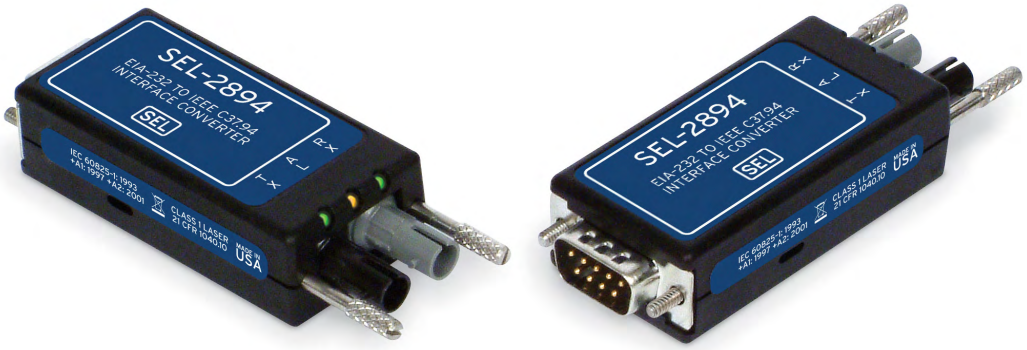
SEL-2894 Interface Converter Instruction Manual



Features, Benefits, and Applications

Use the SEL-2894 to connect any EIA-232 serial communications device to any device equipped with an IEEE C37.94 standard fiber-optic interface. The SEL-2894 converts C37.94 standard fiber-optic signals to and from EIA-232 serial data. Install the SEL-2894 close to equipment with an electrical interface, then use as much as 2 km of inexpensive multimode fiber to connect to equipment with an IEEE C37.94 standard fiber-optic interface. A selector switch configures the internal clock for network or internal time reference.

The SEL-2894 makes possible a short electrical interface that increases safety, robustness, and reliability while reducing the potential for ground loops.

- **IEEE C37.94 Standard Conversion.** Converts EIA-232 equipment (as fast as 19200 bps) to the IEEE C37.94 standard. Using fiber-optic cable, connect the SEL-2894 to an EIA-232 device and communicate to a C37.94-compliant multiplexer as far as 2 km away.
- **Easy Application.** There are no configuration settings or jumpers. LEDs indicate transmit data and receive data. The yellow alarm (AL) LED, for example, indicates signal loss on the transmit link.
- **Fast MIRRORED BITS® Communications With Low Latency.** Connect the SEL-2894 to any relay with MIRRORED BITS communications. The SEL-2894 provides fast end-to-end data transport, making MIRRORED BITS communications applications fast and seamless. Delay is less than 375 µs in back-to-back tests.
- **SEL-2126 Fiber-Optic Transfer Switch Compatibility.** Connect the SEL-2894 fiber-optic interface directly to the SEL-2126 Fiber-Optic Transfer Switch to reroute MIRRORED BITS communications links during circuit breaker bypass operations.
- **Port-Powered.** The SEL-2894 transceivers are port-powered from the host device via the EIA-232 DB-9 connector. They do not require a separate power supply or wiring.
- **Improved Safety.** Fiber optics completely isolate communications devices from ground potential rise and EMI/RFI.
- **Flexibility—Use With Any EIA-232 Device.** The SEL-2894 uses ST connectors and multimode fiber-optic cable to support the IEEE C37.94 optical interface. The SEL-2894 works with SEL relays, other asynchronous EIA-232 devices, and IEEE C37.94-compliant devices.

Product Overview

Figure 1 provides a functional overview of the SEL-2894.

