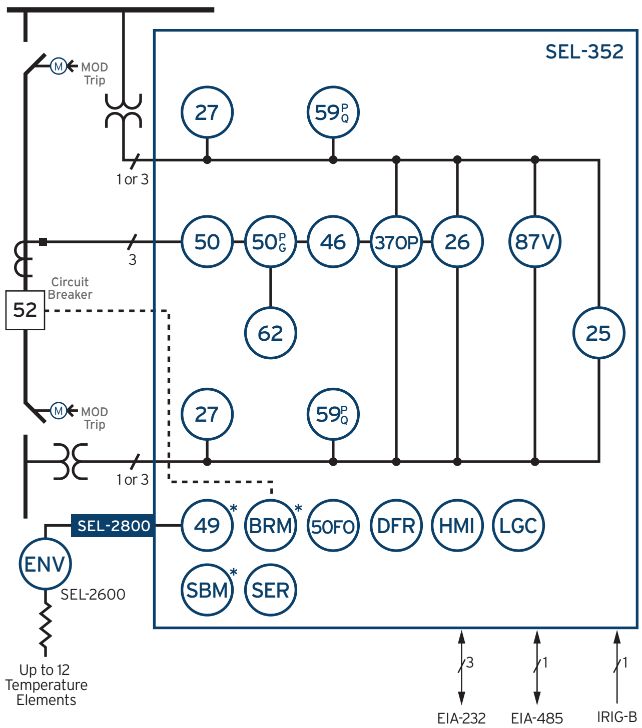
SEL-352 Data Sheet

Breaker Failure Relay, Control Relay, Data Recorder

Major Features and Benefits

- **Circuit Breaker Failure Detection:**
  - Failure while tripping fault conditions
  - Failure while tripping load conditions
  - Failure to close (pole disagreement detection)
  - Failure while open (breaker pole flash-over detection)
  - Failure to complete a trip or close (resistors still inserted)
  - Loss-of-dielectric pressure
- **Control Logic:**
  - Motor-operated disconnect (MOD) trip and power circuit breaker isolation security logic
  - Retripping (instantaneous and time-delayed)
  - Point-on-Wave (POW) breaker control functions
  - Synchronism checking close logic
  - Trapped charge polarity detection
- **Data Recording:**
  - Event report provides 8 seconds of analog fault data and digital oscillography data at 64 samples per cycle
  - 512 Sequential Event Recorder (SER) reports (inputs, outputs, and relay elements)
  - 512 breaker operation events
  - Six voltage measurements
  - Three current measurements
- **Additional Features:**
  - Multiple I/O configurations
  - SELOGIC® control equations:
    Modify default schemes
    Complete custom applications
    Design a recloser
  - Programmable targets for testing
  - Detailed metering
  - Three EIA-232 serial ports
  - EIA-485 serial port
  - Front-panel display:
    Setting and monitoring functions
  - Automatic self-tests
  - Clock synchronization input, IRIG-B
  - Optional DNP3 Level 2 Slave

Functional Overview



ANSI NUMBERS/ACRONYMS AND FUNCTIONS	
25	Synchronism Check
26	Insertion Resistor Thermal
27	Undervoltage
37OP	Breaker Overpower
46	Current Unbalance
49	Thermal*
50	RMS Overcurrent
50FO	Flashover Overcurrent
50 (P, G)	Overcurrent (Phase, Ground)
59 (P, Q)	Overvoltage (Phase, Neg. Seq.)
62	Breaker Failure Timer
87V	Voltage Differential
DFR	Event Reports
ENV	SEL-2600
HMI	Operator Interface
LGC	SELOGIC® Control Equations
SER	Sequential Events Recorder

ADDITIONAL FUNCTIONS	
BRM	Breaker Wear Monitor*
SBM	Station Battery Monitor*

* Optional Feature

Figure 1 Functional Diagram

General Description

The SEL-352 relay is a single- or three-pole breaker failure detection, breaker control, and data recording device. Each of the protection schemes is implemented in SELOGIC control equations, giving relay engineers unparalleled flexibility in adapting the relay to their needs. The relay provides classical overcurrent-based breaker failure protection for a wide variety of breaker arrangements. Additionally, protection is provided for circuit breaker trip and close resistors, for current through an open breaker, and for breaker flashover.

