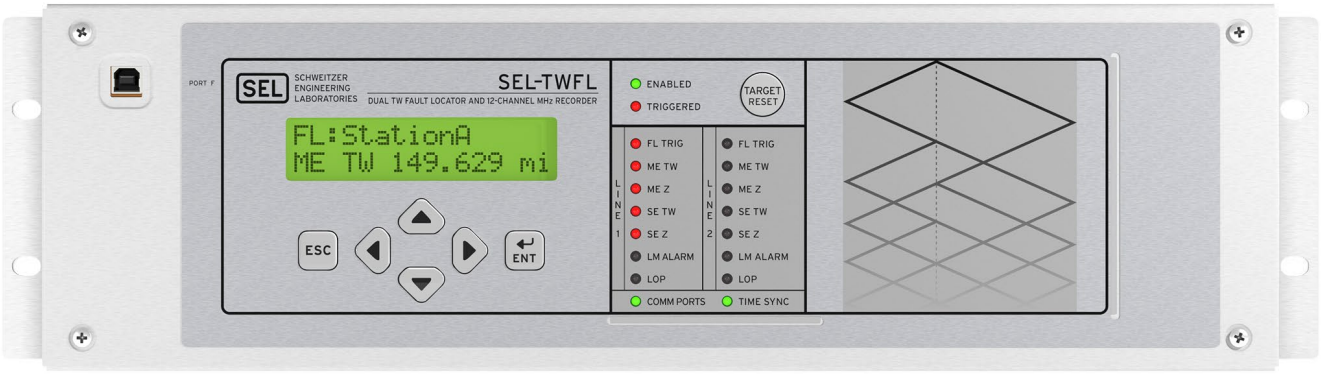
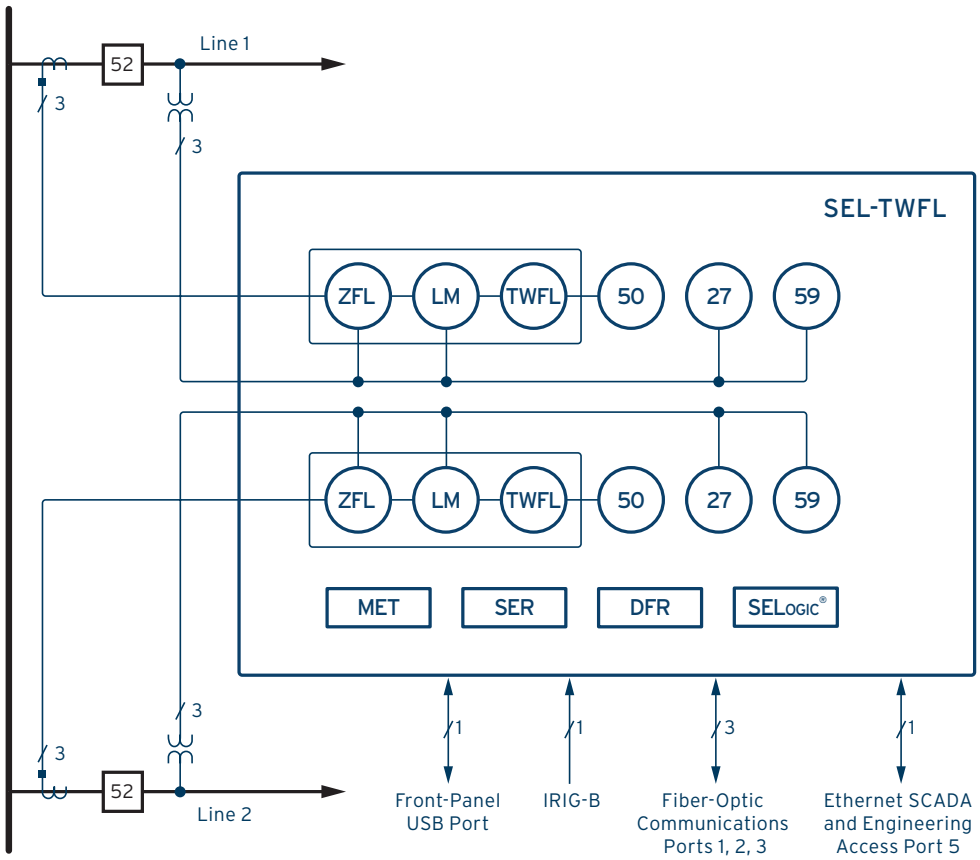
SEL-TWFL

Dual Traveling-Wave Fault Locator and 12-Channel MHz Recorder



Accurate and economical traveling-wave fault locator

- Achieve traveling-wave-based fault-locating accuracy to within one tower span, regardless of line length.
- Monitor the line for incipient faults, recurring faults, or incipient cable faults using the line monitoring function.
- Complement protective relays by adding a standalone fault locator for two- and three-terminal lines.
- Monitor as many as two lines at a substation using one device.



