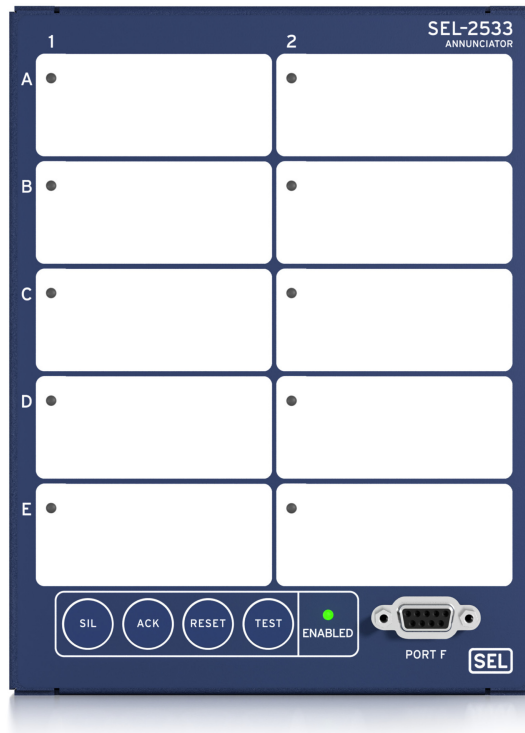# SEL-2533 Annunciator

Compact Annunciation With Complete Alarm Monitoring and Communication

Key Features and Benefits

High Reliability, Low Price

➤ Ten-year, worldwide warranty

➤ –40° to +85°C operating temperature

➤ Ruggedized to meet and exceed industrial and utility standards

Flexible Input, Output, and Logic Choices

➤ Powerful Programmable Logic and Timer Functions

➤ 4 ms Logic Loop Time

➤ EIA-232, EIA-485, and Fiber-Optic Serial Communications

➤ Modbus® RTU, DNP3, MIRRORED BITS® Communications, SEL ASCII, and SEL Fast Messaging

Critical Reporting

➤ 1 ms Accurate Sequential Events Recorder

➤ Storage of as many as 1024 Event Records

➤ IRIG-B time synchronization

Simple Commissioning Tools

➤ Front-Panel Configuration Access

➤ Simple Programming With ACSELERATOR QuickSet® SEL-5030 Software

Product Overview

The SEL-2533 is an advanced ten-window panel that allows complete alarming, notification, reporting, and communication. The SEL-2533 supports many of the standard ISA-18.1 annunciator sequences. It comes standard with 10 alarm windows that can be independently programmed to alarm through contact inputs or communications. The SEL-2533 is designed to read and acknowledge alarms locally or remotely.
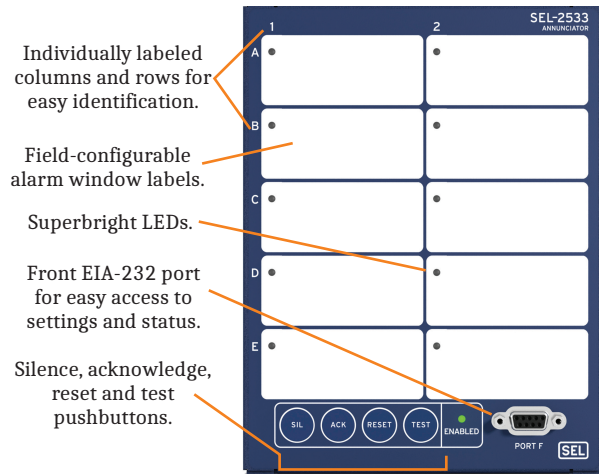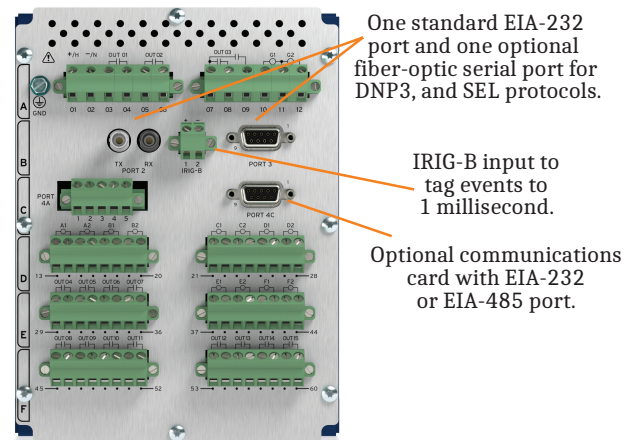

Figure 1   SEL-2533 Front View

Individually labeled columns and rows for easy identification.

