SEL-9220
Fiber-Optic Adapter for SEL-300 Series Relays

Expand Communications for SEL-300 Series Relays

Add a Fiber-Optic Link for Data and Time Code to EIA-485 Port.

Features and Benefits

- **Accomplish More With a Third Serial Link**
  For applications that do not use an EIA-485 network, convert the EIA-485 port of an SEL-300 series relay to a fiber-optic port that is the equivalent of an SEL-2812MR Fiber-Optic Transceiver. For example, connect an SEL-300G Generator Relay to an SEL-2600 RTD Module, an SEL-2664 Field Ground Module, and an SEL-3530 Real-Time Automation Controller (RTAC). Or, add I/O to an SEL distance or feeder relay via an SEL-2505 Remote I/O Module.

- **Easily Apply**
  Connects directly to the Port 1 connector with positive retention screws. Full-duplex serial data and IRIG-B time synchronization are provided via the connector. Attach with duplex optical fiber to an SEL-2812MT Fiber-Optic Transceiver at the other end of the link.

- **Increase Safety and Signal Integrity**
  Isolate devices from ground potential rise and electrical interference through the communications connections, using an eye-safe, Class 1 laser product per EN 60825-1.
Application Information

Connecting and Disconnecting Fiber Cable
Use the supplied connector caps to cover ST® connectors that are not connected to a fiber cable to prevent reflected light from appearing as a received message.

Determining Maximum Cable Length
The table to the right 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. Divide the available optical power budget by the fiber loss/km specification to determine the maximum cable length.

SEL Substation Relay Application Example
One serial port connected to an SEL-3530 RTAC or other communications processor provides interaction with the control center, engineering department, and others. Use the remaining serial ports for:
- SEL Mirrored Bits® communications with two other sites in a three-terminal teleprotection scheme
- Distributed bus protection schemes
- Additional I/O with SEL-2505 or SEL-2506 Remote I/O Modules
- I/O and annunciation via an SEL-2523 Annunciator Panel

Example
Fiber Type ................. 50 μm
Splice Loss (fusion) ......... 0.2 dB/Splice
Fiber Loss @ 850 nm ....... 2.7 dB/km
SEL-9220 Optical Budget ... 16 dB
Less Splice Loss (1 × 0.2 dB) .... 0.2 dB
Available Power ............. 15.8 dB
Maximum Cable Length ...... 15.8 dB ÷ 2.7 dB/km = 5.85 km

Cable Length

<table>
<thead>
<tr>
<th>Fiber Diameter (μm)</th>
<th>Power Budget (dB)</th>
<th>Typical Fiber Loss (dB/km) at 25°C</th>
<th>Maximum Cable Length (km)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>16</td>
<td>2.7</td>
<td>5.85</td>
</tr>
<tr>
<td>62.5</td>
<td>16</td>
<td>3.2</td>
<td>4.9</td>
</tr>
<tr>
<td>200</td>
<td>16</td>
<td>6.5</td>
<td>2.4</td>
</tr>
</tbody>
</table>

* Actual distance depends on specific optical fiber characteristics and number of splices.

SEL-300G Generator Relay Example
Full generator protection and monitoring uses three serial ports. Retrieve RTD temperature information with an SEL-2600 RTD Module, and field excitation data through an SEL-2664 Field Ground Module. Use the third serial port for connection to an SEL-3530 RTAC, another DCS or SCADA system, or an SEL-2523 Annunciator Panel.
Technical Specifications

Data Rate
Up to 115.2 kbps, full duplex, no jumpers or settings

Link Data Delay
Serial Data  6 μs plus 5 μs/km of fiber
IRIG-B Time Code  15 μs plus 5 μs/km of fiber

Note: Link includes two transceivers and fibers

Optical Source
850 nm (infrared) VCSEL transmitter
Typical Transmit Level  —13 dBm

Optical Receiver
850 nm Receiver
Minimum Sensitivity  —29 dBm

Operating Temperature
—40° to +85°C (—40° to +185°F)