ANSI Numbers/Acronyms and Functions

ZFL	Impedance-Based Fault Locator
TWFL	Traveling-Wave-Based Fault Locator
LM	Line Monitor
27	Undervoltage (phase and positive-sequence)
50	Instantaneous Overcurrent (phase, zero-sequence, and negative-sequence)
59	Overvoltage (phase, positive-sequence, zero-sequence, and negative-sequence)
OP	Open-Pole Detection Logic
LOP	Loss-of-Potential Logic

85 RIO	SEL MIRRORED BITS® I/O With Selectable SEL MB8 or IEEE C37.94 Encoding
MET	Metering
SELOGIC®	Programmable Logic
SER	Sequential Events Recorder
DFR	Digital Fault Recorder
TWTEST	Traveling-Wave Test Mode
HMI	Local Operator Interface
DNP3	Distributed Network Protocol 3.0 (Ethernet)
FTP	File Transfer Protocol

Locate Faults Accurately With Traveling-Wave-Based Fault Locating

The SEL-TWFL provides state-of-the-art fault locating based on robust traveling-wave technology. It includes single- and multi-ended traveling-wave-based fault-locating methods that are accurate to within a single tower span. It also includes single- and multi-ended impedance-based methods. The combination of these methods provides the best accuracy and dependability for any combination of operating conditions and fault types. The detailed fault location results allow you to confidently dispatch crews directly to the tower nearest to the fault, reducing the outage time and maintenance expenses.

The multi-ended methods work over a IEEE C37.94-compliant multiplexed channel with high-accuracy external IRIG-B clocks connected to the SEL-TWFL at all line terminals. The fault locator is triggered from the protection system through a contact input or an SEL Mirrored Bits input or from the built-in triggering elements.

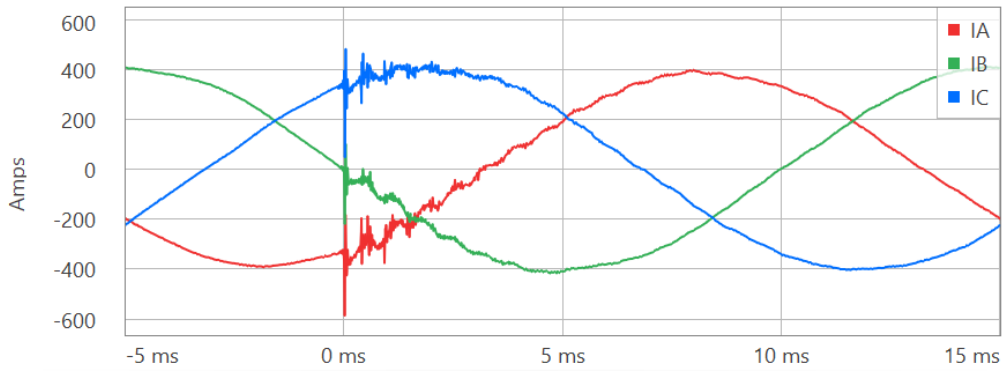
In applications such as those to series-compensated lines, multiterminal lines, and hybrid lines, use the multi-ended traveling-wave-based method.

The single-ended traveling-wave-based fault-locating method is useful in applications without device-to-device communications or when your channel is down. When device-to-device communications are not available, SCADA/HMI software can be programmed to perform multi-ended fault locating by using information from SEL-TWFL devices at the line terminals.

The SEL-TWFL interfaces with conventional voltage and current transformers, and one device can be installed alongside protective relays at a substation to monitor two lines. It can monitor overhead, cable, and hybrid transmission lines. The SEL-TWFL is an economical fault locator, suitable for one-, two-, and three-terminal applications.

Detect Fault Precursors With Line Monitoring

The line monitoring function in the SEL-TWFL allows you to perform condition-based line maintenance and discover weak spots along the line. The line monitor triggers on current traveling waves launched by fault precursors, such as partial discharge due to a dirty insulator, encroaching vegetation, or an incipient cable fault. The line monitor locates fault precursors with high accuracy, tabulates the precursor events for locations along the line, and alarms if the event count exceeds a user-settable alarm threshold at any location. With this information, you can selectively wash or replace insulators and trim vegetation to reduce line faults.