Field-configurable alarm window labels.

Superbright LEDs.

Front EIA-232 port for easy access to settings and status.

Silence, acknowledge, reset and test pushbuttons.

Figure 2   SEL-2533 Rear View

One standard EIA-232 port and one optional fiber-optic serial port for DNP3, and SEL protocols.

IRIG-B input to tag events to 1 millisecond.

Optional communications card with EIA-232 or EIA-485 port.

SEL-2533 Base Unit

Standard Features

➤ Ten alarm windows with configurable red or amber LEDs

➤ ISA-18.1 annunciator sequences: A, M, R, F1A, F1M, F2A, F2M, F3A

➤ Two digital inputs and three digital contact outputs

➤ One front and one rear EIA-232 serial port

➤ Internal power supply 24/48 Vdc, 125/250 Vdc, or 120/240 Vac

➤ IRIG-B input with 1 ms SER time-stamping

➤ QuickSet PC software

➤ Ten front-panel alarm points with configurable windows and indicating LED labels

➤ Modbus RTU, MIRRORED BITS, SEL ASCII and Compressed ASCII, SEL Fast Meter, Fast Operate, Fast SER, SEL Fast Message, and Ymodem file transfer protocols

Optional Features

➤ Fiber-optic serial communication port

➤ EIA-232 or EIA-485 serial communications card

➤ DNP3 Level 2 Outstation

➤ Conformal coating

➤ Fourteen digital inputs and fifteen digital outputs

Functional Overview
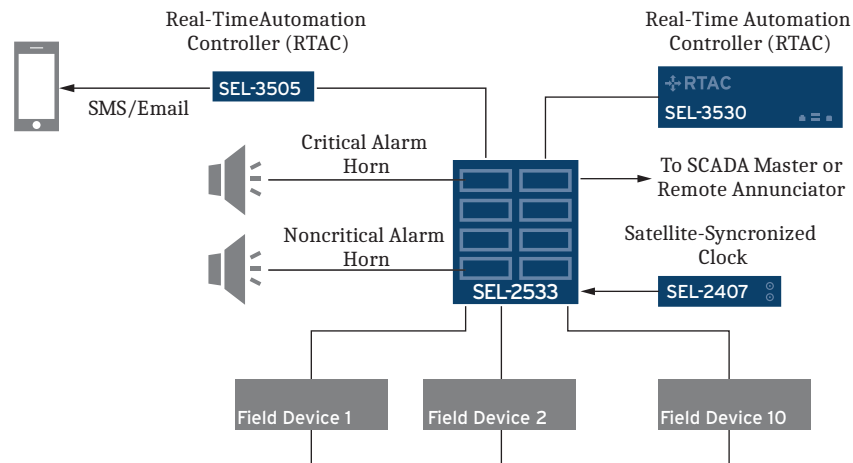
Figure 3 SEL-2533 Functional Diagram

The SEL-2533 is designed to receive station equipment status information through hard-wired contacts or communications devices to provide a single-point alarm station (see *Figure 3*). The SEL-2533 monitors equipment, reports on the status of any equipment that has failed, and notifies local and remote personnel of current conditions. The SEL-2533 provides a safe checkpoint for personnel on-site and a common location where local and remote users can monitor the status of an alarm.

When an alarm condition occurs, the SEL-2533 communicates information to the control center, where the appropriate personnel can be deployed for repair. The SEL-2533 stores the current state of each alarm point in nonvolatile memory. If power is lost at any point, the SEL-2533 will return to the last recorded state upon startup, allowing alarms recorded during power outages to be maintained for post-event analysis.

The SEL-2533 indicates the status of as many as 10 alarm points and can be programmed to indicate as few or as many points as needed for each application. Multiple alarm panels can be used for high-density alarm applications.

Field-configurable labels allow the alarm panel to be customized and modified as needed. A wide range of power supply and contact input voltages allow the SEL-2533 to be installed in virtually any system.

Automation

The SEL-2533 makes it easy to automate a system-wide alarming station. The SEL-2533 comes standard with remote bits, timers, latches, and SELOGIC® variables. Use the logic to replace traditional panel alarms and latching relays, and to eliminate redundant wiring.

