

SEL-2829/2830/2831

Single-Mode Fiber-Optic Transceivers



High-performance transceivers that increase safety and security in teleprotection applications.

- Fiber-optic connections isolate communications from ground potential rise and electrical interference.
- EIA-232 port-powered transceivers communicate serial data up to 110 kilometers.
- Direct connection to DB-9 serial ports requires no special mounting or separate power supply.
- Maximum bit error rate of 10^{-9} provides secure and reliable data transfer.



Features and Benefits

Flexible, Long-Range Fiber-Optic Communication

Send serial data up to 110 kilometers using single-mode optical fiber with standard ST® connectors. Use data rates from 0 - 40,000 bits per second. Use the selector switch to choose between DCE and DTE standard pin configurations, and eliminate the use of adapters.

Easy Application

Plug the transceiver directly onto a standard 9-pin serial connector (DB-9). No special mounting is required. It receives power from the host device via the connector; no separate power supply or power wiring is needed. The transceiver transmits continuous light pulses for simpler testing with an optical meter. Apply with ST preterminated fiber cables.

Secure and Reliable Data Transfer

The transceivers have a maximum bit error rate (BER) of 10^{-9} and are far less susceptible to EMI/RFI than copper links.

Improved Safety

Eye-safe, Class 1 laser or LED products provide improved isolation from ground potential rise and other electrical hazards compared to copper connections.

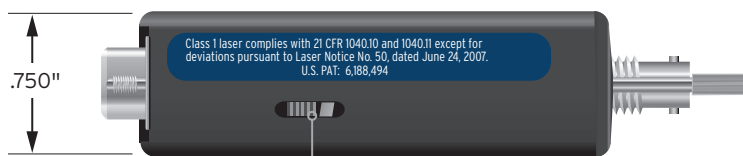
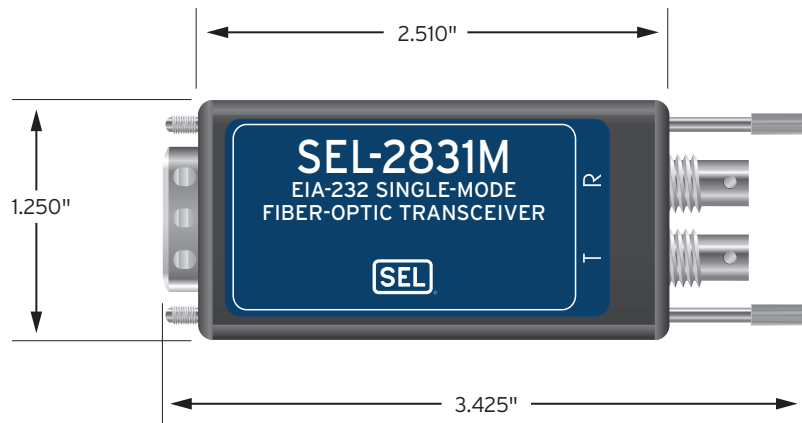
SEL-2831 shown.
SEL-2829 and
SEL-2830 have the
same dimensions.



SEL-2831M



SEL-2831F



DCE/DTE switch

Application Information

Choose the Model That Matches Your Distance Requirement

The SEL-2829, SEL-2830, and SEL-2831 all operate with single-mode optical fibers terminated with ST connectors. Select the model that matches the distance required for your application.

	SEL-2829	SEL-2830	SEL-2831
Typical distance (km)	23	80	110
Wavelength (nm)	1300	1300	1550

Typical Distance and Operating Wavelength

Determining Maximum Cable Length

To calculate the maximum cable length for your application, first obtain the following specifications from your optical fiber supplier, based on the 1300 or 1550 nm optical source and the required temperature range:

1. Fiber loss (or attenuation) in dB/km
2. Connector loss in dB
3. Splice loss in dB

Determine the power lost in connectors by multiplying the number of connectors by the connector loss. Determine the power lost in splices by multiplying the number of splices by the splice loss. Subtract the power lost in splices and connectors from the total optical power to determine the available optical power. Calculate the maximum cable length by dividing the available optical power by the fiber loss.