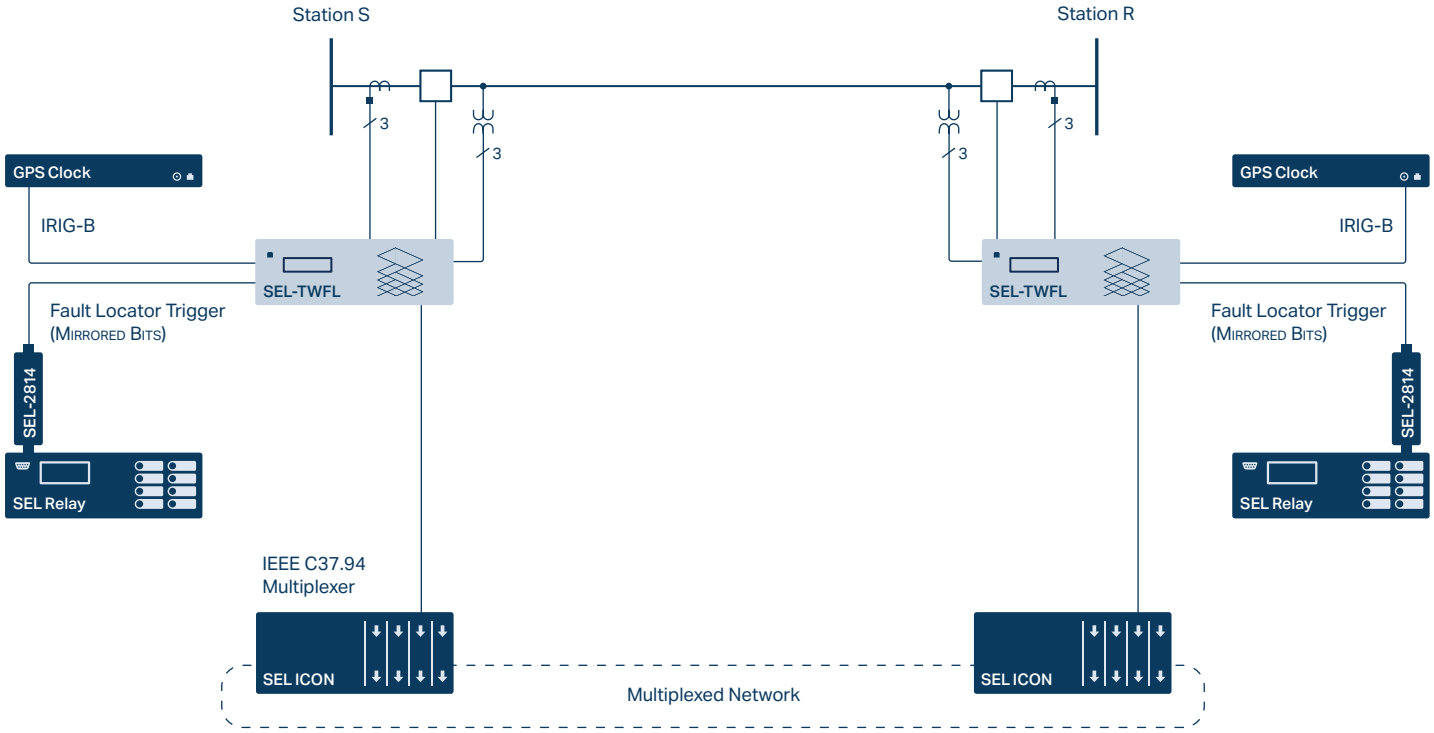
The SEL-TWFL detects, locates, tabulates, and alarms on in-zone events to prevent faults and identify line weak spots.