Eliminate RTU-to-relay wiring with 40 remote control bits. Set, clear, or pulse remote control bits via serial port commands. Program the remote bits into your control scheme with SELOGIC control equations. Use remote bits for SCADA-type control operations, e.g., alarm trigger, acknowledgment, and device status indication. Replace traditional latching relays for such functions as "remote control enable," "auto acknowledge," or "silence" with 32 latching control bits. Program latch set and latch reset conditions with SELOGIC control equations. Set or reset the latch bits via optoisolated inputs, remote bits, or any programmable logic condition. The latch bits retain their state when the device loses power.

Control Inputs and Outputs

The SEL-2533 comes standard with two independent control inputs and three Form A outputs. The annunciator can be ordered with as many as 14 inputs, and 15 outputs.

The control inputs can be ordered to any of the standard control input voltages found on station battery systems. Each input has programmable debounce settings to help ride through false operations of connected equipment. Each input has an ac setting that allows you to connect the input to an ac voltage source. This setting allows the SEL-2533 to recognize a proper on/off state when a sinusoidal waveform is applied.

The outputs are all 6 A continuous-carry contacts. The contact can be used to trigger-on critical or noncritical alarms sent to an internal horn. The contact can be used to connect a strobe light or large display LED to trigger-

off any of the 10 alarm points. This provides maintenance crews with a highly visible alert should a problem arise.

Output 3 is a Form C contact that can be used either as a standard output contact or as an alarm status (default). The alarm status will close the contact any time the SEL-2533 encounters hardware or software issues such as Flash failure, power supply failure, RAM failure, or EEPROM failure.

Configurable Labels

Each SEL-2533 comes with a set of configurable labels. Use the labels to uniquely identify each alarm point LED. Preprinted labels are included (with factory default text), as are blank label media and a Microsoft Word template on CD-ROM. This allows you to quickly make professional-looking labels for the SEL-2533. Blank stock labels are also provided for hand-written customization. These customization features allow easy implementation without the need for adhesive labels.

Fast SER Protocol

SEL Fast Sequential Events Recorder (SER) protocol provides SER events to an automated data collection system. SEL Fast SER protocol is available on any serial port set as "SEL" protocol. Devices with embedded processing capability use these messages to enable and accept unsolicited binary SER messages from an SEL-2533.

SEL relays and communications processors have two separate data streams that share the same serial port. The normal serial interface consists of ASCII character commands and reports that are intelligible to users with a terminal or terminal emulation package. The binary data streams interrupt the ASCII data stream to obtain information, and allow the ASCII data stream to continue. This mechanism allows a single communications channel for ASCII communications (e.g., transmission of a long event report) interleaved with short bursts of binary data to support fast acquisition of metering or SER data.

Integration

The SEL-2533 is equipped with as many as four independently operated serial ports: one EIA-232 port on the front, one EIA-232 port on the rear, one optional fiber-optic port, and one EIA-232 or EIA-485 port option card. The SEL-2533 comes standard with ACSELERATOR QuickSet software to aid in setting the SEL-2533. The SEL-2533 supports settings from a standard ASCII terminal.

The SEL-2533 is designed to easily establish communications to the following:

➤ Connected computers, modems, and protocol converters
➤ An SEL Real-Time Automation Controller (RTAC) or computing platform (e.g., SEL-3530, SEL-3350, or SEL-3355)
➤ SCADA serial ports, and/or RTUs for local or remote communication

Apply an RTAC as the hub of a star network with point-to-point fiber or copper connections between the hub and the SEL-2533 (see *Figure 4*). The communications

processor supports external communications links, including the public switched telephone network for engineering access to dial-out alerts, and private line connections of the SCADA system. SEL manufactures a variety of standard cables for connecting relays to a variety of external devices. Consult your SEL representative for more information.

The SEL-2533 comes with several standardized protocols to make communications, operations, and alarm acknowledgment easy. *Table 1* lists the various protocols that the SEL-2533 supports.
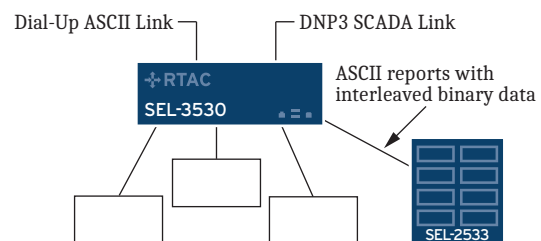
Figure 4   Example Communications System

