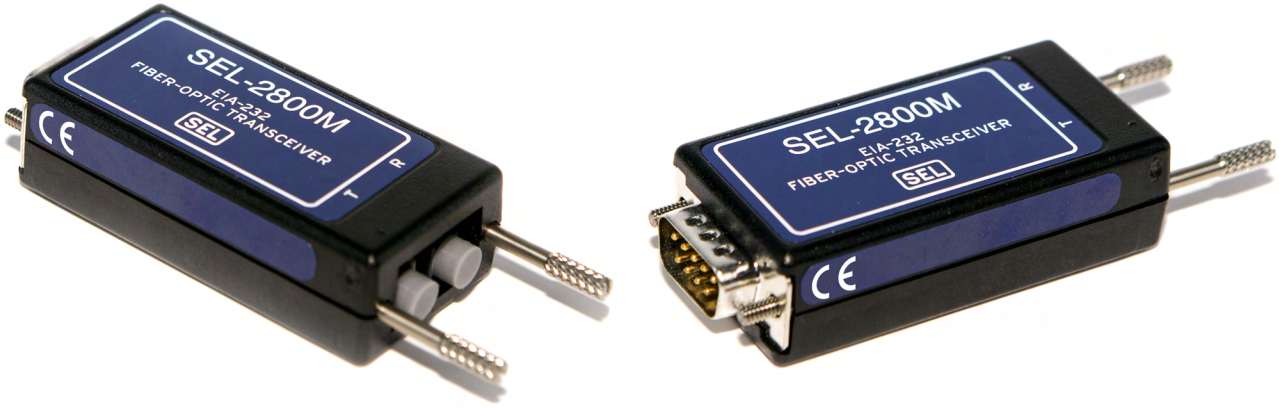
SEL-2800 Fiber-Optic Transceivers

Fiber-Optic Transceivers for Serial Data Time Signals



Major Features and Benefits

The SEL-2800 Fiber-Optic Transceivers provide isolation from dangerous ground potential rise, prevent induced electrical noise, and eliminate signal ground loops. The elimination of electrical interfaces made possible by this product increases safety, robustness, and reliability. These transceivers are suitable for use in the harsh environment of electrical substations.

- **Easy Application.** SEL fiber-optic products are simple to install. Plug an SEL-2800 Transceiver into a standard 9-pin serial connector (DB-9). No special mounting is required.
- **Port Powered.** The SEL-2800 Transceivers are powered from the host device via the connector. They do not require a separate power supply or wiring.
- **Improved Safety.** SEL fiber-optic products provide isolation from induced voltages resulting from ground potential rise and electromagnetic induction commonly caused by control cables.
- **Increased Data Transfer Reliability.** SEL-2800 Transceivers are far less susceptible than copper links to EMI/RFI and can therefore be applied in harsh electrical and physical environments.

Product Overview

Configuring an SEL-2800 link requires a duplex fiber-optic connection between a pair of SEL-2800 Transceivers. The transmit port, **T**, of an SEL-2800 sends serial communication to the receive port, **R**, of a second SEL-2800. The transmit port, **T**, of the second SEL-2800 sends serial communication to the receive port, **R**, of the first SEL-2800.

Figure 1 SEL-2800 Product Overview

Application Examples

Local Relay-to-Relay Protection Data Links

Connect SEL-2800 Transceivers to the serial ports of a relay and an SEL-2100 Logic Processor to provide the framework for the following tasks:

- Coordinate protection between generating plants and associated switchyards or among multiple control enclosures in the same station
- Transfer to backup protection based on loss of potential or failures detected by diagnostic tests
- Keep the dc circuits segregated between cabinets
- Provide directional, element-based bus protection

