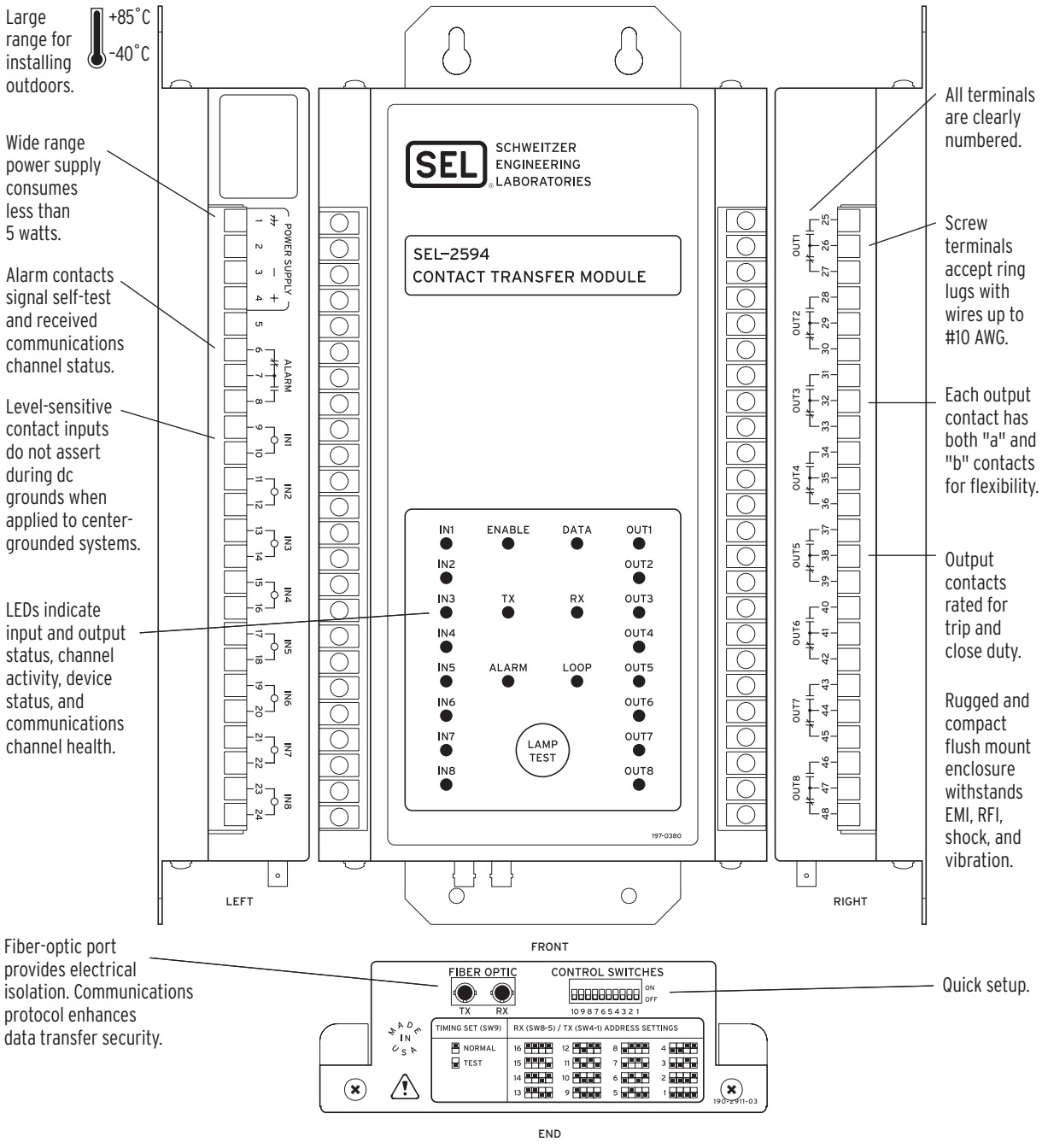


Figure 1 SEL-2594 Functional Overview

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 using one or more of the multiplexer time slots. Often the multiplexer is co-located 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-2594 provides a contact interface between the protective relay and IEEE C37.94 compliant multiplexer equipment via a short haul fiber interface.