Table 1   Open Communications Protocols

| Type	Description
Simple ASCII	Plain language commands for human and simple machine communications; use for settings, self-test status, SER reporting, and other functions
Extended Fast Meter and Fast Operate	SEL binary protocol for machine-to-machine communications; quickly updates SEL RTACs (SEL-3530, SEL-3350, and SEL-3555), SEL computing platforms (SEL-3350, SEL-3355, and SEL-3560), RTUs, and other substation devices with device elements, I/O status, time-tags, control commands, and SER; data are checksum protected; binary and ASCII protocols operate simultaneously over the same communications lines so control operator information is not lost while a technician is transferring an event report.
DNP3 Level 2 Outstation	Distributed Network Protocol with point remapping; includes access to alarm points, contact I/O, targets, and SER
Fast SER Protocol	Provides SER events to an automated data collection system
Modbus	Modbus; includes access to alarm points, device status, contact I/O, device targets, and SER

MIRRORED BITS Relay-to-Relay Communications

The SEL-patented MIRRORED BITS communications technology provides bidirectional device-to-device digital communications. MIRRORED BITS can operate independently on as many as two serial ports on a single SEL-2533 Annunciator. This bidirectional digital communication creates eight additional virtual outputs (transmitted MIRRORED BITS) and eight additional virtual inputs (received MIRRORED BITS) for each serial port operating in the MIRRORED BITS mode. Use these MIRRORED BITS to quickly transmit and receive information from devices, external I/O, or Programmable Automation Controllers already connected to the power system. The communications channel provides a fast, efficient, and simple way of alarming the SEL-2533 without extra wiring. Each MIRRORED BITS channel is monitored for integrity. A communications log tracks the communications status and channel availability, and the SEL-2533 will alarm for any channel or device failures.

Configuration and Commissioning

The included QuickSet software simplifies device configuration in addition to providing the following commissioning and analysis support for the SEL-2533 Annunciator:

➤ Access settings creation help online

➤ Organize settings with the device database manager

➤ Load and retrieve settings using a simple PC communications link

➤ Analyze SER records to verify alarm operation (see *Figure 8*)

➤ Use the PC interface to remotely retrieve reports and other system data

➤ Monitor alarm operation and status during commissioning tests

➤ Operate and monitor the device remotely from a virtual front panel (see *Figure 7*)
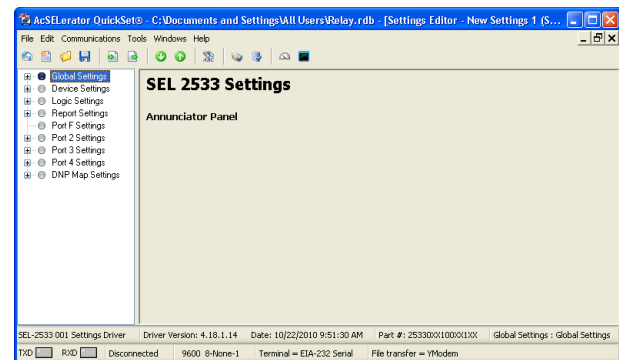
Figure 5   Develop Settings Off-Line With an Intelligent Settings Editor That Only Allows Valid Settings
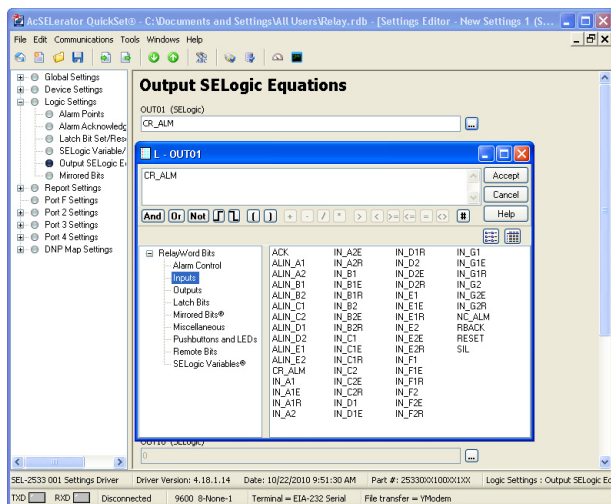
Figure 6 Create SELogic **Control Equations With a Drag-and-Drop Editor and a Text Editor**
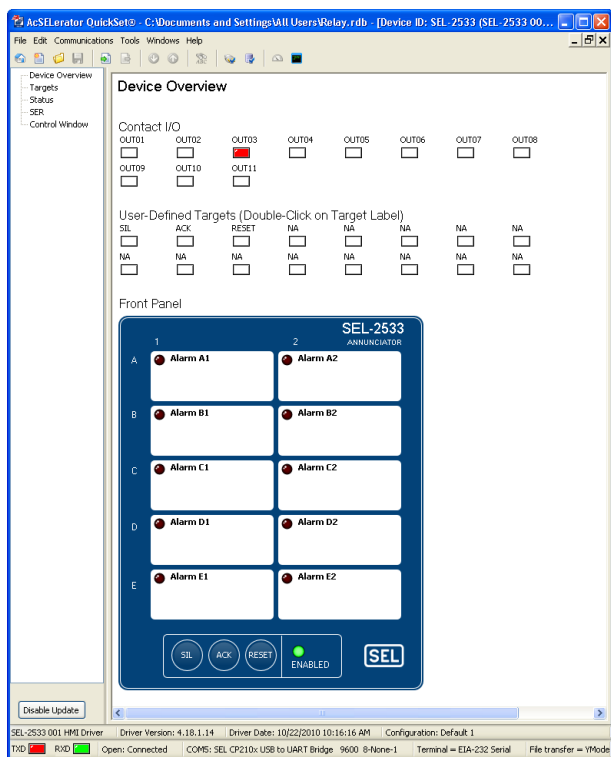

