



SEL-2820 EIA-485 Fiber-Optic V-Pin Transceiver Instruction Manual



Features, Benefits, and Applications

The SEL-2820 connects electrical EIA-485 multidrop networks or point-to-point EIA-422 links.

- **Increases Safety.** Isolate devices from ground potential rise and fault current in the communications connections.
- **Improves Signal Integrity.** Prevent electromagnetic interference and signal ground loops by using optical connections instead of copper wires.
- **Withstands Harsh Conditions.** Operates over -40° to $+85^{\circ}\text{C}$ temperature range, and meets or surpasses electric utility and industrial type-test standards for instrumentation, control, and communications equipment.
- **Easily Applied.** Implement fiber-optic links between two- and four-wire EIA-485 network segments. Set operating modes via control (DIP) switches. Simplify network commissioning and repair with LED traffic indicators for each port. Connect power through terminal block or jack.

Product Overview

The SEL-2820 converts electrical signals in and out of an asynchronous serial EIA-485/422 port and light pulses sent and received via a full-duplex fiber-optic port. Multidrop EIA-485 networks are often applied for low-speed data acquisition and control systems. Example applications for SEL-2820 Transceivers include:

- Connect a distant EIA-485 device to an EIA-485 network with two SEL-2820 Transceivers and optical fiber.
- Add an EIA-485 sub-network for multiple devices, connected to a master or main network via optical fiber and two SEL-2820 Transceivers.
- Use an EIA-232 port on a master computer as the master connection to a distant EIA-485 network.
- Mount an SEL-2800 Fiber-Optic Transceiver to an EIA-232 port on the master computer and connect the SEL-2800 with a fiber-optic cable to an SEL-2820 Transceiver that is the master node of an EIA-485 network.
- Link two devices with a point-to-point fiber-optic link, via their EIA-485 or EIA-422 ports and two SEL-2820 transceivers.

Power Requirements

The SEL-2820 has two power options. Connect 5 to 30 Vdc \pm 5% to either the 2.5 mm power jack or the compression terminal block, as shown in *Figure 1*. The SEL-2820 consumes less than 1.5 W, or at 5.0 Vdc less than 1 W.

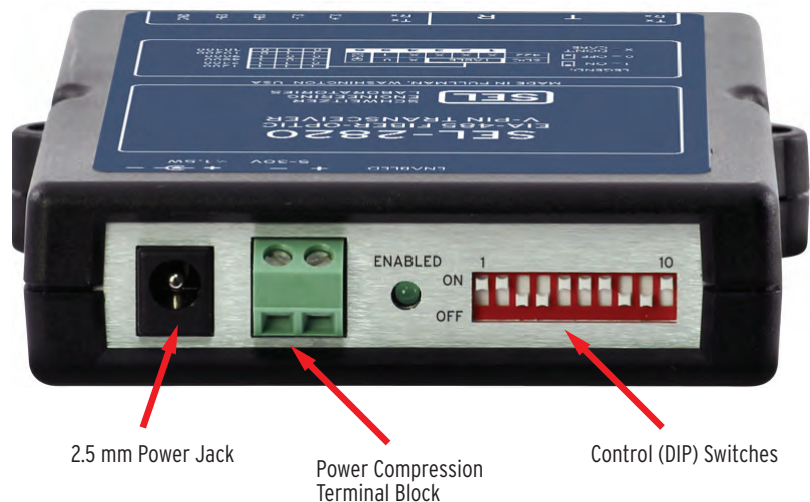


Figure 1 SEL-2820 Power Connections and Control (DIP) Switches

SEL options to provide the power include the following:

- **AC Power Adapter**—An SEL 230-0604 ac power adapter provides 15 Vdc, from an input of 90 to 264 Vac.
- **SEL-9321 DC Power Supply**—Use the SEL-9321 to power SEL-2820 transceivers from higher voltage power sources, including 48, 125, and 250 Vdc station batteries, and 125 and 250 Vac sources.
- **SEL-C577 EIA-232 Port Power Cable**—Provide power from an SEL relay or controller that has a 5 Vdc pin-one jumper for an unused EIA-232 port. Connect the tinned leads of the