Logic to control the closing and opening of the circuit breaker is also included. Additional features include metering, sequence-of-event reporting, digital fault recording, remote setting capabilities, breaker operating time monitors, energy interruption monitors, and breaker resistor thermal protection. Simple hardware design and efficient digital signal processing ensure reliability. Extensive self-testing and communication capabilities enhance availability.

Figure 2 shows a single-phase diagram of the ac connections. All nine connections are not required for most relay functions.

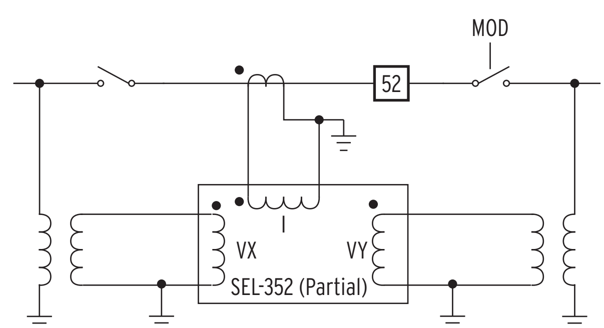


Figure 2 Single-Phase Diagram of AC Inputs to the Relay

Circuit Breaker Failure Detection

The SEL-352 has five fault current-driven breaker failure detection schemes, including one specifically designed for ring-bus or breaker-and-a-half applications. Tailor the relay to your circuit breaker failure detection requirements by selecting the most appropriate scheme or use SELOGIC control equations to implement your own scheme.

The relay detects failures to interrupt fault, load, or line-charging current. It also detects failure of breaker poles to complete a close sequence and can detect open breaker flashover failures. If trip or close resistors remain in service after an operation, the relay detects this failure by using a thermal model.

Independent phase current detectors, protection logic, and timers make the relay easy to apply on both simple systems and more complicated breaker arrangements such as single-pole trip installations.

The SEL-352 stores summaries of the last 512 breaker operations in nonvolatile memory. Event type, maximum current, mechanical and electrical operating times, and breaker energy are stored along with the date and time of operation. Using this breaker history, you can monitor breaker wear and effectively schedule routine breaker maintenance.

When a MOD switch is used with the protected breaker, the SEL-352 can trip the MOD to isolate the failed breaker when phase current drops below a settable value. When a MOD is not installed, use the MOD logic to indicate a “Safe to Disconnect” condition to personnel.

The relay also includes SELOGIC control equations, which allow you to configure the programmable outputs to operate when any of the protective elements pick up. You can implement complete application-specific protective schemes with a minimum of wiring and panel space. SELOGIC control equations also simplify relay testing.

Control Logic

Control logic provides flexibility for closing, opening, and tripping. For minimal breaker wear, the SEL-352 can be used to close the breaker at an optimum time. Close using a simple pole staggered close or use complete control by monitoring synchronism, trapped charge polarity, and zero crossings. Use controlled breaker opening in the SEL-352-2 and SEL-352-3 for synchronizing the maximum breaker contact separation to peak or zero voltage crossings to help reduce the occurrence of re-strike in reactive loads. Use ambient temperature and dc control voltage monitoring to compensate for variations in breaker close and opening times in the controlled opening and closing schemes. Control breaker tripping through lockout and reset conditions, instantaneous retripping, and time-delayed retripping.

Use the flexible SELOGIC control equations to create your own recloser, implement manual closing supervision, and /or change existing control logic to meet your needs.

Data Recording

A wide range of user-selectable events trigger the sequence-of-events recording and digital fault recording (DFR) functions, including any input or output assertion. Breaker Failure Trip (86BFT) output assertion automatically generates a DFR record, and you can set the relay to trigger an event for OPEN, CLOSE, or TRIP input assertions. This ensures a record of every normal circuit breaker operation as well as every circuit breaker failure.