Figure 7 View Device Overview Display With ac**SEL**erator **QuickSet Software**

Sequential Events Recorder (SER) for Your Digital I/O

The SER records as many as 1024 state changes to the millisecond for as many as 96 digital points, and captures the time of device power-up and settings changes. The SEL-2533 Annunciator comes standard with alias names for each element. Each defined SER point can be assigned different element names for the asserted and deasserted state. Assigning familiar names for each element provides the SER record reviewer with a clear, at-a-glance view of an event. *Figure 8* shows an example of an SER report.

Control inputs are time-tagged and accurate to the millisecond. All other Device Word bits are time-stamped to the millisecond and processed every four milliseconds.
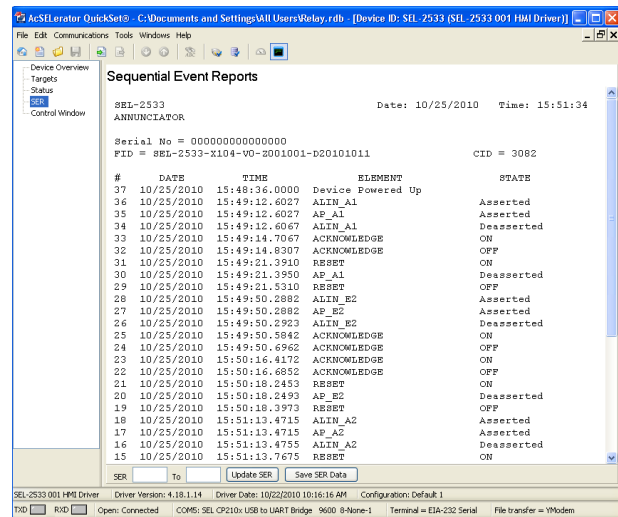