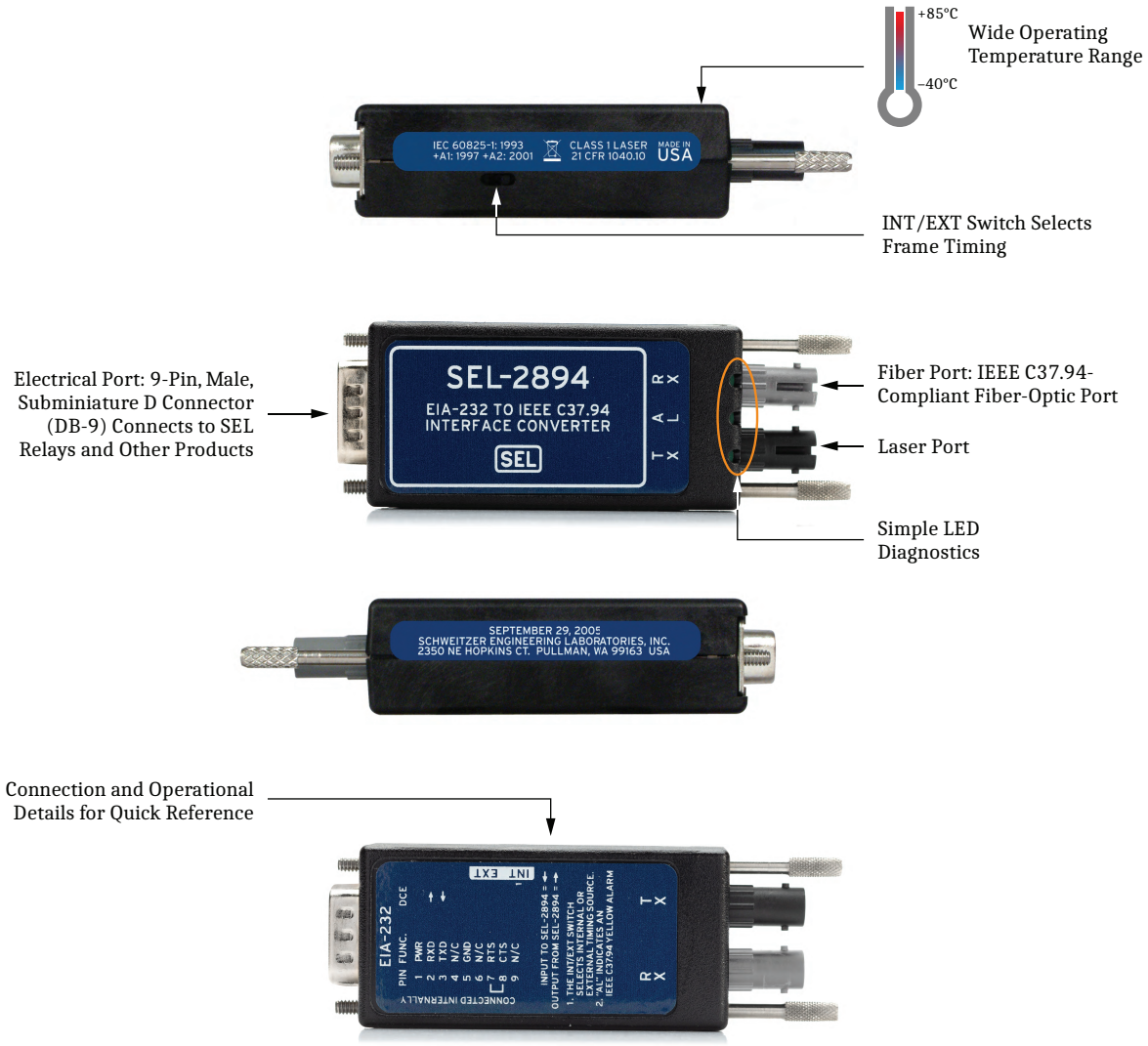


Figure 1 SEL-2894 Functional Overview

Applications

Connect IEEE C37.94-Compliant Teleprotection to a Noncompliant EIA-232 Device

Figure 2 shows an application in which the SEL-2894 provides an interface conversion between a digital multiplexer that supports the IEEE C37.94 standard and teleprotection equipment that has an EIA-232 electrical interface.

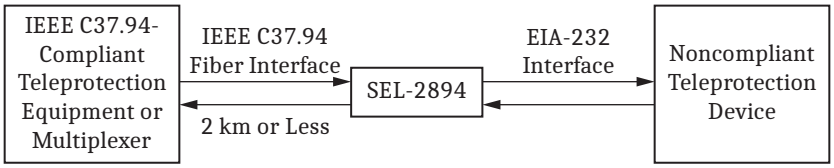


Figure 2 Optical-to-Electrical Conversion Between an IEEE C37.94-Compliant Digital Multiplexer and a Noncompliant Teleprotection Device

Functional Description

Use the SEL-2894 to interface asynchronous EIA-232 devices (as fast as 19200 bps) to synchronous networks for an efficient and reliable end-to-end connection. The SEL-2894 provides short- to medium-range EIA-232 full-duplex communication over the IEEE C37.94 fiber-optic standard interface. For further information on the standard, reference the *IEEE Std C37.94-2017: IEEE Standard for N Times 64 Kilobit Per Second Optical Fiber Interfaces Between Teleprotection and Multiplexer Equipment*.