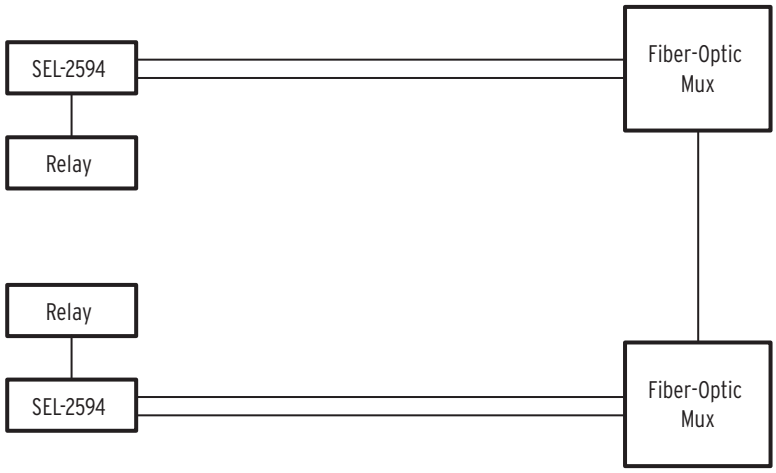


Figure 2 The SEL-2594 Is a Low-Cost Teleprotection System for Use with IEEE C37.94 Compliant Digital Multiplexers

SCADA

Use the SEL-2594 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-2594.

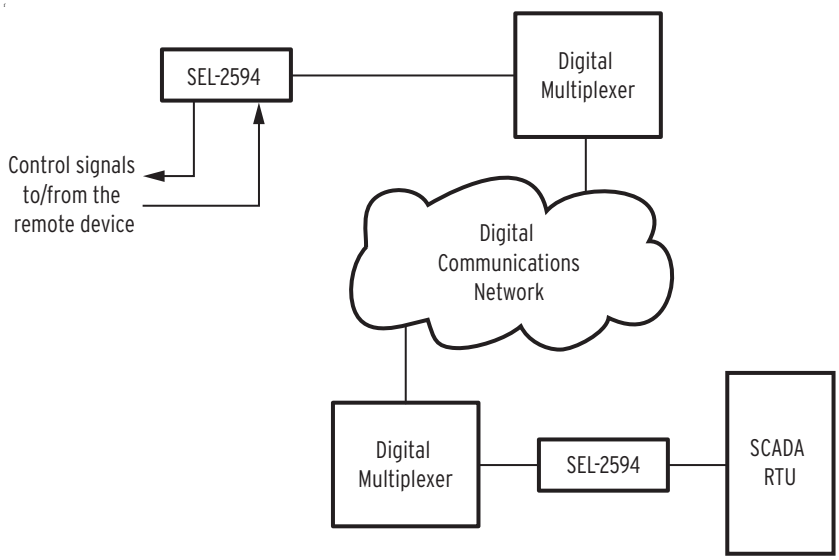


Figure 3 Use the SEL-2594 to Extend RTU Status and Control to Other Locations

Functional Description

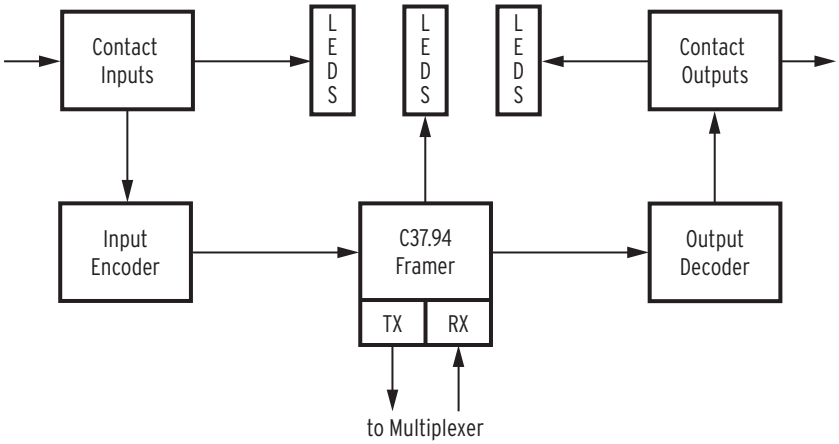


Figure 4 SEL-2594 Functional Block Diagram

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, contact output framing 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-2594 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.