Figure 8 Example SER Report

Time Synchronization

The SEL-2533 can be time-synchronized through several different time sources. The IRIG-B input is the most accurate, and can be wired either through the separate IRIG-B input (see *Figure 10*) or through Port 3 on pins 4 and 6. The time code input synchronizes the SEL-2533 control inputs to within ±1 ms and all other SER time-stamped data to ±4 ms of the time-source input. *Figure 10* shows the location of the IRIG-B ports on Card B. The SEL-2533 can also be time-synchronized through DNP via any of the rear serial ports set to "DNP" protocol. Although the system times can vary, the accuracy will typically be 5 to 10 ms. As a last resort, the SEL-2533 can be manually set to the correct time.
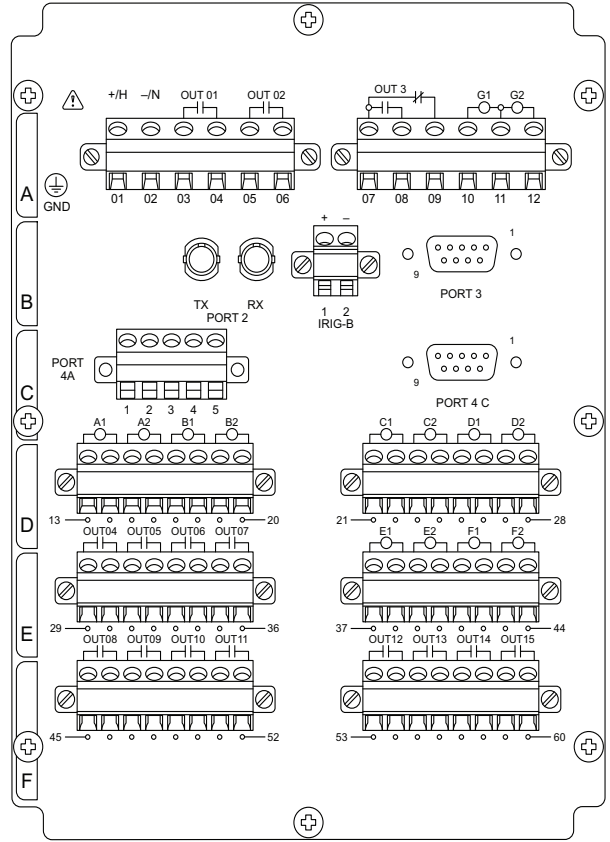
Diagrams and Dimensions
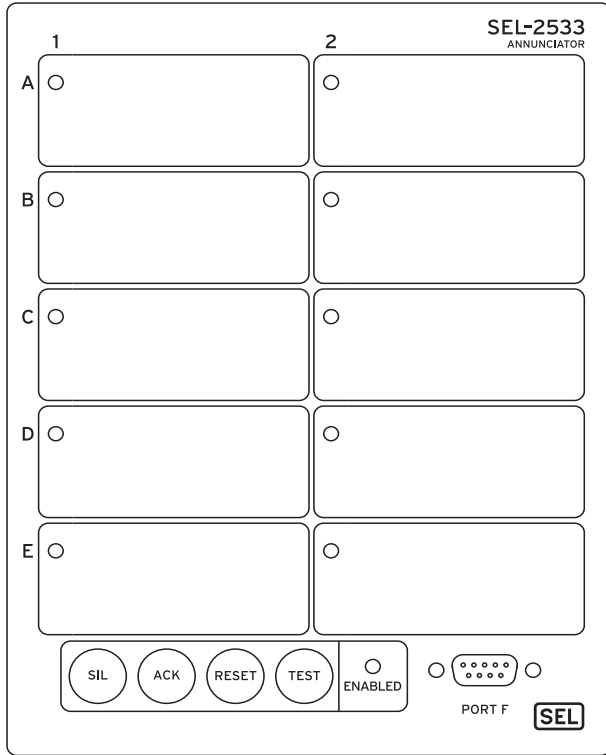
Figure 9   SEL-2533 Panel Mount

Figure 10   SEL-2533 Rear Panel
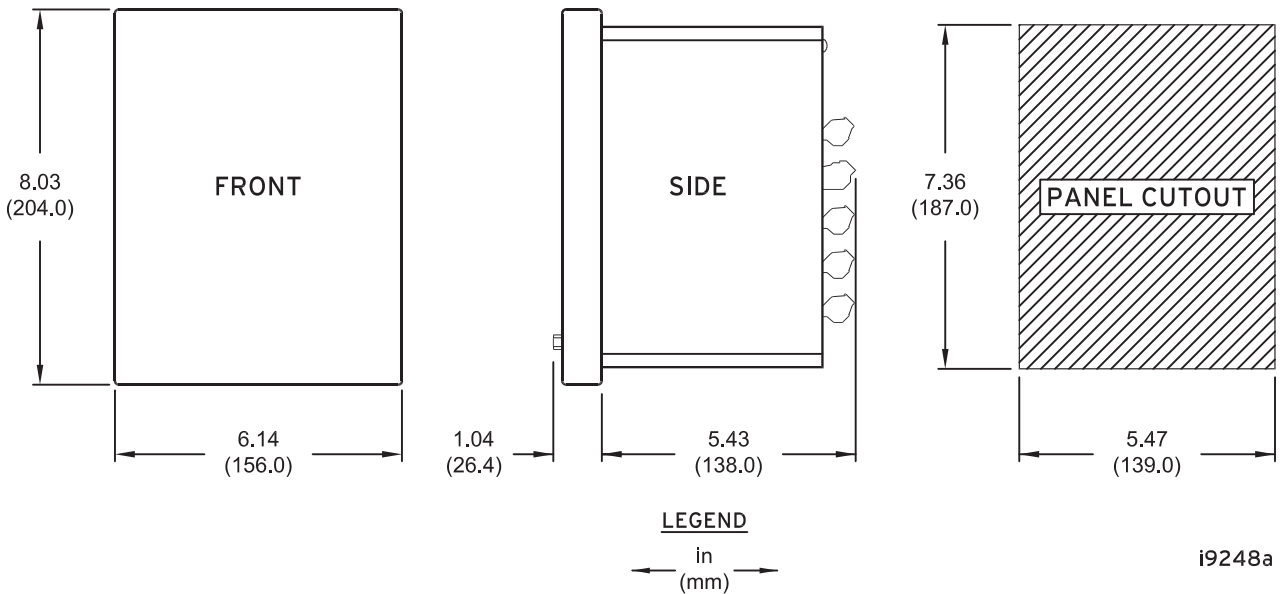
CHASSIS

Figure 11   SEL-2533 Dimension Diagram

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

UL Listed to U.S. and Canadian safety standards (File E220228; NRAQ, NRAQ7)