The table below shows a distance calculation for an example optical fiber and each SEL single-mode fiber-optic transceiver. The fiber has the following characteristics:

- Fiber core diameter.....9.3 μm
- Connector loss.....2 dB/connector
- Splice loss (fusion)0.2 dB/splice
- Fiber loss @ 1300 nm0.4 dB/km
- Fiber loss @ 1550 nm0.3 dB/km

	SEL-2829	SEL-2830	SEL-2831
Optical budget (dB)	14.0	40.0	40.0
Less connector loss (2 x 2 dB)	-4.0	-4.0	-4.0
Less splice loss (4 x 0.2 dB)	-0.8	-0.8	-0.8
Available power = budget – losses	P=14-4-0.8	P=40-4-0.8	P=40-4-0.8
Available power (dB)	9.2	35.2	35.2
Length = available power/fiber loss	9.2/0.4	35.2/0.4	35.2/0.3
Maximum h (km)	23	88	117

Fiber Loss Test With Optical Meter

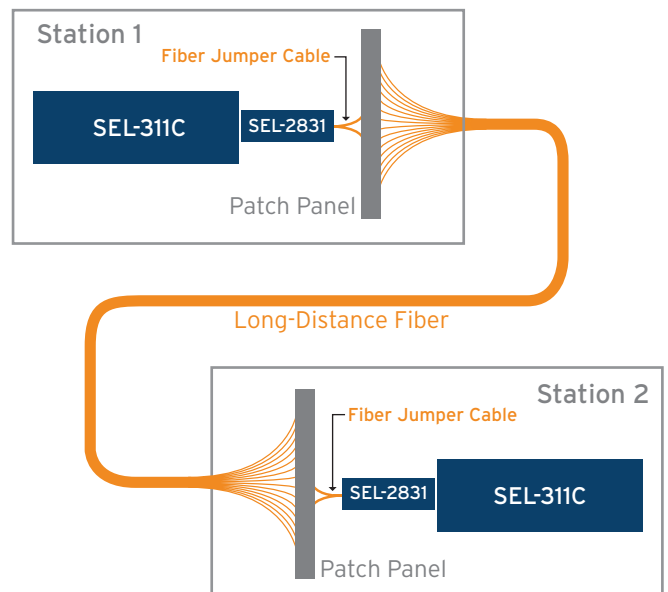
1. Configure your optical meter to measure 1300 or 1550 nm wavelength.
2. Temporarily connect the optical meter to the transmit ST connector (T) of the local transceiver, and note the dBm reading.
3. Temporarily connect the fiber-optic cable that would go to the receive ST connector (R) of the remote transceiver to the meter, and note the dBm reading.
4. Calculate the measured loss by subtracting the measurement taken in Step 3 from the measurement taken in Step 2. If the difference is less than the optical budget, the attenuation is low enough to allow proper operation.
5. Repeat Steps 1 - 4 using the transmit ST connector (T) of the remote transceiver and the receive ST connector (R) of the local transceiver.

Connecting and Disconnecting Fiber Cable

Use the supplied connector caps to cover ST connectors that are not connected to a fiber cable. If the transceiver is transmitting data and both ST connectors are open, the transmitted (TXD) light signals may reflect off external objects into the receiver (RXD) ST connector. The reflected signals appear as messages sent from a remote transceiver.

Interstation Teleprotection Example

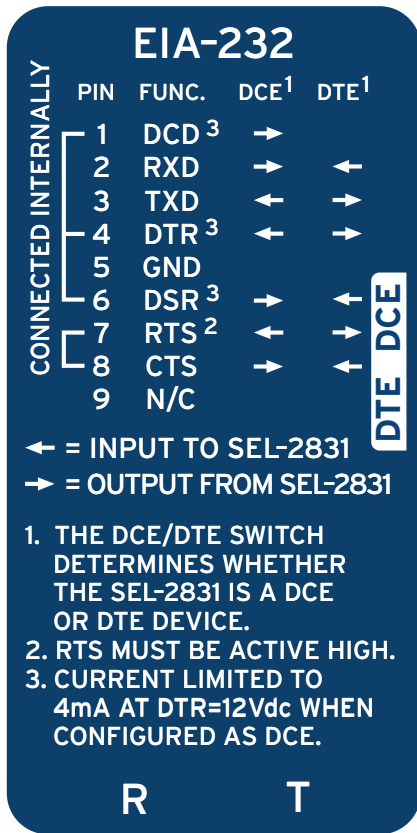
Connect the transceivers to the EIA-232 port of SEL relays on opposite ends of a protected line, and connect them with two fibers. Use MIRRORING BITS® communications for teleprotection schemes, including POTT, DCUB, or DCB.