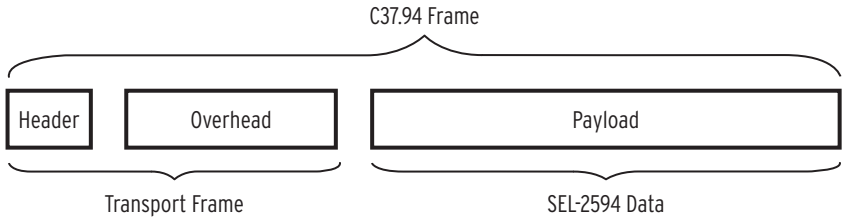


Figure 5 Frame Structure

The Multiplexer

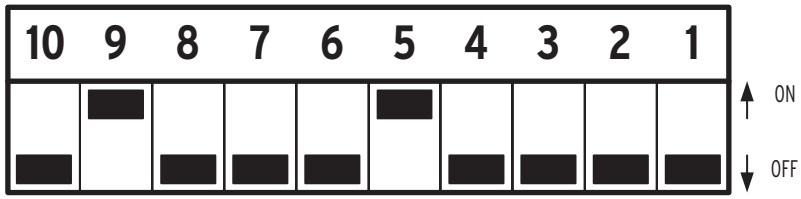
The transport frame is stripped off at the multiplexer channel card and the payload data is included as a DS0 channel in the multiplexer payload. At the remote multiplexer the DS0 data is decoded and inserted into a new transport C37.94 frame and sent to the remote SEL-2594.

Receive Section

The SEL-2594 receives data frame from the multiplexer channel card. In the framer section the payload data is 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.

Configuring the SEL-2594

The SEL-2594 has a 10 position dip switch to set the transmit address, receive address and timing mode as shown in *Figure 6*.



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

Figure 6 SEL-2505 Control Switch Position Identifications

Setting the Transmit and Receive Addresses

Set the transmit (TX) address of each local SEL-2594 to match the receive (RX) address of the remote SEL-2594. The RX and TX addresses of each device should always be set to different numbers. The SEL-2594 detects a loop back condition when it receives the same address as the TX address setting. When the SEL-2594 detects loop back, it illuminates the LOOP LED and extinguishes the DATA LED. The SEL-2594 disables the contact outputs to prevent acting on its own message during loop back.

The SEL-2594 provides 16 transmit and receive address choices. *Table 1* lists the switch positions for the 16 addresses.

Table 1 Transmit and Receive Address Settings

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

Setting the Timing Mode

Switch 9 sets the timing mode for the SEL-2594. For normal operation set this switch to ON. In this mode, timing is recovered from the host multiplexer. When testing SEL-2594 devices without a multiplexer, connect the fiber directly between two SEL-2594s and set Switch 9 to the test position on only one SEL-2594.

When connecting two SEL-2594s back-to-back, set one timing mode switch to OFF. With the timing mode switch set to OFF, the SEL-2594 provides timing source for both of the SEL-2594s.

Connecting the SEL-2594 to a Multiplexer

Use a duplex fiber optic patch cord to connect the SEL-2594 to an IEEE C37.94 compliant channel card. Connect the TX ST connector on the SEL-2594 to the RX ST connector on the multiplexer channel card, and connect the RX ST connector on the SEL-2594 to the TX ST connector on the multiplexer channel card, as shown in *Figure 7*.