FCC: 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 operated 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

Temperature Range

–40° to +85°C (–40° to +185°F), per IEC 60068-2-1 and 60068-2-2

> **Note:** Not applicable to UL applications.

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Relative Humidity:	5–95%, noncondensing
Maximum Altitude:	2000 m

Weight

4.2 kg (10 lb)

Printable Window Size

30.5 mm x 61 mm (1.20" x 2.40")

Inputs

Optoisolated Control Inputs

When Used With DC Control Signals

250 V	ON for 200–275 Vdc	OFF below 150 Vdc
220 V	ON for 176–242 Vdc	OFF below 132 Vdc
125 V	ON for 100–137.5 Vdc	OFF below 75 Vdc
110 V	ON for 88–121 Vdc	OFF below 66 Vdc
48 V	ON for 38.4–52.8 Vdc	OFF below 28.8 Vdc
24 V	ON for 15–30 Vdc	OFF for <5 Vdc

When Used With AC Control Signals

250 V	ON for 170.6–300 Vac	OFF below 106 Vac
220 V	ON for 150.3–264 Vac	OFF below 93.2 Vac
125 V	ON for 85–150 Vac	OFF below 53 Vac
110 V	ON for 75.1–132 Vac	OFF below 46.6 Vac
48 V	ON for 32.8–57.6 Vac	OFF below 20.3 Vac
24 V	ON for 14–27 Vac	OFF below 5 Vac

Current Draw at Nominal DC Voltage:	2 to 4 mA (except for 24 V, 8 mA)
Rated Insulation Voltage:	300 Vac
Rated Impulse Withstand Voltage (U_{imp}):	4000 V

Time-Code Input

Format:	Demodulated IRIG-B
On (1) State:	$V_{ih} \geq 2.2$ V
Off (0) State:	$V_{il} \leq 0.8$ V
Input Impedance:	2 kΩ
Accuracy:	±1 ms

Outputs

General

OUT11 is Form C Trip Output, all other outputs are Form A.

Dielectric Test Voltage:	2000 Vac
Impulse Withstand Voltage (U_{imp}):	4000 V
Mechanical Durability:	10,000 no load operations

DC Output Ratings

Electromechanical

Rated Operational Voltage:	250 Vdc
Rated Voltage Range:	19.2 to 275 Vdc
Rated Insulation Voltage:	300 Vdc
Make:	30 A @ 250 Vdc per IEEE C37.90

> **Note:** Make rating per IEEE C37.90:1989.

Continuous Carry:	6 A @ 70°C; 4 A @ 85°C
Thermal:	50 A for 1 s
Contact Protection:	360 Vdc, 40 J MOV protection across open contacts
Operating Time (coil energization to contact closure, resistive load):	Pickup or dropout time ≤8 ms typical

Breaking Capacity (10,000 operations) per IEC 60255-0-20:1974:

24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

Cyclic Capacity (2.5 cycles/second) per IEC 60255-0-20:1974:

24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

> **Note:** Per IEC 60255-23:1994, using the simplified method of assessment.

AC Output Ratings

Electromechanical

Maximum Operational Voltage (U_e) Rating:	240 Vdc
Insulation Voltage (U_i) Rating (excluding EN 61010-1):	300 Vac
Voltage Protection Across Open Contacts:	270 Vac, 40 J
Rated Operational Current (I_e):	3 A @ 120 Vac; 1.5 A @ 240 Vac

Conventional Enclosed

Thermal Current (I_{the}) Rating:	5 A
Rated Frequency:	50/60 ± 5 Hz

Pickup/Dropout Time:	≤8 ms (coil energization to contact closure)
Electrical Durability Make VA Rating:	3600 VA, cosϕ = 0.3
Electrical Durability Break VA Rating:	360 VA, cosϕ = 0.3

Communications

Communication Ports

Standard EIA-232 (2 Ports)

Location (fixed):	1 front panel 1 rear panel
Data Speed:	300–38400 bps

Multimode Fiber-Optic Serial Port (Ordering Option)