Analyze High-Frequency Transients Using MHz Recording

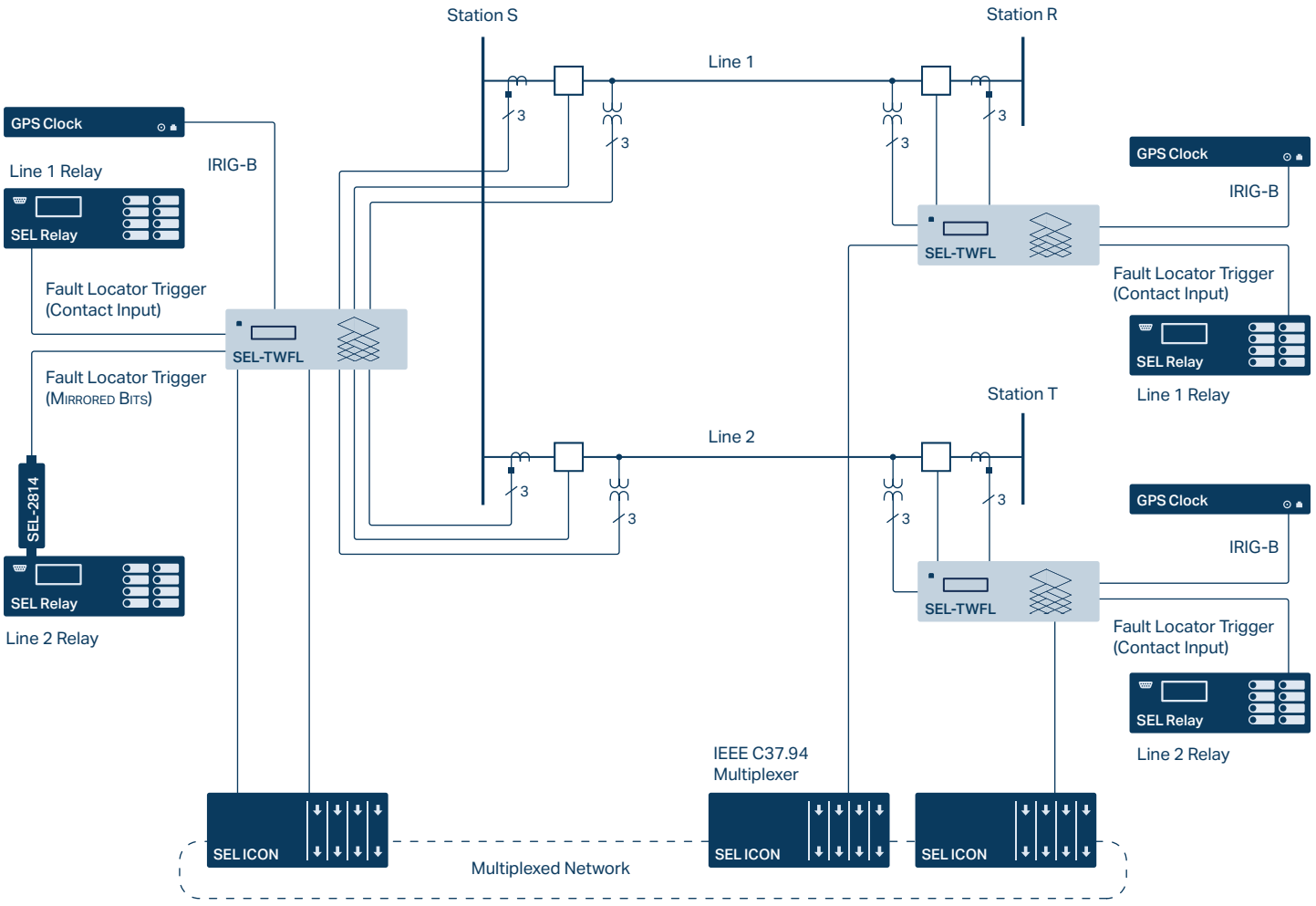
The SEL-TWFL measures and records line currents and voltages (12 channels) with high-fidelity (1 MHz, 18-bit) sampling, offering you an enhanced understanding of the events on your power system. Use these data to analyze high-frequency transients, such as traveling waves from faults, switching events, breaker restrikes, and self-extinguishing faults. The device allows at least 60 seconds of total transient recording time; the longest record length is 1.2 seconds, and the relay stores as many as 50 records that are 1.2 seconds long. The device uses 18 true bits of resolution for excellent data fidelity. You can trigger data capture from any of the Relay Word bits (driven by overcurrent, undervoltage, and overvoltage elements), a contact input, an SEL Mirrored Bits input, or any combination thereof.

Application Examples

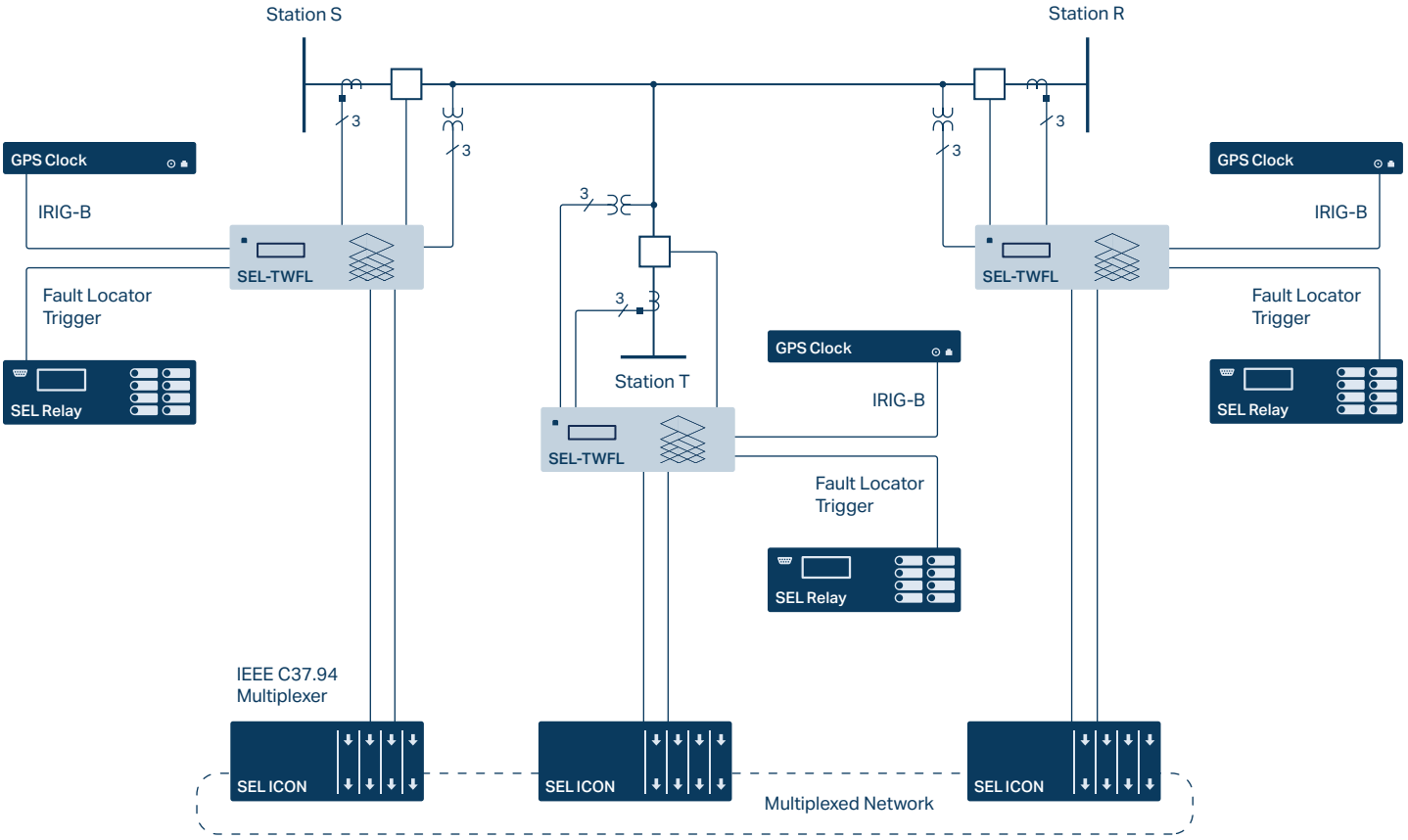
In the following application examples, the SEL-TWFL devices monitor overhead transmission lines with three-pole breakers at each line terminal. Each SEL-TWFL device uses an IEEE C37.94-compliant multiplexer to exchange fault information with the device(s) at the other station(s) to calculate traveling-wave- and impedance-based fault locations. At each line terminal, an SEL protective relay sends fault locator trigger signals to the connected SEL-TWFL by using either MIRRORED BITS communications via an SEL-2814 Fiber-Optic Transceiver With Hardware Flow Control or contact inputs.