The converter connects directly to a standard 9-pin serial port and draws power from the EIA-232 data and control lines. Therefore, no external power is necessary.

Use the SEL-2894 with the SEL-2126 Fiber-Optic Transfer Switch to reroute MIRRORED BITS communications to maintain power system protection during circuit breaker maintenance operations.

Installation and Maintenance

EIA-232 Serial Port

The SEL-2894 electrical interface port is an EIA-232 interface with a male, 9-pin, D-subminiature connector (DB-9). The port is configured as a DCE (Data Communications Equipment) device with the pinout listed in *Table 1*.

Table 1 EIA-232 Pinout

Pin	Function	Comment
1	+5 Vdc input[a]	Optional
2	RXD	Data out of the converter
3	TXD	Data in to the converter
4	No connection	
5	GND	
6	No connection	
7	RTS	Short to Pin 8
8	CTS	Short to Pin 7
9	No connection	

[a] SEL-2894 Interface Converters built before May 2019 require power from Pin 1.

Fiber-Optic Port

The SEL-2894 uses an 850 nm VCSEL (vertical cavity surface emitting laser) transmitter. When working with this device, observe the following safety precautions:

- Do not look into the fiber (laser) ports/connectors.
- Do not look into the end of an optical cable connected to an optical output.
- Do not perform any procedures or adjustments that this manual does not describe.
- During installation, maintenance, or testing of the optical ports, use only test equipment qualified for Class 1 laser products.
- Incorporated components, such as transceivers and laser emitters, are not user serviceable. Return units to SEL for repair or replacement.

Power Requirements

The SEL-2894 draws power from the data and control lines of the 9-pin subminiature D connector (DB-9) as shown in *Table 2*. Total current draw is less than 15 mA. Upon connecting power, you will see the green TX LED illuminate.

Table 2 Data and Control Line Power Input

Pin	Signal
3, 7	DCE

The SEL-2894 can also draw power from a connected SEL device that provides Pin 1 power (+5 Vdc), as shown in *Table 3*.

Table 3 Other Power Input

Pin	Voltage (Vdc)
1	+5 to +10

Disconnect Device

For installations that comply with IEC regulations, note that you can disconnect power by unplugging the converter from the serial port.

Configuration

Select between internal and external timing for the IEEE C37.94 interface, according to the specific application. Select external timing for interfacing with existing C37.94 multiplexers. When two SEL-2894 converters connect in a back-to-back arrangement, one of the converters must supply a timing reference. In a connection of this kind, select internal timing on one of the two converters.

There are no other configuration settings or jumpers in the SEL-2894. Once the device has operational power and connects to an EIA-232 port, operation is automatic.

Converter Mounting Options

Use an SEL Converter Mounting Kit and adapter cable when connecting the SEL-2894 to IEDs with an RJ45 male serial connector or when the mounting depth is an issue (e.g., in switchgear applications). These kits provide a simple and secure way to remotely mount the converter away from the host connector.

915900573: Mounting kit for SEL converter; includes mount only

915900574: Mounting kit for SEL converter; includes mount and SEL-C478A cable (6 ft, DB-9 female to RJ45 male)

915900575: Mounting kit for SEL converter; includes mount and SEL-C641 cable (6 ft, DB-9 female to DB-9 male)

Figure 3 Converter Mount

Cleaning

Use care when cleaning the SEL-2894. Use a mild soap or detergent solution and a damp cloth to clean the device. Do not use abrasive materials, polishing compounds, or harsh chemical solvents (such as xylene or acetone) on any surface.

Testing and Troubleshooting

Test Procedure

Test the SEL-2894 with IEEE C37.94-compliant teleprotection equipment or multiplexer as *Figure 4* shows.