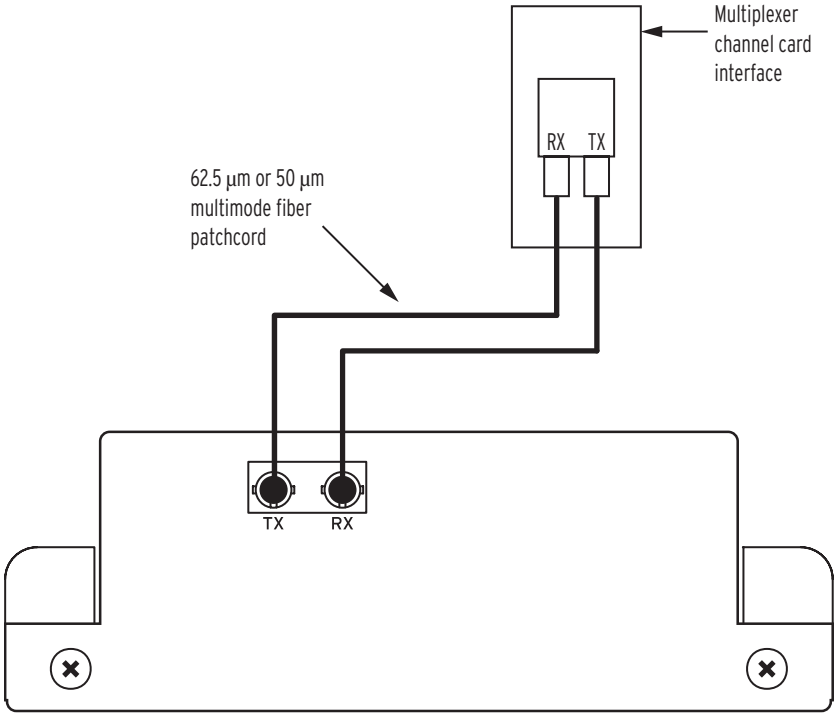


Figure 7 Fiber-Optic Connections

Testing the SEL-2594

Test the SEL-2594 with either a direct fiber connection to another SEL-2594, or with two SEL-2594s connected through a multiplexer.

Step 1. Configure the SEL-2594 dip switch ID settings. Make sure the TX address of the local SEL-2594 matches the RX address of the remote SEL-2594. If the connection between the SEL-2594s is direct fiber, set the timing control switch 9 to off (test) on one SEL-2594. If the test setup includes multiplexers set switch 9 to on (normal) on both SEL-2594s.

Step 2. Connect the chassis ground terminal of the SEL-2594 to ground (Terminal1).

Step 3. Connect and apply rated voltage to the power supply inputs of the SEL-2594 (positive to terminal 4, negative to terminal 3). The ENABLE LED should illuminate. The form "B" ALARM contact will remain closed and the ALARM LED will illuminate (red) due to no communications.

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-2594s 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 IN1 LED should illuminate on this device. On the other SEL-2594 the OUT1 contact should close and the OUT1 LED should illuminate.

Step 7. Repeat step 6 for the remaining contacts.

Step 8. To test the loop-back feature, 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.

Alarm Conditions

Figure 8 on page 8 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-2594 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-2594. The channel card sets the yellow alarm bit in the transport frame header in the transmit direction back to the SEL-2594. If the SEL-2594 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 is invalid, the ALARM LED will be red, the DATA LED will turn off, and the RX LED will remain lit.

NOTE: The SEL-2594 can decode and display the yellow alarm bit but does not generate a yellow alarm.

NOTE: Implementation of the yellow alarm bit is not a requirement of IEEE Standard C37.94. Check the multiplexer channel card data sheet to verify use.