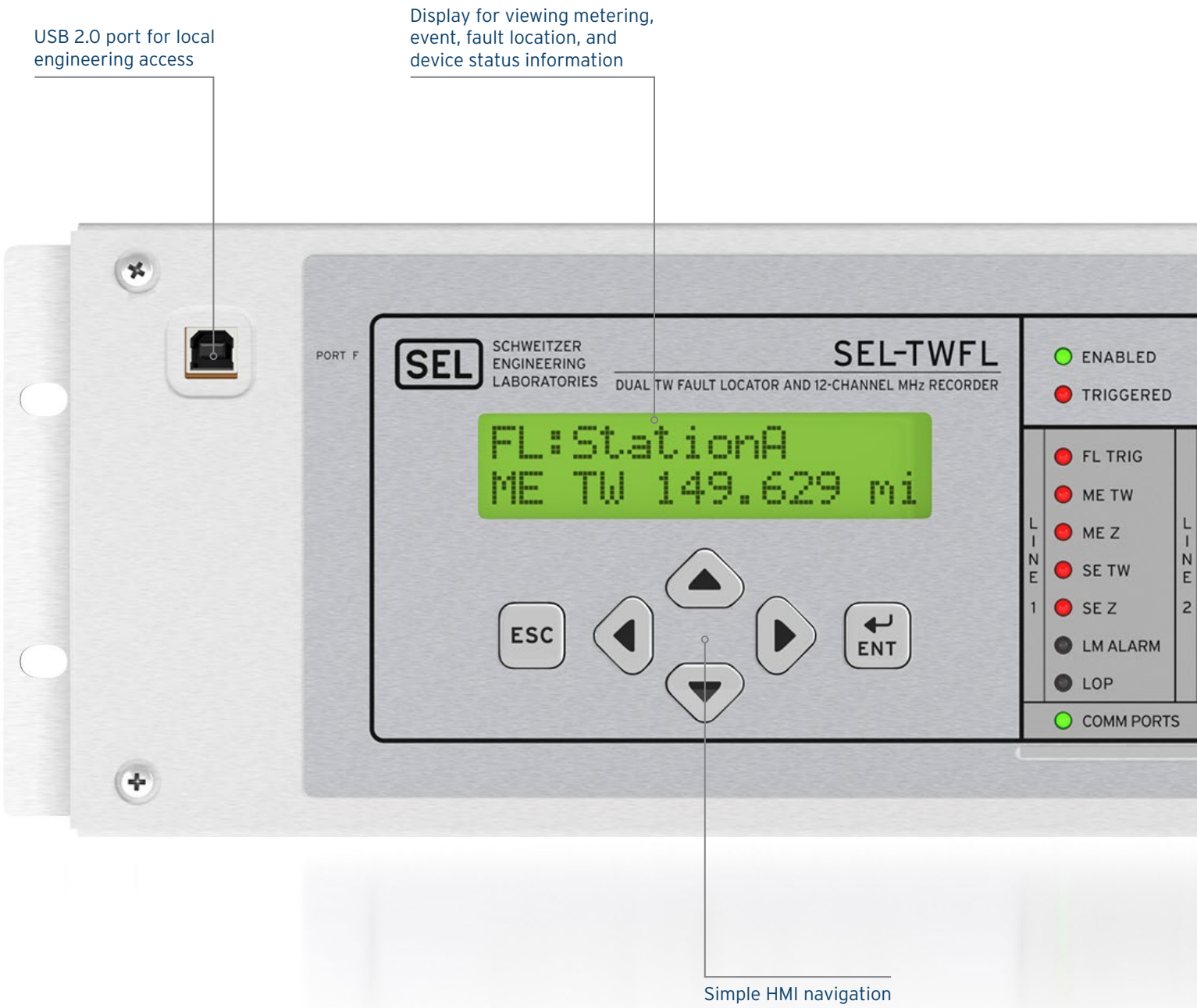
Two SEL-TWFL devices monitor a two-terminal line.