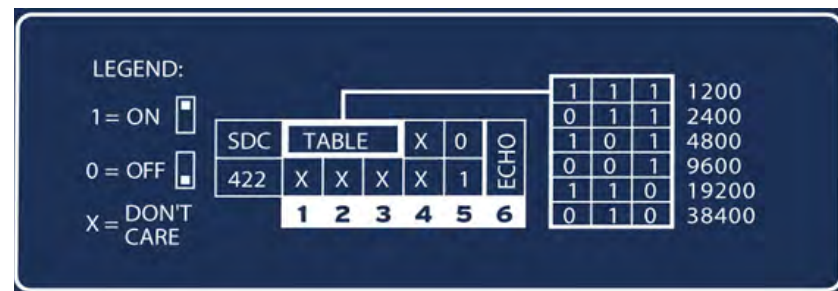
SEL-C577 cable to the compression block power input, before plugging the 9-pin connector into the unused EIA-232 port.

Control Switches

The SEL-2820 Interface Converter has several operating modes. These modes are enabled through the use of control (DIP) switches as shown in *Figure 1*.

Table 1 Switch Functions

Switch (SW) Position	Function
1,2,3	Set data rate for Send Data Control (SDC), see <i>Table 2</i>
5	Transmitter is always enabled (EIA-422 mode) (On)
6	Receiver echo on or off (2 wire mode)
7,8,9,10	Unused



Transmit Data Control (Switches 1-5)

There are several options to control the electrical transmitter output.

- **EIA-422 mode**—In the EIA-422 mode the transmitter is always enabled. Only use this mode in a point-to-point, four-wire remote application because the transmitter is always terminating the circuit.
- **SDC mode**—In the Send Data Control (SDC) mode the transmitter is enabled when data are present on the fiber-optic receive (R) input. Apply a one-character time delay to ensure the transmitter stays enabled through low data transitions. This time delay is set using SW1–SW3. Note these switches are only used by the SEL-2820 when SDC mode is enabled (SW5 = 0).

Table 2 displays the interdependencies of control switches 1 through 5.

Table 2 Switch Settings to Control Electrical Transmitter

SW1	SW2	SW3	SW4	SW5	Application
X ^a	X	X	X	1 ^b	EIA-422 mode (TX always enabled)
* ^c	* ^c	* ^c	0	0 ^d	TX enabled by the data (SDC)

a. X = Does not matter.

b. 1 = On.

c. * = Set per Table 3.

d. 0 = Off.

Table 3 Switch Settings for SDC Timing and Associated Data Rates

SW1	SW2	SW3	TX Enable Hold Time ms/Rate
1	1	1	11.66 ms/1200 bps
0	1	1	5.83 ms/2400 bps
1	0	1	2.91 ms/4800 bps
0	0	1	1.45 ms/9600 bps
1	1	0	0.72 ms/19200 bps
0	1	0	0.36 ms/38400 bps

ECHO Control (Switch 6)

When ECHO is set to On, the receiver is always enabled.

When ECHO is set to Off, the receiver is disabled while the transmitter is active. When operating in two-wire mode, turn ECHO off to prevent the transmitted data from echoing back into the receiver.

Fiber-Optic Connections

The fiber-optic port consists of two V-pin connectors and two traffic indication LEDs, as shown in *Figure 2*. Data received from the EIA-485 port are sent on the transmit (T) V-pin connector. Data sensed from the receive (R) V-pin connector are transmitted to the EIA-485 port. For a link between two transceivers, connect a fiber from the T connector of each transceiver to the R connector of the other transceiver.