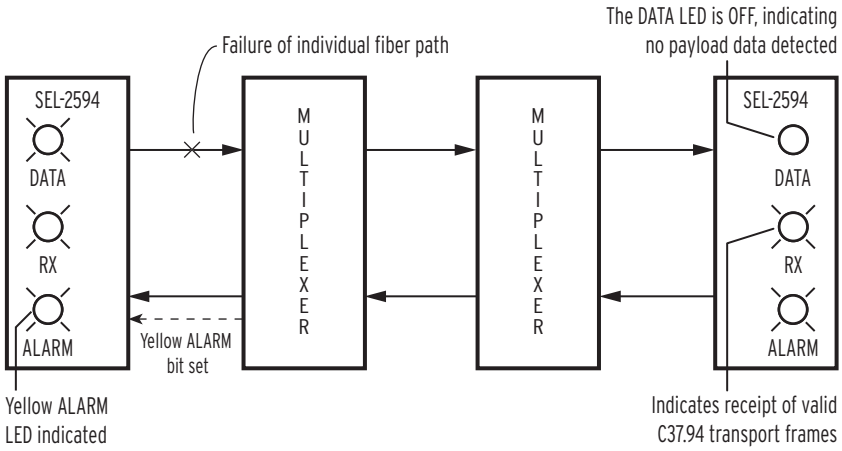


Figure 8 Link Failure and Yellow Alarm Condition

LED Indications

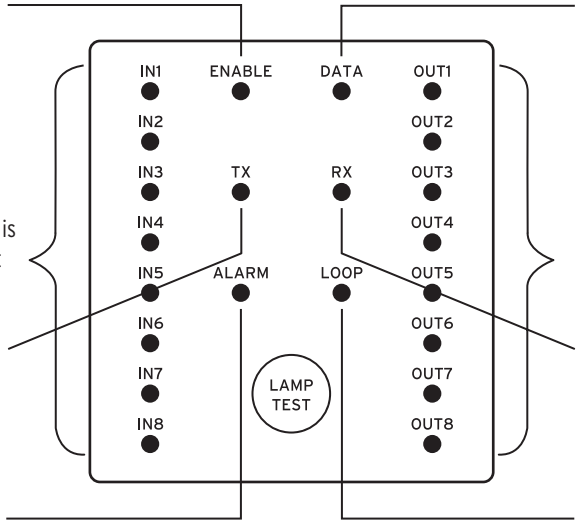
When illuminated the ENABLE LED indicates that the SEL-2594 has power applied, has passed the self-test routines, and is ready to receive data.

IN1 through IN8 indicate that voltage is applied to the corresponding contact input terminals.

TX LED indicates the SEL-2594 is transmitting data.

A red ALARM LED indicates that DATA or ENABLE criteria have not been met.

A yellow ALARM LED indicates the SEL-2594 is receiving valid data from the multiplexer but the multiplexer is not receiving valid data from the SEL-2594.



When illuminated, the DATA LED indicates the received payload data has passed all error checks.

When this LED is off, the contact outputs and alarm relays are de-energized.

OUT1 through OUT8 indicate that the contact output associated with that LED is energized.

RX LED indicates receipt of valid C37.94 transport frames.

An illuminated LOOP LED indicates that the SEL-2594 is receiving data with the same channel address that it is transmitting.

SEL-2594 Operating Time Performance

Figure 9 depicts the time to transfer a contact closure between a local and remote SEL-2594. This figure includes a nominal 0.5 millisecond multiplexer through delay. Actual through delay will vary depending on multiplexer type and network configuration.