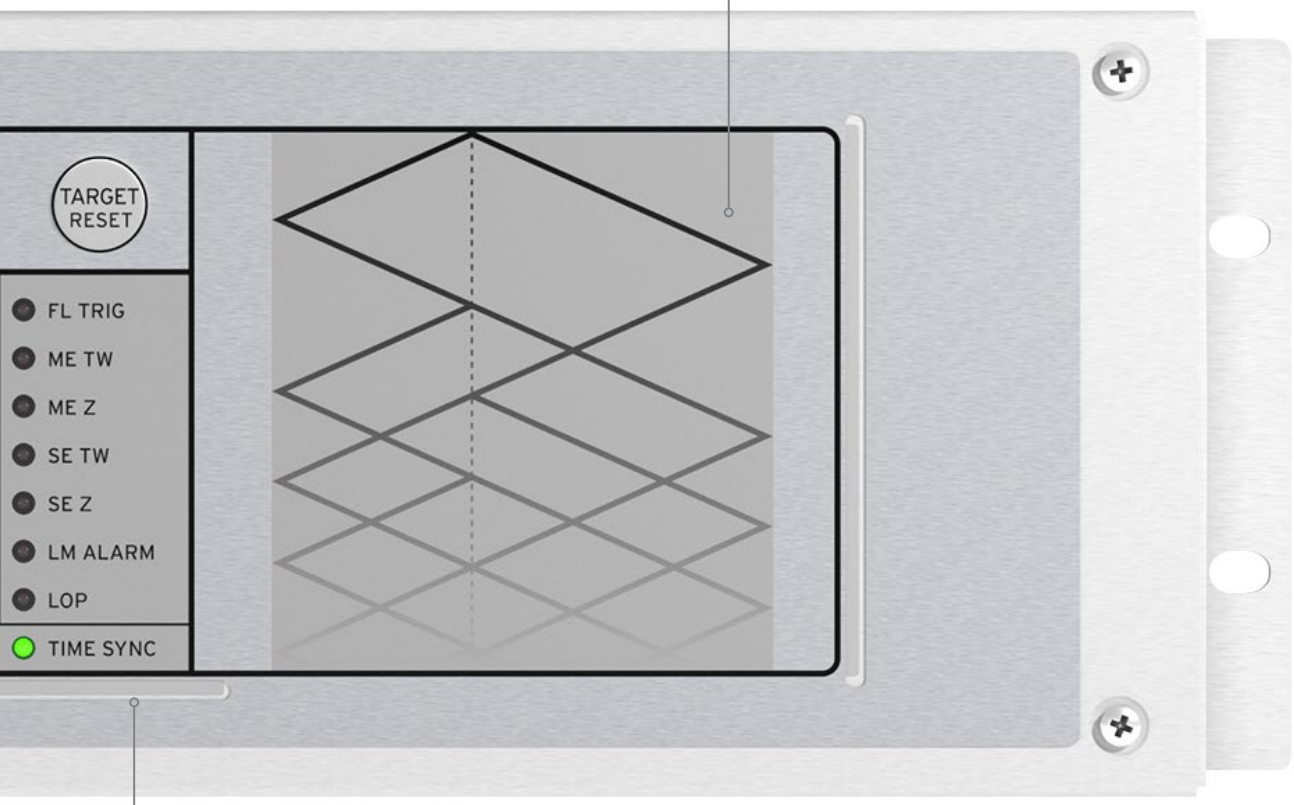
Three SEL-TWFL devices monitor and locate faults on two lines; one SEL-TWFL monitors both lines from Station S.



Three SEL-TWFL devices monitor a three-terminal line.