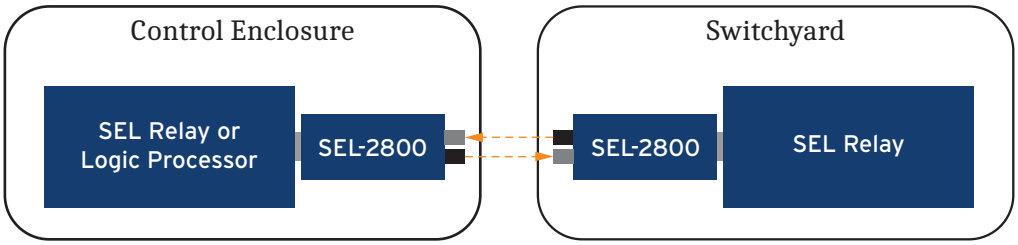


Figure 2 Local Relay-to-Relay Protection Data Links

Communicate With SEL-2505 Remote I/O Modules

Connect the SEL-2800 to an EIA-232 port of an SEL relay or an SEL-2100 and install two fibers from the SEL-2800 to the V-pin connectors on an SEL-2505 Remote I/O Module. The SEL-2505 provides eight contact outputs and eight contact inputs and communicates via MIRRORED BITS communications to provide isolated remote I/O. You can also use this application to bring in data from electromechanical relays or other non-SEL devices for use in MIRRORED BITS communications-based logic in SEL relays or an SEL-2100.

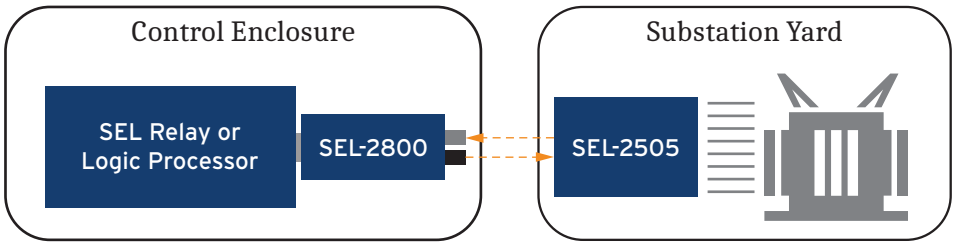


Figure 3 Communicate With SEL-2505 Remote I/O Modules

Receive Data From an SEL-2600 RTD Module

Install an SEL-2800 on a serial port of an SEL information processor and connect a single fiber between the SEL-2800 Receive (**R**) fiber input and the SEL-2600 to obtain temperature data from as many as 12 resistance temperature detectors (RTDs).

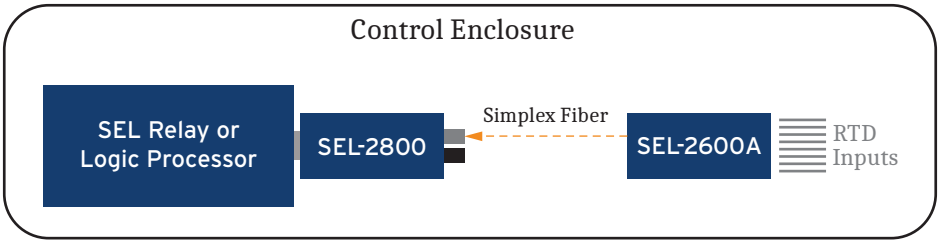


Figure 4 Receive Data From an SEL-2600 RTD Module

Application Information

Determining Maximum Cable Length

You must use 200 µm diameter cable with the SEL-2800. The maximum cable length for an application is based on the optical power budget and the typical fiber loss. The power budget includes the transmit and receive connector coupling loss, so you can determine the maximum cable length by dividing the total optical power budget by the typical fiber loss/km specification.

$$\text{Maximum Cable Length} = \frac{\text{Power Budget}}{\text{Fiber Loss}}$$

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 the expected temperature range) based on a 650 nm wavelength optical source. Calculate the available optical power budget by subtracting the total connector/splice attenuation from 9 dB (the power budget for the SEL-2800). Then divide the available optical power budget by the fiber loss/km specification to determine the maximum cable length.

