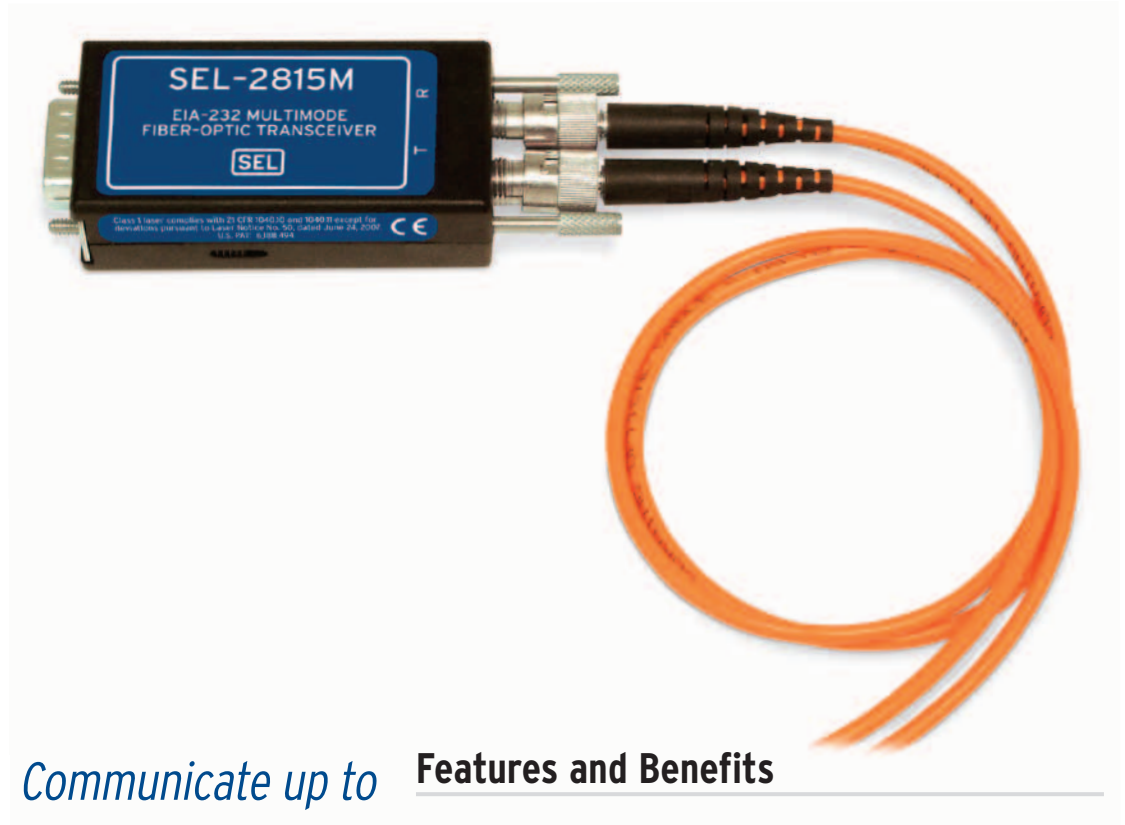


# SEL-2815 Fiber-Optic Transceiver



## Fiber-Optic Transceiver for Long-Distance Communication



*Communicate up to  
15 kilometers with  
EIA-232 port-powered  
transceivers.*

### Features and Benefits

- **Flexible, Long-Range Fiber-Optic Communication**  
Send serial data up to 15 kilometers (9 miles) using multimode optical fiber with standard ST® connectors. Use data rates from 0-40,000 bits per second.
- **Easy Application**  
Plug transceiver directly onto a standard 9-pin serial connector (DB-9). No special mounting is required. Receives power from the host device via the connector; no separate power supply or power wiring is needed. Order transceivers with male or female DB-9 connectors. Use switch to select DCE or DTE standard pin configurations, and eliminate the need for adapters. Transmits continuous light pulses for simpler testing with an optical meter. Apply with ST pre-terminated fiber cables.
- **Secure and Reliable Data Transfer**  
Maximum bit error rate (BER) of  $10^{-9}$ . Far less susceptible to EMI/RFI than copper links. Vertical-cavity surface-emitting laser (VCSEL) technology provides component isolation and low power consumption.
- **Improved Safety**  
Eye-safe, Class 1 laser product. Provides improved isolation from ground potential rise and other electrical hazards compared to copper connections.