Technical Specifications

Connect Directly to DB-9 Serial Ports	Compatible with SEL-200, -300, -400, -500, and -700 series relays, SEL-2032/2030/2020, SEL-2100, and SEL-4000 Relay Test System																		
Projection From DB-9 Connector	12.7 mm (5.0 in) typical, including fiber-optic connector and minimum cable bend radius																		
Data Rate	0 - 40000 bits per second, full duplex, no jumpers or settings																		
Data Delay	36 μ s plus 5 μ s/km of fiber																		
Optical Source	Transceiver	Wavelength and Type	Typical Average Transmit Level																
	SEL-2829	1300 nm (infrared) LED	-27 dBm																
	SEL-2830	1300 nm (infrared) Laser	-3.6 to -17.6 dBm																
	SEL-2831	1550 nm (infrared) Laser	-3.6 to -17.6 dBm																
Operating Temperature	-40° to +85°C (-40° to +185°F)																		
Power Requirements	<p>Receives power from the transmit-data input pin plus one other power input pin in the DB-9 connector. These SEL single-mode transceivers do not support hardware handshaking. Non-SEL devices should provide at least the current and voltage indicated below.</p> <p>DCE Pin 3 or DTE Pin 2 (Transmit Data): 11 mA at \pm5.2 Vdc, and</p> <p>DCE Pin 4 or DTE Pin 6: 11 mA at -5.2 Vdc, or</p> <p>DCE Pin 7 or DTE Pin 8: 11 mA at +5.2 Vdc</p>																		
	<table border="1"> <thead> <tr> <th colspan="2">Transmit Data Power Input</th> </tr> <tr> <th>Pin</th> <th>Switch Position</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>DTE</td> </tr> <tr> <td>3</td> <td>DCE</td> </tr> </tbody> </table>		Transmit Data Power Input		Pin	Switch Position	2	DTE	3	DCE	<table border="1"> <thead> <tr> <th colspan="2">Other Power Input</th> </tr> <tr> <th>Pin</th> <th>Polarity and Voltage (Vdc)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+5 to +15</td> </tr> <tr> <td>4^a, 6, 7, 8</td> <td>\pm5 to \pm15</td> </tr> </tbody> </table>	Other Power Input		Pin	Polarity and Voltage (Vdc)	1	+5 to +15	4 ^a , 6, 7, 8	\pm 5 to \pm 15
Transmit Data Power Input																			
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3	DCE																		
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4 ^a , 6, 7, 8	\pm 5 to \pm 15																		
Connectors and Cable	ST connectors and SEL-C809 single-mode fiber (9.3 μ m)																		

Back Label With EIA-232 Pin Usage



(imprinted on back of device)

Review ratings and installation guidelines before commissioning.

It is the responsibility of the user to ensure that the equipment is installed, operated, and used for its intended function as specified.

DTE/DCE Switch Selection

A DTE/DCE switch is available on the SEL-2829, SEL-2830, and SEL-2831. It selects whether the transceiver is operating as data terminal equipment (DTE) or as data communications equipment (DCE).

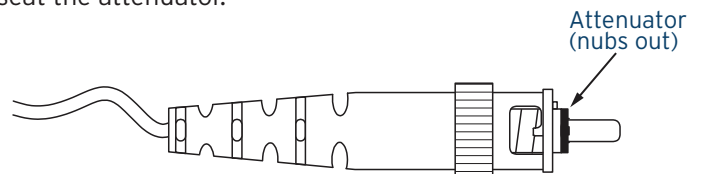
When the transceiver is connected to an SEL relay or communications processor port, the DCE position must be selected.

Function	Pin	DCEa	DTEa
DCD	1	>	
RXD	2	>	<
TXD	3	<	>
DTR	4	<	>
GND	5		
DSR	6	>	<
RTS	7	<	>
CTS	8	>	<
N/C	9		

< Input to transceiver
> Output from transceiver

Fiber-Optic Attenuator Kit

This kit (SEL part number 91560) is only necessary for SEL-2830 or SEL-2831 Fiber-Optic Transceivers in single-mode fiber applications less than ten miles. Additional attenuation is not required for distances greater than ten miles. Every product shipped with the SEL-2830 and SEL-2831 comes with an attenuator kit. This kit includes four attenuation spacers, enough for two fiber pairs. Use one of these attenuators on the transmit ST fiber connection on each side, as shown below. Be sure to fully seat the attenuator.



Single-Mode Fiber-Optic Cables

SEL-C809

All SEL-C809 Cables are built with high-precision ceramic ferrule connectors, offering best-in-class optical performance.