Example

Fiber Type:	200 µm
Splice Loss (Mechanical):	0.4 dB/splice
Fiber Loss @ 650 nm:	12 dB/km
SEL-2800 Optical Budget:	9 dB
Less Splice Loss (4 • 0.4 dB):	1.6 dB
Available Power:	7.4 dB
Maximum Cable Length:	7.4 dB / 12 dB/km = 0.62 km

Intrastation Example

Intrastation applications are typically very simple and consist of two fiber-optic devices connected by a patch cord. The primary benefit of an intrastation application is the replacement of metallic cables between two EIA-232 devices. Fiber-optic transceivers also allow application

of EIA-232 connections longer than the specified 50-foot limitation. The SEL-2800 is a simple, inexpensive solution for these applications.

To calculate the viability of an example intrastation system that is 0.5 km (1640 ft) long and configured as shown in *Figure 5*, perform the following steps:

Step 1. Calculate the fiber attenuation:

Cable attenuation for 650 nm = 12 dB/km

0.5 km • 12 dB/km = 6 dB

Step 2. Subtract the total losses from the system gain:

9 dB – 6 dB = 3 dB
(system gain – fiber loss = system margin)

If the fiber loss adds as much as 9 dB or greater, the system is not viable.

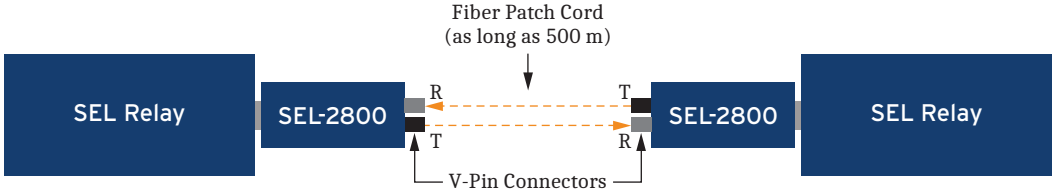


Figure 5 Intrastation Communication Using SEL-2800 Transceivers

Connecting to Serial Ports

Plug the SEL-2800 directly onto a standard 9-pin serial connector (DB-9). No special mounting is required and the transceiver requires no jumpers or settings. Power is received from the host device via the connector—no separate power supply or wiring is needed. A single pair of fibers handles a full-duplex serial data link.

Depth-Restricted Adapter Cables

When mounting depth is an issue, such as in switchgear applications, use an SEL-C780, SEL-C641, or SEL-C641R adapter cable. The SEL-C780 is a 6-inch ribbon cable that allows for mounting of the fiber transceiver at a 90-degree angle to the mating DB-9 host connector. The SEL-C641 (shielded) and SEL-C641R (double-shielded with metal connector housings) cables are configurable in length and allow for mounting of the SEL-2800 Transceiver as far as 1.8 m (6.0 ft) away from the DB-9 host connector.

SEL-C780:	15.24 cm (6.00 in), low-profile adapter cable, DB-9 male to DB-9 female
SEL-C641:	0.3 to 1.8 m (1.0 to 6.0 ft) shielded adapter cable, DB-9 male to DB-9 female
SEL-C641R:	0.3 to 1.8 m (1.0 to 6.0 ft) double-shielded adapter cable, DB-9 male to DB-9 female

Safety Information

⚠CAUTION
To ensure proper safety and operation, the equipment ratings and installation instructions must be checked before commissioning or maintenance of the equipment. 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 data sheet. If misused, any safety protection provided by the equipment may be impaired.

Fiber-Optic Port

The SEL-2800 uses a fiber-optic transmitter. When working with this device, observe the following safety precautions:

- Do not perform any procedures or adjustments that this data sheet does not describe.
- Do not use controls or adjustments, or perform procedures, other than those specified in this data sheet.
- Incorporated components, such as transceivers and laser emitters, are not user serviceable. Return units to SEL for repair or replacement.

Power Requirements

⚠CAUTION
SEL fiber-optic transceivers have combinations of input/output pins jumpered or shorted together. Ensure that these connections will not harm the device to which you want to attach the transceiver.

The SEL-2800 has the following power specifications:

- ➤ Operating Voltage: 5.7–15.0 Vdc
- ➤ Typical Current Draw: 12 mA

The transceiver draws power from the EIA-232 data as shown in *Table 1*.