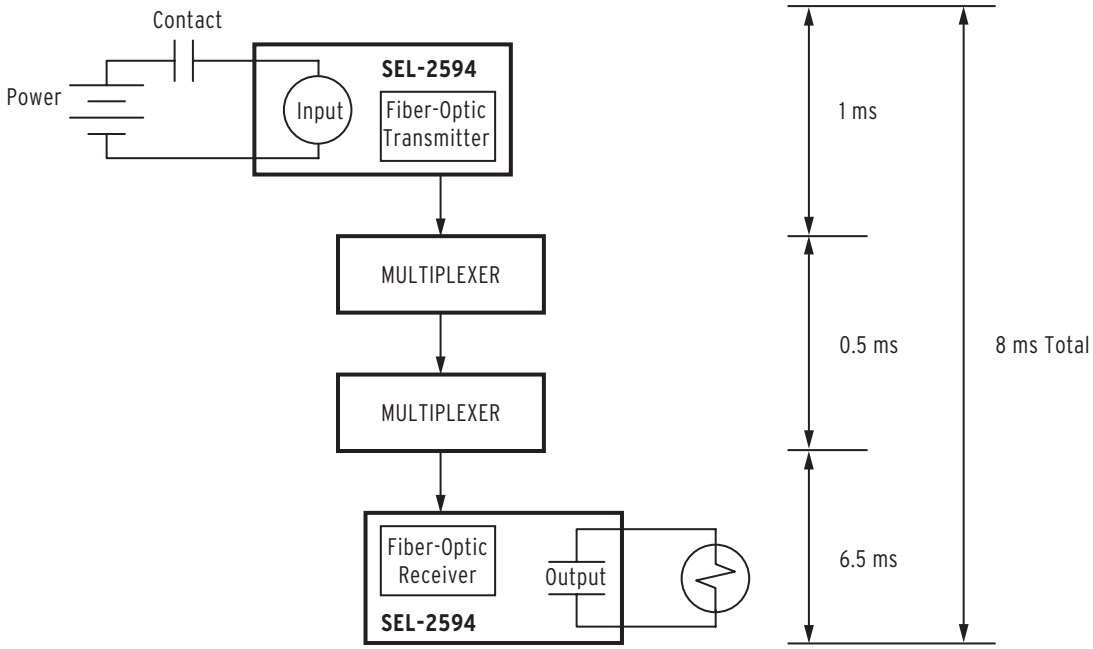


Figure 9 End-to-End Operating Time Diagram

Mechanical Diagram

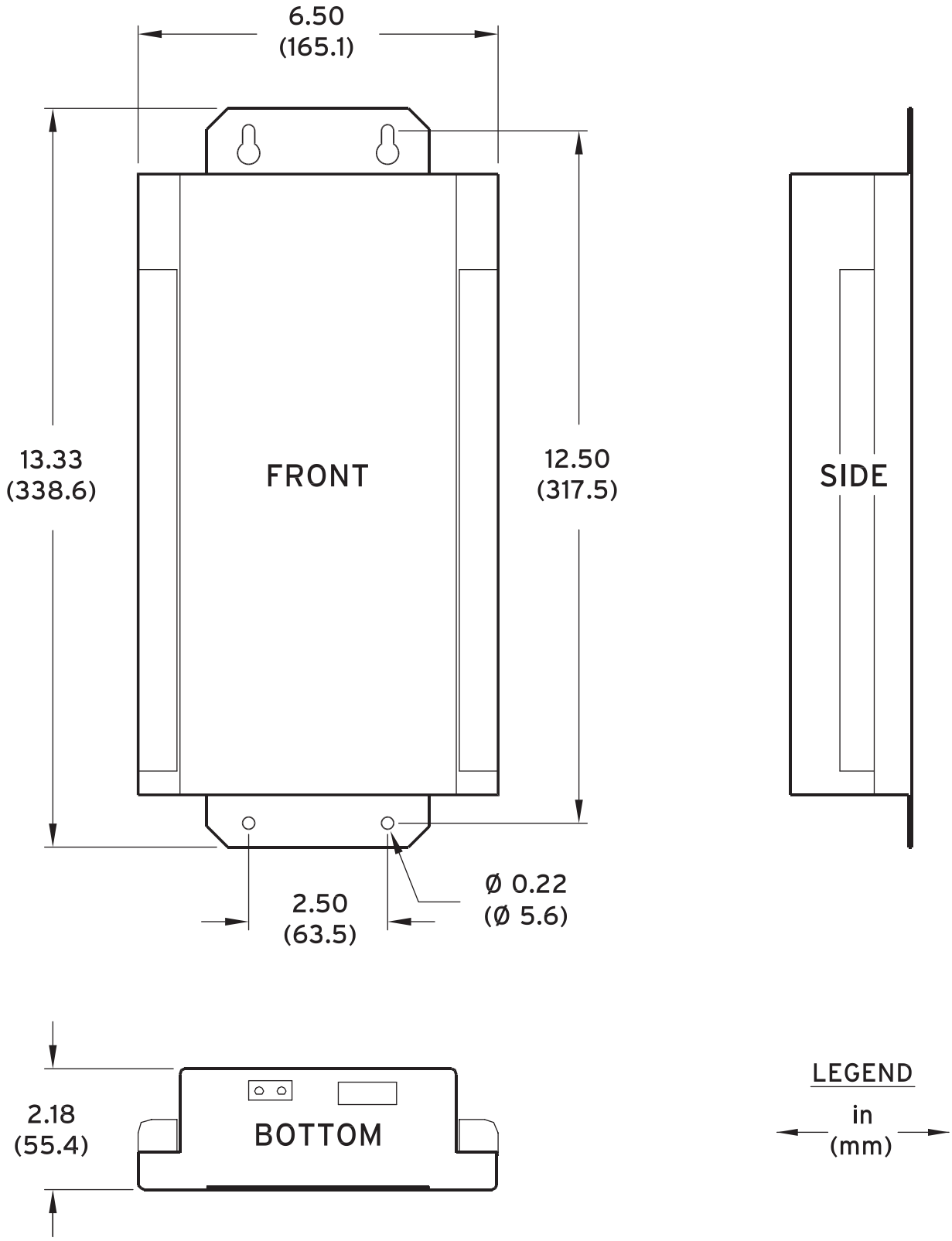


Figure 10 SEL-2594 Dimensions and Drill Diagram

Specifications

Output Contacts

IEEE C37.90 Tripping Output Performance.

Make:	30 A
Carry:	6 A
MOV protected:	270 Vac rms
	360 Vdc continuous

Optoisolated Inputs

250 Vdc:	Pickup 210–300 Vdc
	Dropout <150 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: 24, 48, 110, and 125 Vdc optoisolated inputs draw approx. 4 mA of current.

Contact Input/Output Update Rate

1 kHz

Power Supply

Rated:	125/250 Vdc or Vac
Range:	85–350 Vdc or 85–264 Vac
Burden:	<5 W
Rated:	48/125 Vdc or 125 Vac
Range:	36–200 Vdc or 85–140 Vac
Burden:	<5 W

Back-to-Back Operate Time Without Propagation Delay

8 ms

Protocol

IEEE C37.94*

Port Speed (Data Rate)

64 kbps (1DS0)

Fiber Optic

Optical Fiber Core Size	Optical Budget	2 km Fiber 820 nm Typical Attenuation
50 µm	9.0 dB	5.6 dB (margin = 3.4 dB)
62.5 µm	13.0 dB	6.2 dB (margin = 6.8 dB)

Operating Temperature Range

–40° to +85°C
–40° to +185°F

Unit Weight

2.73 kg (3 lb, 0 oz)

Dimensions

338.6 mm x 165.1 mm x 55.4 mm
(13.33" H x 6.5" W x 2.18" D)

Type Tests

Dielectric:	IEC 255-5: 1977, 2.5 kV rms, 1 min
Environmental:	IEC 68-2-1: 1990
	IEC 68-2-2: 1974
Damp Heat Cycle:	IEC 68-2-30:1980
Impulse:	IEC 255-5: 1977, 5 kV 0.5 J
Electrostatic Discharge:	IEC 801-2: 1991, Level 4
	IEC 255-22-2: 1989, Level 4
Radio Frequency Immunity:	IEC 801-3: 1984