Order finished cables built to your length specifications with ST, LC, and SC connectors.

Use 1- or 2-fiber zipcord for indoor risers (C809Z01/Z02) and indoor plenum spaces (C809P01/P02) and 2-fiber PVC-jacketed cable for indoor risers and outdoors (C809G02).



Parameter	C809Z01 Zipcord (1 fiber)	C809Z02 Zipcord (2 fibers)	C809P01 Zipcord (1 fiber)	C809P02 Zipcord (2 fibers)	C809G02 Heavy-Duty Waterproof (2 fibers)
Operating temperature*	-20° to +85°C		0° to +85°C		-40° to +85°C
Fiber material	Glass				
Wavelength	1310/1383/1550 nm				
Core/cladding diameters	9/125 μm				
Outside cable dimensions	2.9 mm (0.11 in) diameter	2.8 mm x 5.6 mm (0.11 in x 0.22 in)	2.9 mm (0.11 in) diameter	2.8 mm x 5.6 mm (0.11 in x 0.22 in)	6.8 mm (0.27 in) diameter
Nominal weight	6.4 kg/km (4.3 lb/1000 ft)	12.8 kg/km (8.5 lb/1000 ft)	7.4 kg/km (5 lb/1000 ft)	14 kg/km (10 lb/1000 ft)	39 kg/km (26 lb/1000 ft)
Maximum tensile loads (short-term)	220 N (50 lb)				660 N (150 lb)
Maximum tensile loads (long-term)	66 N (15 lb)				330 N (75 lb)
Minimum bend radius (loaded)	5 cm (2 in)				10.2 cm (4.1 in)
Minimum bend radius (installed)	1.4 cm (0.55 in)				6.8 cm (2.7 in)
Maximum attenuation @ 1310/1383/1550 nm	0.65/0.65/0.50 dB/km				
UL® rating	Riser-rated (OFNR)		Plenum-rated (OFNP)		Riser-rated (OFNR)

Specifications

Type Tests and Standards

IEEE C37.90.2

Trial Use Standard, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference From Transceivers.

Exceptions:

- 5.5.2(2) Performed with 200 frequency steps per octave.
- 5.5.3 Digital Equipment Modulation Test not performed.
- 5.5.4 Test signal turned off between frequency steps to simulate keying.

IEC 60068-2-1 Fifth Edition 1990

Cold, -40°C

IEC 60068-2-2 Fourth Edition 1974

Dry Heat, +85°C

IEC 60068-2-30 Second Edition 1980

Damp Heat Cyclic, +55°C, 6 cycles

IEC 60255-22-2 Second Edition 1996

Electrostatic Discharge Immunity
Level 4

IEC 60255-21-1 First Edition 1988

Vibration Endurance Class I
Vibration Response Class II

IEC 60255-21-2 First Edition 1988

Bump and Shock Withstand Class I
Shock Response Class II

IEC 60255-21-3 First Edition 1993

Quake Response Class I

IEC 60825-1: 1993+A1: 1997+A2: 2001

Class 1 Laser Product (SEL-2830 and SEL-2831)
Class 1 LED Product (SEL-2829)

EN 60825-1: 1994+A1+A2

Class 1 Laser Product (SEL-2830 and SEL-2831)
Class 1 LED Product (SEL-2829)

IEC 60255-27:2013

Product Safety Requirements (SEL-2829)

Ingress Protection 30 (IP30)

Pollution Degree II

Insulation Class III

21 CFR 1040.10

Class 1 Laser Product (SEL-2830 and SEL-2831)

Safety Notes: Although Class 1 lasers and LEDs are considered to be eye safe, avoid staring into the transmitter or fiber-end infrared radiation.

The lasers and LEDs do not require maintenance and are not user-serviceable. Return 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.

FCC CFR 47 Part 15 Class B

This Class B device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Fiber-Compatible Products

SEL-C809 Fiber-Optic Cables

Single-mode, fiber-optic patchcords with ST connectors.

SEL-2505 Remote I/O Module, ST Option

Provides MIRRORRED BITS communications for eight logic inputs and eight contact outputs (SEL-2830-compatible option).

SEL-2506 Rack-Mount I/O Module

Provides MIRRORRED BITS communications for eight logic inputs and eight contact outputs (SEL-2829/2830/2831-compatible options).



**Making Electric Power Safer,
More Reliable, and More Economical**

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