Table 1 Transmit Data Power Input

Pin	Signal
3	DCE

The transceiver additionally draws power per *Table 2*.

Table 2 Other Power Input

Pin	Voltage (Vdc)
4[a]	±5.7 to ±15.0[b]
7, 8	±5.7 to ±15.0[b]

[a] A positive voltage on Pin 4 will supply a DCD output on Pin 1.
[b] One of the signals must be positive for proper operation.

Figure 6 shows the transceiver rear label, which indicates the internally jumpered pins, pinouts, and signal names.

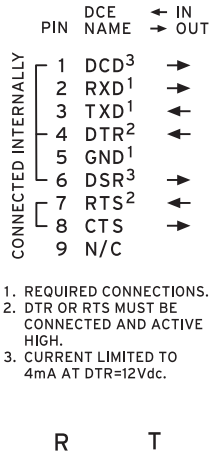


Figure 6 SEL-2800 Signal Flow

Dimensions

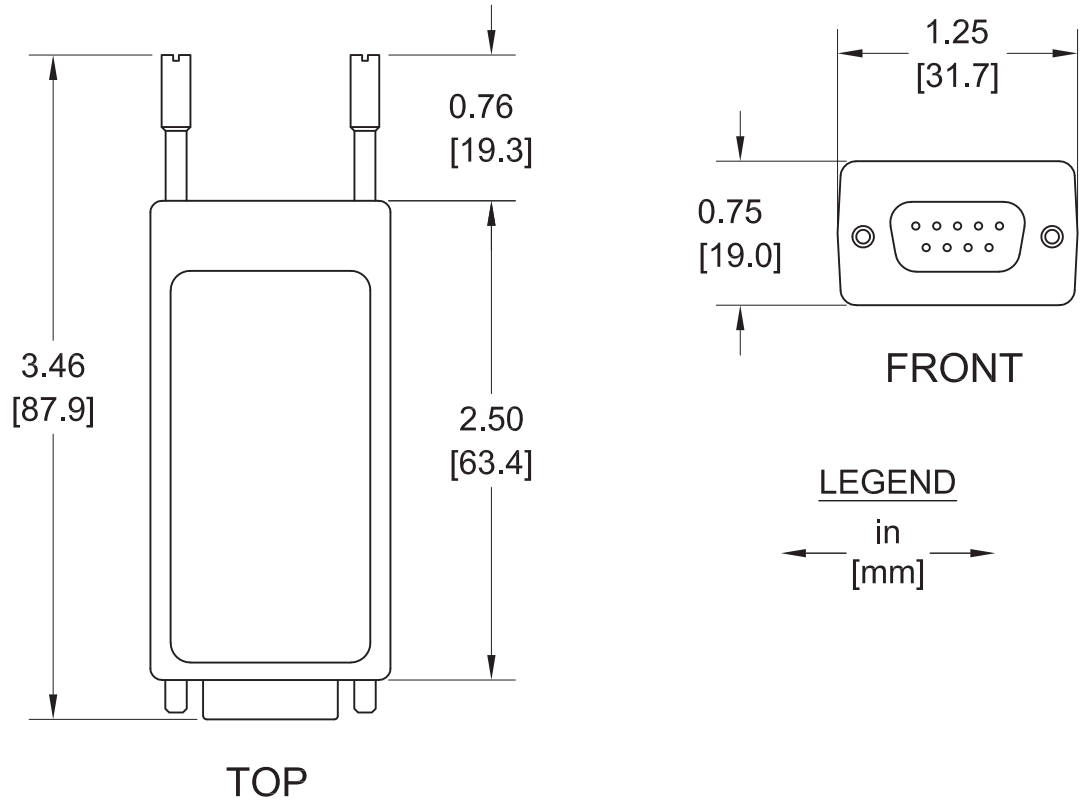


Figure 7 SEL-2800 Dimensions

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

CE Mark

UKCA Mark

CFR 47 Part 15 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 operating 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 may be likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Any changes or modifications not expressly approved by the manufacturer can void the user's authority to operate the equipment.