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

## Application Information

### Connecting and Disconnecting Fiber Cable

Use the supplied connector caps to cover ST connectors that are not connected to a fiber cable. If the SEL-2815 Fiber-Optic 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 SEL-2815.

### Determining Maximum Cable Length

The table below shows maximum cable lengths based on typical fiber loss. The optical power budget includes transmit and receive connector coupling loss; therefore, the maximum cable length is determined by dividing the total optical power budget by the typical fiber loss/km specification.

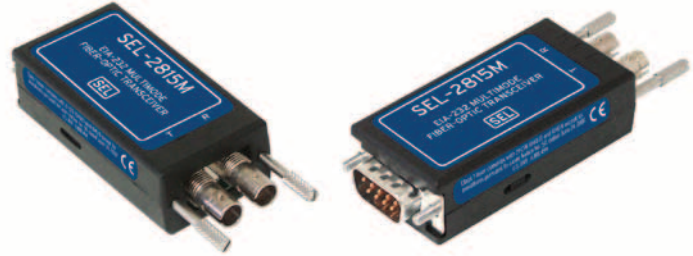
To calculate the maximum cable length for your application, first ask your fiber cable supplier for fiber loss/km and connector/splice loss specifications (over expected temperature range) based on an 850 nm wavelength optical source. Calculate the available optical power budget by subtracting the total connector/splice attenuation from the power budget specification shown in the table below. Divide the available optical power budget by the fiber loss/km specification to determine the maximum cable length.

#### Example

Fiber Type.....	50 $\mu$ m
Connector/Splice Loss Specification.....	2 dB/Connector
Number of Connector/Splices (not including SEL-2815 TX/RX connectors) .....	2
Fiber Loss Specification .....	2.7 dB/km
Available Optical Power Budget.....	41 dB - (2 x 2 dB) = 37 dB
Maximum Cable Length.....	37 dB/2.7 dB/km = 13.7 km

### Typical Cable Length

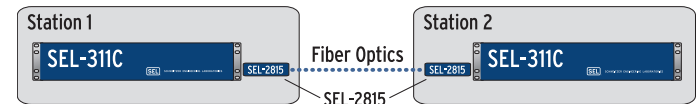
Fiber Diameter ( $\mu$ m)	Power Budget (dB) (-40° to +85°C)	Typical Fiber Loss (dB/km) at 25°C	Maximum Cable Length (km)
50	41	2.7	15.2
62.5	41	3.2	12.8
100	41	4.0	10.2
200	41	6.5	6.3



## Fiber Loss Test With Optical Meter

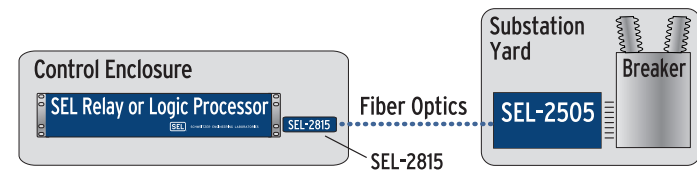
1. Configure your optical meter to measure 850 nm wavelength.
2. Temporarily connect optical meter to transmit ST connector (T) of local transceiver, and note dBm reading.
3. Temporarily connect the fiber-optic cable that would go to the receive ST connector (R) of the remote transceiver to the meter, and note dBm reading. Note: The difference between the readings in Steps 2 and 3 should not exceed 41 dB. (If measured readings exceed 41 dB, the fiber's attenuation is too great.)
4. Repeat Steps 1-3 using transmit ST connector (T) of remote transceiver and receive ST connector (R) of local transceiver.