USB 2.0 port for local engineering access
Display for viewing metering, event, fault location, and device status information
PORT F
SEL
SCHWEITZER ENGINEERING LABORATORIES
SEL-TWFL
DUAL TW FAULT LOCATOR AND 12-CHANNEL MHz RECORDER
FL:StationA
ME TW 149.629 mi
ESC
ENT
ENABLED
TRIGGERED
LINE 1
FL TRIG
ME TW
ME Z
SE TW
SE Z
LM ALARM
LOP
LINE 2
COMM PORTS
Simple HMI navigation

Large slide-in label pocket for
diagrams or asset information



Slide-in label pocket
and LED targets

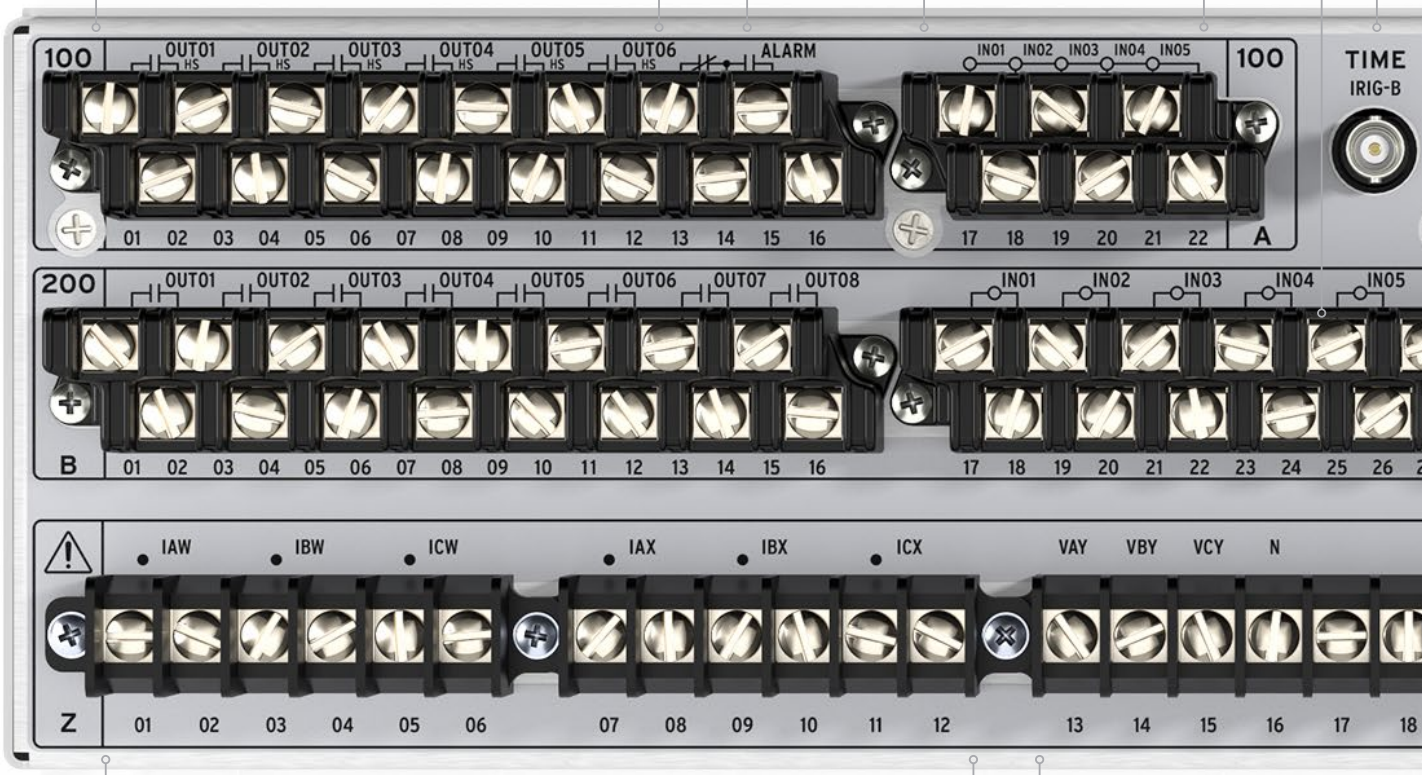
IRIG-B time input

Eight inputs and outputs for digital signaling

Alarm output

Five inputs with a common terminal

Six high-speed, high-current interrupting outputs

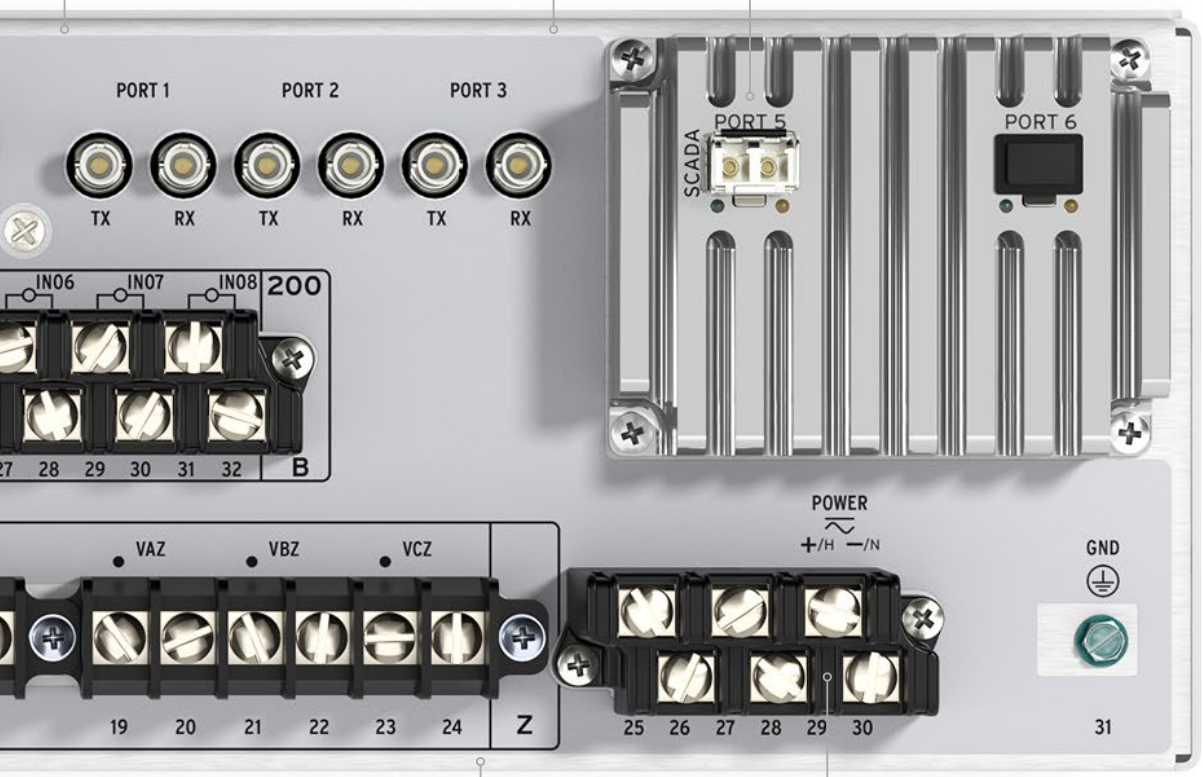


Current inputs for two single-breaker line terminals or one dual-breaker line terminal

Voltage inputs for one or two lines

Three fiber-optic ports for multi-ended fault locating or triggering the fault locator and event recorder (SEL MB8 or IEEE C37.94)

100 Mbps or 1 Gbps small form-factor pluggable (SFP) Ethernet port for engineering access and SCADA



Power supply

SEL-TWFL Specifications

General	
Six AC Current Inputs	Rated input current (5 A model): 5 A Rated input current (1 A model): 1 A Sampling rate: 1 MHz A/D resolution: 18 bits
Six AC Voltage Inputs	Rated voltage range: 57.7—144.3 $V_{L\text{-}N}$ (V_{NOM} = 100—250 $V_{L\text{-}L}$) Connection (voltage input VY): Four-wire connection with a shared neutral Connection (voltage input VZ): Six-wire connection, individually isolated Sampling rate: 1 MHz A/D resolution: 18 bits