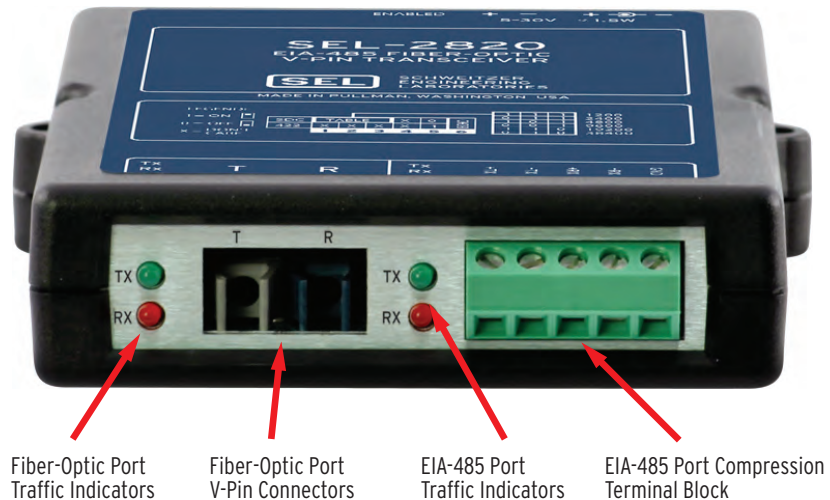
**Figure 2 SEL-2820 Port Connectors and Traffic Indicators**

Table 4 shows typical fiber-optic cable lengths for compatible fiber-optic cables. For the calculations to determine if a specific fiber-optic cabling plan has sufficient optical power to reliably overcome attenuation from splices and patch panels, see *Appendix B: Determining Maximum Cable Length*.

Table 4 Typical Fiber-Optic Cable Lengths

SEL Cable	Fiber Diameter (μm)	Power Budget (dB) (-40° to +85°C)	Typical Fiber Loss (dB/km) at 25°C	Maximum Cable Length (m)
SEL-C805	200	9	6.5	500

EIA-485/422 Connections

The EIA-485/422 connections are made on the green five-position compression terminal block located on one end of the SEL-2820. Connection wiring will vary based on the application. The following schematics provide wiring diagrams for each of the operating modes.