## Application Examples



### Relay-to-Relay Teleprotection

Connect the SEL-2815 to the EIA-232 port of SEL relays on opposite ends of a protected line, and connect them with two fibers. Use MIRRORING BITS<sup>®</sup> communications for teleprotection schemes, including POTT, DCUB, or DCB.



### Communications With SEL-2505 Remote I/O Module

Connect the SEL-2815 to the EIA-232 port of an SEL relay or SEL-2100 Logic Processor. Connect via fiber to an SEL-2505 Remote I/O Module with the ST connectors option. The SEL-2505 provides eight contact outputs and eight logic inputs and uses MIRRORING BITS communications.

## Technical Specifications

### Connect Directly to DB-9 Serial Ports

Compatible with SEL-200, -300, -500, and -700 series relays, SEL-2032/2030/2020, SEL-2100, SEL-4000, and SEL-DTA2

### Projection From DB-9 Connector

127 mm (5.0 in) typical, including fiber-optic connector and minimum cable bend radius

### Data Rate

0–40,000 bits per second, full duplex, no jumpers or settings

### Data Delay

36  $\mu$ s plus 5  $\mu$ s/km of fiber

### Optical Source

850 nm (infrared) VCSEL transmitter  
Typical transmit level: -10 dBm

### Operating Temperature

-40° to +85°C (-40° to +185°F)

### Power Requirements

The SEL-2815 typically receives adequate power from a single EIA-232 TXD data line connected to Pin 2 or 3 of the DB-9 connector. Additionally, the SEL-2815 accepts power applied to the following pins:

Pins 4, 6: -4.9 Vdc (10 mA) to -12 Vdc (25 mA)

Pins 7, 8: +4.9 Vdc (10 mA) to +12 Vdc (25 mA)

The SEL-2815 does not support hardware handshaking.

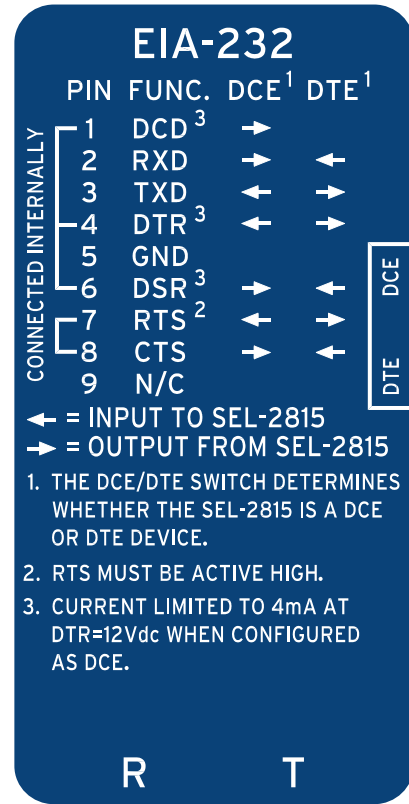
### Fiber-Optic Cable and Connectors

ST connectors

Multimode fiber (50–200  $\mu$ m)