Projection From SEL-300 Series Connector
100 mm (4 in) typical, including fiber-optic connector and minimum cable bend radius

Power Requirements
Receives power from the SEL-300 series relay

Fiber-Optic Cable and Connectors
ST connectors
Multimode fiber (50–200 μm)
SEL provides ST-connected 200 and 62.5 μm fiber-optic cables

Dimensions

Back Label With EIA-485 Pin Usage
SEL-9220 Fiber-Optic Adapter for SEL-300 Series Relays

Type Tests and Standards

Cold

Dry Heat
A1:1995] 16 hours at +85°C

Damp Heat, Cyclic
95% r.h., 25°C to 55°C, 6 cycles (12 + 12 hour cycle)

Vibration

EMC Immunity
Electrostatic Discharge Immunity
IEEE C37.90.3-2001
Severity Level: 2, 4, 6, 8 kV contact discharge; 2, 4, 8, 15 kV air discharge

Radio Frequency Interference Immunity
IEC 60100-4-2:2002 [BS EN 60100-4-2:2002]
IEEE C37.90.2-2004 Severity Level: 35 V/m
Digital Radio Telephone RF Immunity ENV 50204:1995

Radiated Radio Frequency
ENV 50204:1995, 10 V/m

Emissions
FCC CFR 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.

Eye Safety
21 CFR 1040.10 and 1040.11
Class 1 laser complies with 21 CFR 1040.10 and 1040.11 except for
deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

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

Accessories

Adapter Cables for EIA-485 Ports
Use an adapter cable to apply an SEL-9220 to devices that do not
have an eight-position EIA-485 compression block. The transmitter
(TX) outputs of the device must be asserted to properly operate the
SEL-9220. These cables convert a four-wire EIA-485 port to a point-
to-point fiber-optic link.

<table>
<thead>
<tr>
<th>Device</th>
<th>EIA-485 Port</th>
<th>Cable Only</th>
<th>Cable Data and IRIG-B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Port No.</td>
<td>Connector</td>
<td>(IRIG connector if separate)</td>
</tr>
<tr>
<td>SEL-300 series including “legacy” products</td>
<td>1</td>
<td>8-position compression</td>
<td>None Needed</td>
</tr>
<tr>
<td>SEL-300 series with a USB and Ethernet port</td>
<td>1</td>
<td>5-position compression</td>
<td>C685</td>
</tr>
<tr>
<td>SEL-500 series</td>
<td>1</td>
<td>DB9</td>
<td>C688</td>
</tr>
<tr>
<td>SEL-700 series, -2411, -2414, -2523</td>
<td>4A</td>
<td>5-position compression</td>
<td>C685</td>
</tr>
<tr>
<td>SEL-2431</td>
<td>1</td>
<td>DB9</td>
<td>C688</td>
</tr>
<tr>
<td>SEL-2431</td>
<td>2</td>
<td>DB9</td>
<td>C688</td>
</tr>
<tr>
<td>SEL-2440</td>
<td>2</td>
<td>DB9</td>
<td>C688</td>
</tr>
</tbody>
</table>

Fiber-Optic Cable
- SEL-C805 fiber-optic cables for distances up to 2.5 km
- SEL-C807 fiber-optic cables for distances up to 4 km

Fiber-Compatible Devices

<table>
<thead>
<tr>
<th>Device (option)</th>
<th>Optical Fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL-2812 Fiber-Optic Transceiver (MT or FT)</td>
<td>2</td>
</tr>
<tr>
<td>SEL-2600 RTD Module (SEL-2812 compatible)</td>
<td>1</td>
</tr>
<tr>
<td>SEL-2664 Field Ground Module</td>
<td>1</td>
</tr>
<tr>
<td>SEL-700 series, SEL-2407**, SEL-2411, SEL-2414, SEL-2431, SEL-2440 (SEL-2812 compatible)</td>
<td>2</td>
</tr>
<tr>
<td>SEL-2505, SEL-2515 Remote I/O Modules (SEL-2812 compatible)</td>
<td>2</td>
</tr>
</tbody>
</table>