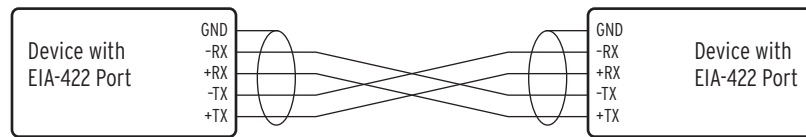


Figure 3 EIA-422 Electrical Link

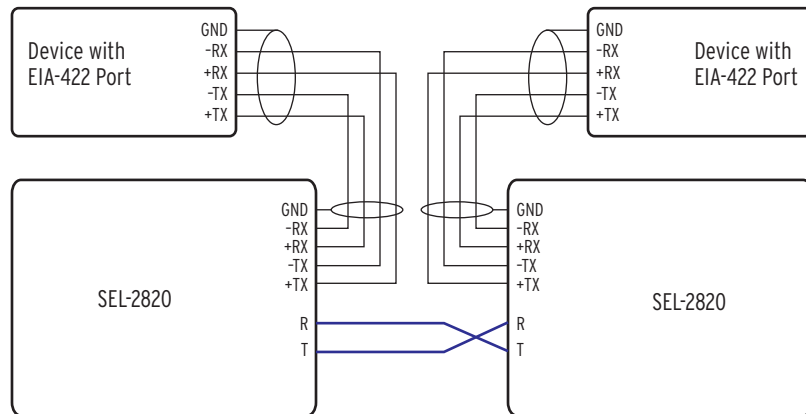


Figure 4 EIA-422 Fiber-Optic Link

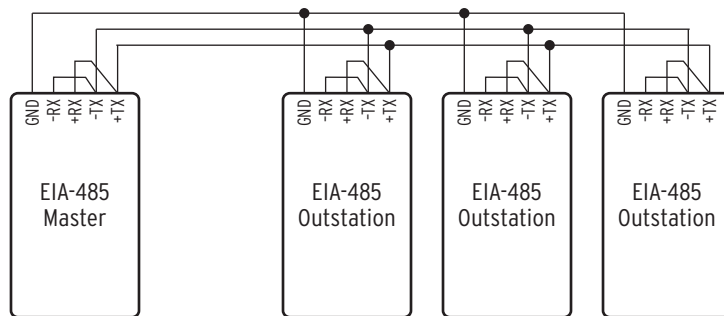


Figure 5 EIA-485 Two-Wire Multidrop

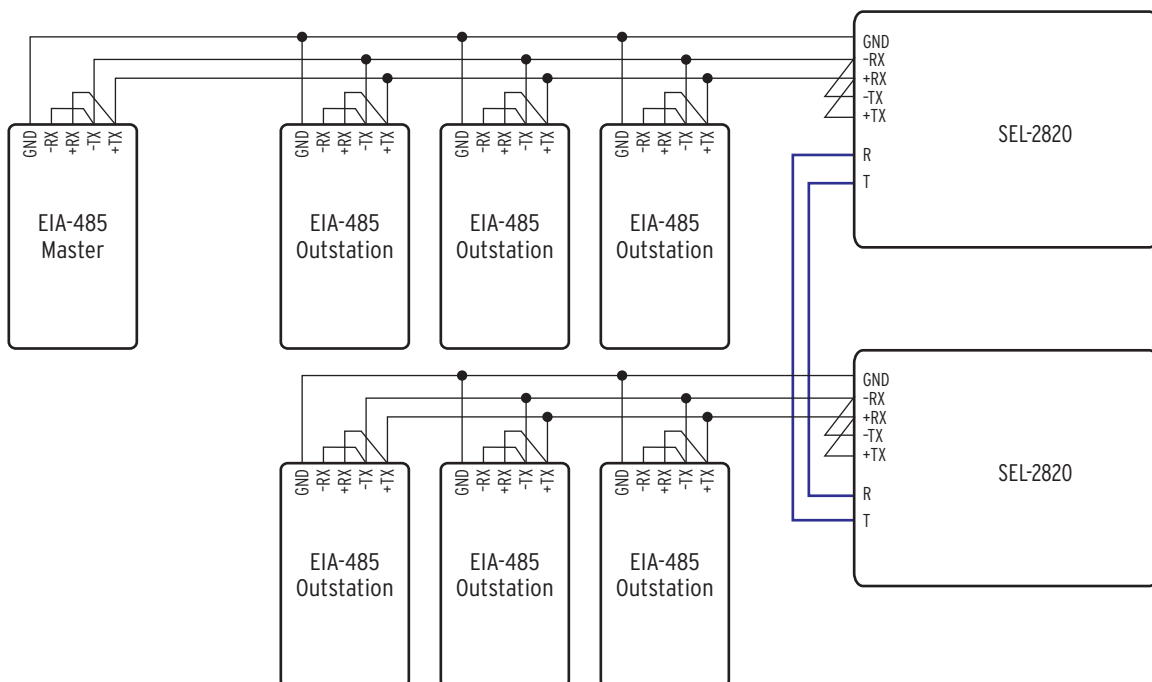


Figure 6 EIA-485 Two-Wire Multidrop With Fiber-Optic Extension

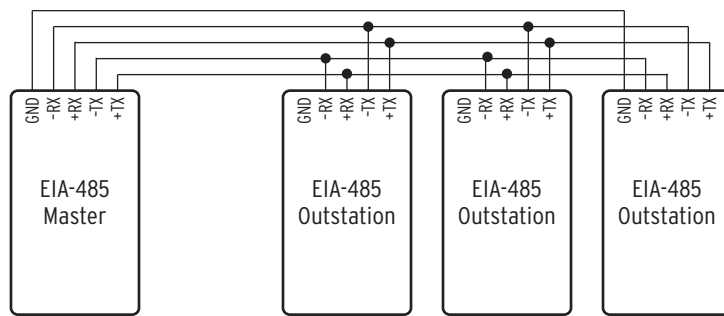


Figure 7 EIA-485 Four-Wire Multidrop

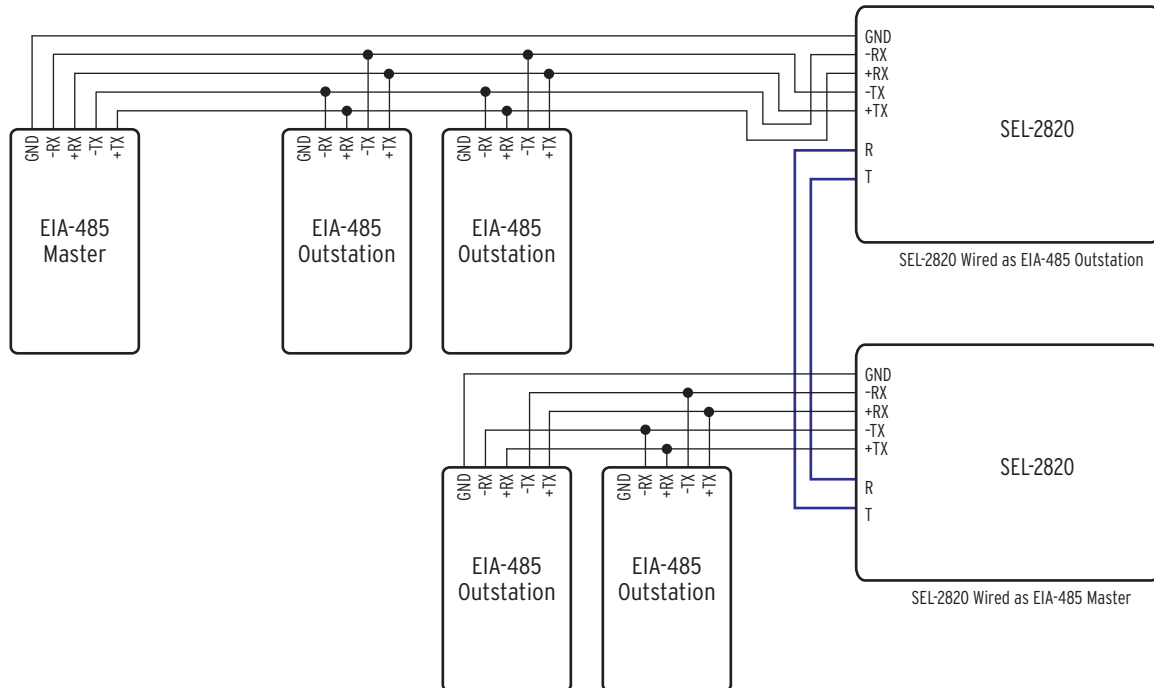


Figure 8 EIA-485 Four-Wire Multidrop With Fiber-Optic Extension

EIA-485 Terminations

EIA-485 systems operating at high speeds and long distances require termination resistors to prevent reflected signals from interfering with proper operation. Theoretically, the only applications of the SEL-2820 that require termination resistors are those operating at 38400 bps with wire lengths of 1364 meters (2240 feet) or more. It would be better to use SEL-2820 transceivers and optical links than to have such long EIA-485 wire lengths.

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

Data Rate

Up to 38.4 kbps

Data Delay

5 μ s plus 5 μ s/km of fiber

Operating Temperature

-40° to +85°C (-40° to +185°F)

Power Requirements

5 to 30 Vdc 5% tolerance, <1.5 W

Fiber-Optic Port

Connectors:	Two V-pin female
Wavelength:	650 nm
Typical Tx Power:	-30 dBm
Min Rx Sensitivity:	-39 dBm
Optical Budget:	9 dB
Compatible Optical Fiber:	200 μ m core diameter

Electrical Port

Connector:	5 position compression terminal block
Connections:	4-wire full-duplex or 2-wire half-duplex
Operation:	EIA-485 multidrop or EIA-422 point-to-point