Contact Outputs	Rated voltage: 48—250 Vdc Operational voltage range: 0—300 Vdc **Six Fast Hybrid (High-Speed, High-Current Interrupting) Form A Outputs** Operating time (pickup): ≤10 µs (resistive load) **Eight Standard Form A Outputs** Operating time (pickup): ≤6 ms (resistive load) **Alarm Output (Form C)**
Contact Inputs	Optoisolated (bipolar operation): 5 inputs with a shared common terminal; 8 inputs individually isolated Sampling rate: 10 kHz Rated voltage: 48, 110, 125, 220, or 250 Vdc
Three Fiber-Optic Ports	Data rates: 19,200 to 115,200 bps (SEL MIRRORED BITS encoding) or 64 kbps (IEEE C37.94 encoding) Connector type: ST Fiber type and range: Multimode, 2 km for typical continuous fiber-optic cable Wavelength: 820 nm
Front-Panel Port	USB type: 2.0 Connector type: Type B
Fiber-Optic Ethernet Port	Data rate: 100 Mbps or 1 Gbps Connector type: LC Fiber type and range: Multimode, 2 km for typical continuous fiber-optic cable Wavelength: 1,310 nm
Time Input	IRIG-B input format: Demodulated IRIG-B
Power Supply	Rated high-voltage range: 125—250 Vdc, 110—240 Vac Rated medium-voltage range: 48—125 Vdc, 110—120 Vac
Operating Temperature Range	−40° to +85°C (−40° to +185°F)
Weight and Dimensions	3U rack unit; 7.54 kg (16.63 lb) 482.6 W × 132.6 H × 236.4 mm D (19.00 W × 5.22 H × 9.31 in D)

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