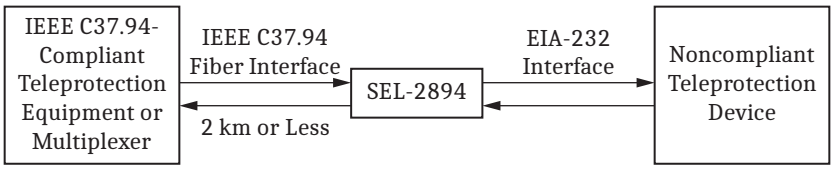


Figure 4 Test Configuration

Step 1. Connect the SEL-2894 (connect the device to an EIA-232 port. The green **TX** LED illuminates to indicate that the converter is transmitting C37.94 frames.

Step 2. Make the fiber-optic connections between the SEL-2894 and the relay or multiplexer by connecting a fiber between the relay C37.94 transmit (TX) connector and the SEL-2894 RX ST connector. Repeat this step for the remaining fiber connection. The green **RX** LED should now illuminate.

Troubleshooting

Yellow Alarm LED AL

A yellow alarm is a remote receive alarm that the local channel card communicates to the local SEL-2894 via a predefined alarm bit in the IEEE C37.94 frame. The local multiplexer channel card declares a yellow alarm when it fails to receive data from the local SEL-2894. The channel card sets the yellow alarm bit in the transport frame header in the transmit direction back to the SEL-2894. If the SEL-2894 is still receiving data from the channel card, the converter decodes a yellow alarm bit and illuminates the **AL** LED yellow.

Figure 5 illustrates the operation of the yellow alarm LED.

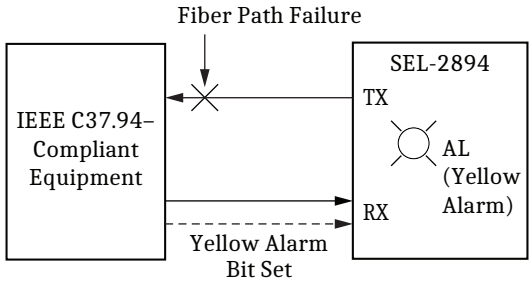


Figure 5 Link Failure and Yellow Alarm Condition

Operational Issues

Table 4 shows troubleshooting instructions for particular situations.

Table 4 Troubleshooting

Problem	Possible Cause	Solution
The converter LEDs are dark		
	Input power is not present	Verify that input power is present.
	No fiber connection to the IEEE 37.94-compliant device	Verify fiber connections.
	Self-test failure	Exchange converter with a known good device and verify proper functioning. If replacement is OK, contact SEL.
The converter does not communicate data		
	Wiring error	Verify fiber connections.
	EIA-232 data rate too fast	Reduce data rate to 19.2 kbps or slower.
	Yellow alarm	Verify TX path connection (see *Yellow Alarm LED AL*).
	Insufficient power from the data and control lines, Pin 3 and Pin 7 of the host device	Apply sufficient power (see *Power Requirements*) to Pin 1 of the SEL-2894.

Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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Email: info@selinc.com