LED Indicators

Enable:	Powered and operating
Fiber Tx:	Data sent to T fiber
Fiber Rx:	Data received from R fiber
EIA-485 Tx:	Data send to EIA-485 network
EIA-485 Rx:	Data received from EIA-485 network

Dimensions

Height (without DIN mount):	25.4 mm (1.0 in)
Width:	93.35 mm (3.675 in)
Depth:	121.9 mm (4.8 in)

Type Tests

Environmental Tests

Cold:	IEC 60068-2-1:2007 Test Ad: 16 hours at -40°C IEEE 1613:2003
Dry Heat:	IEC 60068-2-2:2007 Test Bd: 16 hours at +85°C IEEE 1613:2003
Damp Heat Cyclic:	IEC 60068-2-2-2007 Test Db: 95% r.h., 25° to 55°C, 6 cycles (12 + 12 hour cycle)

Vibration and Shock Tests

Shock and Bump:	IEC 60255-21-2:1988 Class 1 Shock Withstand Class 2 Shock Response Class 1 Bump Withstand
Seismic:	IEC 60255-21-3:1993 Class 2 Quake Response
Sinusoidal Vibration:	IEC 60068-2-6:2007 Test Fc: Vibration (Sinusoidal). 3G, 10-160 kHz IEC 60255-21-1:1988 Class 1 Vibration Endurance Class 2 Vibration Response

Electrostatic Discharge Immunity

ESD:	IEC 60255-22-2:2008 IEC 61000-4-2:2008 IEEE C37.90.3-2001 Severity Level: 2, 4, 6, 8 kV contact discharge; 2, 4, 8, 15 kV air discharge
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Electromagnetic Compatibility Emissions

Product Specific:	IEC 60255-25:2000 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. Canada ICES-001(A) / NMB-001(A)
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Electromagnetic Compatibility Immunity

Conducted RF Interference Immunity:	IEC 61000-4-6:2008 IEC 60255-22-3:2001 Severity Level: 10 V/m
Digital Radio Telephone RF Immunity:	ENV 50204-1995
Radiated Radio Frequency Immunity:	IEC 61000-4-3:2006 IEC 60255-22-3:2007 Severity Level: 10 V/m IEEE C37.90.2-2004 Severity Level: 35 V/m IEEE 1613:2009 + A1: 2011

Appendix A: Manual Versions

Determining the Manual Version

The date code at the bottom of each page of this manual reflects the creation or revision date.

Table 5 lists the product manual release dates and a description of modifications. The most recent product manual revisions are listed at the top.

Table 5 Manual Revision History

Revision Date	Summary of Revisions
20210715	Updated <i>Specifications</i> .
20110729	Initial version.

Appendix B: Determining Maximum Cable Length

The optical power budget of 9 dB 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 650 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.

Table 6 Example Calculation for SEL-C805 Fiber-Optic Cable

Value	Variable or Calculation
Fiber Type	200 µm
Splice Loss	3 dB/splice
Fiber Loss @ 650 nm	12 dB/km
SEL-2820 Optical Budget	9 dB
Less Splice Loss (1 • 3 dB)	3 dB
Available Power	6 dB
Maximum Cable Length	$6 \text{ dB} \div 12 \text{ dB/km} = 0.5 \text{ km}$

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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Notes

⚠ 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

Looking into optical connections, fiber ends, or bulkhead connections can result in hazardous radiation exposure.

⚠ WARNING

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

⚠ DANGER

Contact with instrument terminals can cause electrical shock that can result in injury or death.

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This product is covered by the standard SEL 10-year warranty. For warranty details, visit selinc.com or contact your customer service representative.

⚠ 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

Regarder vers les connecteurs optiques, les extrémités des fibres ou les connecteurs de cloison peut entraîner une exposition à des rayonnements dangereux.

⚠ AVERTISSEMENT

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

⚠ DANGER

Tout contact avec ce circuit peut être la cause d'un choc électrique pouvant entraîner des blessures ou la mort.

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