Class 1 LED Product:	Complies with IEC 60825-1:1993 + A1:1997 + A2:2001

Optional Communications Card

Standard EIA-232 or EIA-485 (Ordering Option)

Data Speed:	300–38400 bps

Fiber-Optic Serial Port Characteristics

Wavelength:	820 nm
Optical Connector Type:	ST
Fiber Type:	Multimode
Link Budget:	8 db
Typical TX Power:	–16 dBm
RX Min. Sensitivity:	–24 dBm
Fiber Size:	50–200 μm
Approximate Range:	~2 km with 62.5 μm, ~1 km with 200 μm
Data Rate:	300–38400 bps
Typical Fiber Attenuation:	–4 dB/km

Protocols

Modbus RTU slave

DNP3 Level 2 Outstation (Serial)

SEL Mirrored Bits (MBA, MBB, MB8A, MB8B)

Ymodem file transfer on the front and rear ports

Xmodem file transfer on the front port

SEL ASCII and Compressed ASCII

SEL Fast Meter

SEL Fast Operate

SEL Fast SER

SEL Fast Message read request

SEL Messenger Points

Maximum Concurrent Connections

DNP3 Level 2 Outstation:	3
Modbus Slave:	3

Power Supply

Rated Supply Voltage

Low-Voltage Model:	24/48 Vdc
High-Voltage Model:	125/250 Vdc 110/240 Vac, 50/60 Hz

Input Voltage Range

All Models:	±10% of Rated Supply Voltage

Power Consumption

AC:	<40 VA
DC:	<15 W

Interruptions

Low-Voltage Model:	10 ms @ 24 Vdc 50 ms @ 48 Vdc
High-Voltage Model:	50 ms @ 125 Vac/Vdc 100 ms @ 250 Vac/Vdc

Sampling and Processing Specifications

Digital Inputs

Sampling Rate:	2 kHz

Contact Outputs

Refresh Rate:	2 kHz
Logic Update:	Every 4 ms
Control Processing:	Every 4 ms

Type Tests

Environmental Tests

Enclosure Protection:	IEC 60529:2001 IP40 front panel and IP20 for rear terminals
Vibration Resistance:	IEC 60255-21-1:1988, Class 1 IEC 60255-21-3:1993, Class 2
Shock Resistance:	IEC 60255-21-2:1988, Class 1
Cold:	IEC 60068-2-1:2007 16 hr at –40°C
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25° to 55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:2007 16 hr at +85°C

Dielectric Strength and Impulse Tests

Dielectric (HiPot):	IEC 60255-5:2000 IEEE C37.90-2005 2.0 kVac on contact I/O 2.83 kVdc on power supply
Impulse:	IEC 60255-5:2000 IEEE C37.90:2005 0.5 J, 5 kV on power supply, contact I/O

RFI and Interference Tests

EMC Immunity

Electrostatic Discharge Immunity:	IEC 61000-4-2:2001 Severity Level 4 8 kV contact discharge 15 kV air discharge IEEE C37.90.3-2001 8 kV contact discharge 15 kV air discharge
Radiated RF Immunity:	IEC 61000-4-3:2008, 10 V/m IEEE C37.90.2-2004, 35 V/m
Fast Transient, Burst Immunity:	IEC 61000-4-4:2004 + CRGD:2006 4 kV @ 5.0 kHz 2 kV @ 5.0 kHz for comm. ports

Surge Withstand Capability:	IEC 60255-22-1:2005
	2.5 kV common-mode
	1 kV differential-mode
	IEEE C37.90.1-2002
	2.5 kV oscillatory
	4 kV fast transient
Conducted RF Immunity:	IEC 61000-4-6:2008, 10 Vrms

EMC Emissions

Radiated and Conducted Emissions:	IEC 60255-25:2000
	Canada ICES-001 (A) / NMB-001 (A)

Power Interruption Tests

Interruptions:	IEC 61000-4-11:2004 Voltage Dips

Operating Sequences

All per ISA-18.1-1979 (R1992)

Sequence M—Manual Reset
Ringback Sequence—Ringback
Sequence A—Automatic Reset
Sequence F2A—Automatic Reset First Out With no Subsequent Alarm Flashing
Sequence F1M—Manual Reset First Out With no Subsequent Alarm State
Sequence F1A—Automatic Reset First Out With no Subsequent Alarm State
Sequence F2M—Automatic Reset First Out With no Alarm Flashing
Sequence F3A—Automatic Reset First Out With First Out Flashing and Reset Pushbutton

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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