General

Data Rate

As high as 40 kbps, full duplex, no jumpers or settings

Link Data Delay

5 µs + 5 µs/km of fiber

Optical Source

650 nm (visible red) LED

Typical Transmit Level:	–24 dBm
Maximum Output Level:	–16 dBm

Projection From DB-9 Connector

127 mm (5 in) typical, including fiber-optic connector and minimum cable bend radius

Power Requirements

The SEL-2800 can be powered from Pin 3, 4, 7, or 8 of its DB-9 connector.

Pin 3, 4, 7, 8 Power:	±5.7 to ±15 Vdc
Maximum Current Draw:	12 mA

Fiber-Optic Cables and Connectors

V-pin connectors

Multimode fiber (200 µm)

SEL offers compatible SEL-C805 multimode 200 µm core fiber-optic cables as orderable accessories.

Environmental

Operating Environment

- Indoor Use Only
- Insulation Class 3
- Pollution Degree 2
- Overvoltage Category 2

Operating Temperature:	–40° to +85°C (–40° to +185°F)
Non-Operating Temperature:	–40° to +85°C (–40° to +185°F)
Relative Humidity:	0%–95%, noncondensing
Altitude:	2000 m (6562 ft)

Type Tests

Electromagnetic Compatibility General

Measuring Relays and Protection Equipment:	IEC 60255-26:2013

Electromagnetic Compatibility Emissions

Radiated and Conducted Emissions:	IEC 60255-26:2013, Clause 7.1 EN 60255-26:2013, Clause 7.1 CISPR 22:2008 EN 55022:2010 CISPR 11:2009 + A1:2010 EN 55011:2009 + A1:2010 Canada ICES-001 (A) / NMB-001 (A)

Electromagnetic Compatibility Immunity

Conducted RF Immunity:	IEC 60255-26:2013, Clause 7.2.8 EN 60255-26:2013, Clause 7.2.8 IEC 61000-4-6:2008 Severity Level: 10 V unmodulated, open circuit equivalent
Radiated RF Immunity:	IEC 60255-26:2013, Clause 7.2.4 EN 60255-26:2013, Clause 7.2.4 IEC 61000-4-3:2006 + A1:2007 + A2:2010 Severity Level: 10 V/m IEEE C37.90.2-2004 Severity Level: 20 V/m

Power Frequency

Magnetic Field Immunity:	EN 60255-26:2013, Clause 7.2.10 IEC 61000-4-8:2009 Severity Level 5: 100 A/m >60 seconds; 1000 A/m 1 to 3 seconds; 50/60 Hz

Electrostatic Discharge

Immunity:	IEC 60255-26:2013, Clause 7.2.3 EN 60255-26:2013, Clause 7.2.3 IEC 61000-4-2:2008 Discharge Severity Level: ±2, 4, 6, 8 kV contact; ±2, 4, 8, 15 kV air IEEE C37.90.3-2001 Discharge Severity Level: ±2, 4, 8 kV contact; ±4, 8, 15 kV air

Environmental

Cold:	IEC 60068-2-1:2007 Severity: 16 hours at –40°C
Dry Heat:	IEC 60068-2-2:2007 Severity Level: Test Bd; 16 hours at +85°C
Damp Heat, Steady State:	IEC 60068-2-78:2012 Severity Level: Test Cab; 10 days, 40°C, 93% RH
Damp Heat, Cyclic:	IEC 60068-2-30:2005 Severity Level: Test Db, Variant 2; 12 hr at 25°C + 12 hr at 55°C, 95% RH, 6 cycles
Vibration:	IEC 60255-21-1:1988 Severity Level: Class 1 Endurance; Class 2 Response
Shock and Bump:	IEC 60255-21-2:1988 Severity Level: Class 1 Shock Withstand, Bump; Class 2 Shock Response
Seismic:	IEC 60255-21-3:1993 Severity Level: Class 2 Quake Response

Safety

Measuring Relays and Protection Equipment:	IEC 60255-27:2014

Notes

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