	IEC 255-22-3: 1989
Fast Transient Burst:	IEC 801-4: 1988, Level 4
	IEC 255-22-4: 1992, Level 4
Surge Withstand:	IEC 255-22-1: 1988
	IEEE C37.90.1: 1989
5 kV Impulse:	IEC 255-5: 1997
Vibration:	IEC 255-21-1: 1988
Endurance:	Class 1
Response:	Class 2
Shock and Bump:	IEC 255-21-2: 1988
Bump:	Class 1
Shock Withstand:	Class 1
Shock Response:	Class 2

Certifications

ISO: Module is designed and manufactured to an ISO-9001 certified quality program.
CE Mark.

* At the time of this printing, the IEEE C37.94 had not been released. This device is compliant to C37.94 Draft 6 dated 11-1-2000.

Notes

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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.

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

DANGER: Contact with this circuitry may cause electrical shock that can result in injury or death.

ATTENTION: Le module contient des pièces sensibles aux décharges électrostatiques. Quand on travaille sur le module avec les panneaux avant ou du dessus enlevés, toutes les surfaces et le personnel doivent être mis à la terre convenablement pour éviter les dommages à l'équipement.

ATTENTION: Le retrait des panneaux du boîtier expose le circuit qui peut causer des chocos électriques pouvant entraîner des blessures ou la mort.

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

DANGER: Tout contact avec ce circuit peut être la cause d'un choc électrique pouvant entraîner des blessuers ou la mort.