Mechanical Diagram

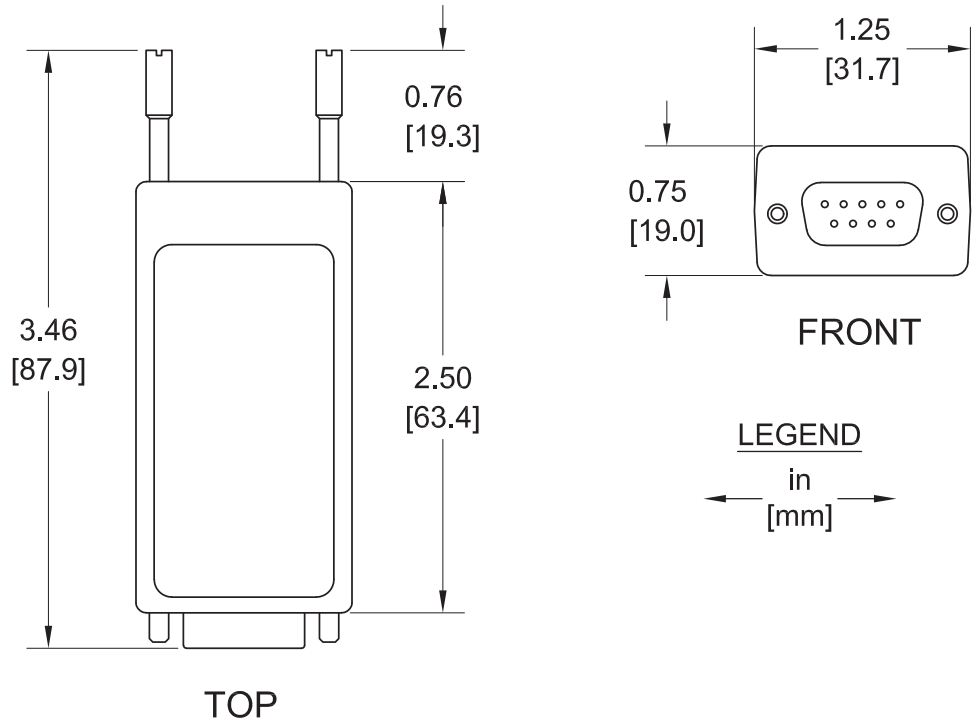

Figure 6 SEL-2894 Dimensions

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.

Power Supply Requirements

Range: Pin 1: +5 to +10 Vdc
Pin 3, 7: DCE, Parasitic Power

Burden: <15 mA

Maximum Data Delay

200 µs

Maximum Delay Asymmetry

50 µs

Electrical Interface

EIA-232

Electrical Data Rate

300 to 19200 bps

Electrical Interface Connection

DB-9 Male

Optical Interface Protocol

IEEE C37.94

Optical Data Rate

64 kbps (1DS0)

Optical Interface Connector

ST

Fiber-Optic Link Budget

Optical Fiber

Core Size	Optical Budget
50 µm	9.0 dB
62.5 µm	13.0 dB

Optical Source

850 nm VCSEL Transmitter

Transmit Level: –23 dBm to –11 dBm
(50 µm multimode fiber size)

–19 dBm to –11 dBm
(62.5 µm multimode fiber size)

Fiber-Optic Receiver Sensitivity

–32 dBm

Operating Temperature Range

–40° to +85°C (–40° to +185°F)

Operating Environment

Indoor Use Only

Insulation Class 3

Pollution Degree 2

Overvoltage Category 2

Humidity

0% to 95% noncondensing

Altitude

2000 m maximum

Unit Weight

50 g (2 oz)

Dimensions

19 mm x 32 mm x 87 mm
(0.75 in x 1.25 in x 3.425 in)

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

Laser Safety:
Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

⚠WARNING
Operator safety may be impaired if the device is used in a manner not specified by SEL.

⚠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 manual. If misused, any safety protection provided by the equipment may be impaired.

⚠CAUTION
Equipment components are sensitive to electrostatic discharge (ESD). Undetectable permanent damage can result if you do not use proper ESD procedures. Ground yourself, your work surface, and this equipment before removing any cover from this equipment. If your facility is not equipped to work with these components, contact SEL about returning this device and related SEL equipment for service.

⚠CAUTION
Class 1 LASER product. This product uses visible or invisible LASERs based on model option. Looking into optical connections, fiber ends, or bulkhead connections can result in hazardous radiation exposure.

⚠CAUTION
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

⚠AVERTISSEMENT
La sécurité de l'opérateur peut être compromise si l'appareil est utilisé d'une façon non indiquée par SEL.

⚠ATTENTION
Pour assurer la sécurité et le fonctionnement correctes, il faut vérifier les valeurs nominales des équipements et les instructions de l'installation avant de mettre en service ou d'entretenir les équipements. L'utilisateur est responsable d'assurer l'installation, le fonctionnement et l'utilisation de chaque équipement selon sa fonction prévue et de la manière décrite dans ce manuel. Au cas du mauvais usage, toute protection de sécurité fournie par l'équipement pourrait être réduite.

⚠ATTENTION
Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-décelables peuvent résulter de l'absence de précautions contre les DES. Raccordez-vous correctement à la terre, ainsi que la surface de travail et l'appareil avant d'en retirer un panneau. Si vous n'êtes pas équipés pour travailler avec ce type de composants, contacter SEL afin de retourner l'appareil pour un service en usine.

⚠ATTENTION
Produit LASER de Classe 1. Ce produit utilise des LASERS visibles ou invisibles dépendant des options du modéle. Regarder vers les connecteurs optiques, les extrémités des fibres ou les connecteurs de cloison peut entraîner l'exposition à des radiations dangereuses.

⚠ATTENTION
La sécurité de l'opérateur peut être compromise se l'appareil est utilisé d'une façon non indiquée par SEL.

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