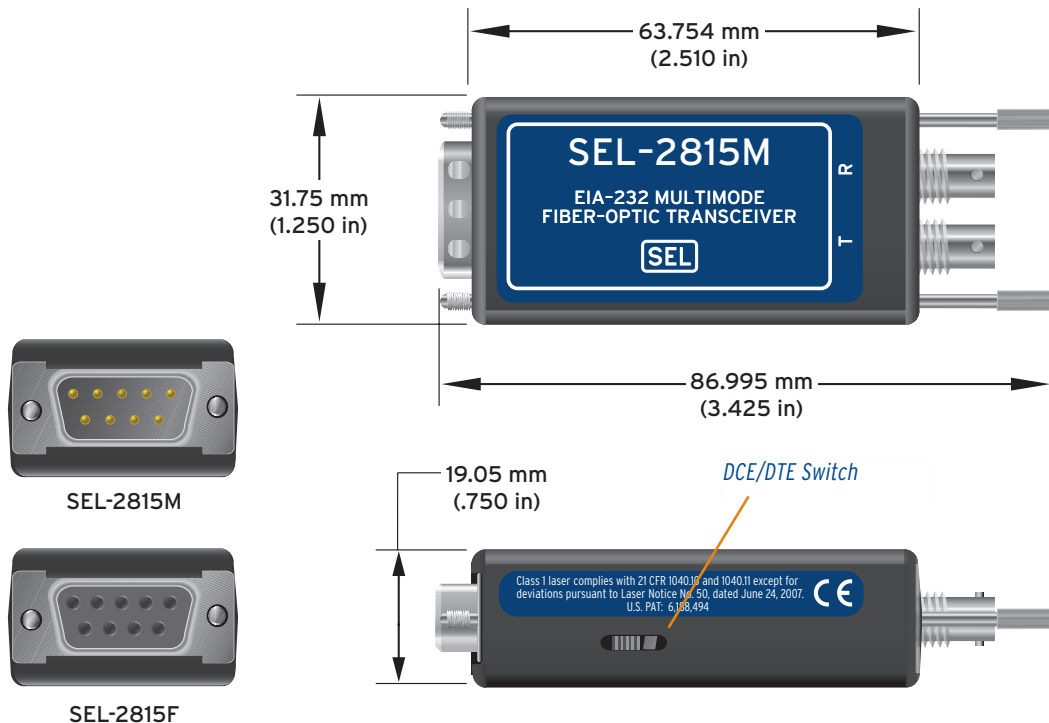
SEL provides ST-connected 62.5  $\mu$ m and 200  $\mu$ m fiber

## Back Label With EIA-232 Pin Usage



*Imprinted on back of device.*

## Transceiver Dimensions



# SEL-2815 Fiber-Optic Transceiver

## 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

### ANSI Z136.1 1993

Optical Safety Standard Class 1

### ANSI Z136.2 1988

Optical Safety Standard Service Group 1

### CEI/IEC 60825-1 First Edition 1993

Optical Safety Standard Class 1

### 21 CFR 1040.10

Optical Safety Standard Class 1

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

### 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-2505 Remote I/O Module, ST Option

Provides MIRRORING communications for eight logic inputs and eight contact outputs.

### SEL-2506 Rack-Mount Remote I/O Module

Provides MIRRORING communications for eight logic inputs and eight contact outputs.

## Related Products

### SEL-2800 Fiber-Optic Transceiver

Electrically isolated, noise-free EIA-232 communication for 500 meters (1,640 feet) at up to 40,000 bits per second, with HCS® V-System® connectors.

### SEL-2810 Fiber-Optic Transceiver With IRIG-B

Electrically isolated, noise-free EIA-232 communication and demodulated IRIG-B time-code transmission for 500 meters (1,640 feet) at up to 20,000 bits per second with HCS V-System connectors.

### SEL-2812 Fiber-Optic Transceiver With IRIG-B

Electrically isolated, EIA-232 full-duplex communications for 4 km (2.5 mi), at up to 115,200 bps, and multiplexed IRIG-B timing signals on a single pair of multimode fibers with ST® connectors.

### SEL-2814 Fiber-Optic Transceiver With Hardware Handshaking

Electrically isolated, EIA-232 full-duplex communications for 4 km (2.5 mi), at up to 115,200 bps, with ST connectors and multimode fiber. Serial communications may be controlled with hardware handshaking.

### SEL-2829, -2830, -2831 Single-Mode Fiber-Optic Transceiver

Electrically isolated, EIA-232 full-duplex communications for up to 110 km (68 miles) at up to 40,000 bits per second using ST connectors and single-mode fiber.



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