The recorded data contain all information needed to determine the cause of relay and breaker operations. The data collected include current through the circuit breaker, voltage on both sides of the circuit breaker, input, output, and relay element data. Parameters such as event type, relay response time, circuit breaker operation time, currents, voltages, and breaker power dissipation appear directly in the breaker monitor report or can be calculated from the data stored. All event reports are time tagged by a self-contained clock/calendar.

Additional Features

Additional features make the SEL-352 reliable and economical. The communication functions provide remote and local examination of a wide range of data, including the voltages and currents presented to the instrument, relay settings, history of events, breaker alarms, sequence-of-events, and self-test status data. You can enter and modify relay settings remotely; you can also control all outputs via the communications channel.

A three-level password scheme protects settings and circuit breaker control. The SEL-352 monitors password execution and closes the ALARM contact output to indicate possible unauthorized access. The relay requires no special communications software. Access the relay with a dumb terminal, printing terminal, or computer with serial port and terminal emulation software. The SEL-5010 Relay Assistant is also available for communication and settings database management.

Circuit Breaker Failure Detection

Protection Overview

The SEL-352 provides protection for several circuit breaker failure modes:

- Failure to clear a fault (five available schemes)
- Failure to trip during load conditions (two available schemes)
- Failure to complete trip sequence because of trip resistor(s) remaining inserted
- Failure to complete close sequence because of close resistor(s) remaining inserted
- Failure to close: pole disagreement detection
- Failure while open: breaker pole flashover detection
- Loss of dielectric pressure

Protection While Tripping Fault Current

The SEL-352 provides five different protection schemes to detect the failure of the circuit breaker to clear a fault. While the schemes share elements and timers, each is independent. You may enable only one protection scheme at a time. The SEL-352 applies the single chosen scheme to all three breaker poles. The SEL-352 provides instantaneous overcurrent elements (50FT) with fast reset times, even in the presence of subsidence current after the breaker opens.

In ring-bus and breaker-and-a-half installations, two circuit breakers must operate to interrupt line current. Current distribution between the two breakers is unknown until the first breaker opens. This causes an uncertainty with respect to the timing of 50FT overcurrent element assertion. This uncertainty is not present in a single breaker arrangement.

Timing uncertainty is accounted for in the SEL-352 breaker failure detection schemes intended for these complex bus/breaker arrangements. The SEL-352 is intended to monitor a single breaker, regardless of the bus/breaker arrangement. In breaker-and-a-half and ring-bus arrangements, you must use an independent breaker failure relay for each breaker.

An overview of the five protection schemes is shown below.

Scheme 1: Protection for Simple and Complex Arrangements

In this scheme, the breaker failure timer starts independently from 50FT assertion. This independence allows scheme usage in bus configurations where the 50FT element may assert after trip input assertion, such as ring-bus and breaker-and-a-half bus arrangements.

Logic latches in the trip signal so that trip signal dropout does not affect the breaker protection scheme.

Scheme 2: Basic Protection for Simple Arrangements

In a single breaker arrangement, fault current causes 50FT assertion immediately after fault inception and just prior to trip input assertion. In Scheme 2, the breaker failure timer does not start until the trip input and 50FT element are asserted. This allows definite, predictable scheme timing in single-breaker configurations.

Scheme 3: Simple Arrangement Protection Independent of 50FT Reset Time

Scheme 3 is intended for a single breaker arrangement. When a fault occurs, 50FT asserts. The line protective relay asserts the SEL-352 trip input, and the breaker failure timer starts. If the trip input and 50FT are asserted until the timer expires, a breaker failure condition is declared.

In Scheme 3, the trip input must remain asserted while current flows in the protected breaker. Scheme 3 resets when either the trip input deasserts or the 50FT element drops out.

Scheme 4: Sensitive Scheme for Simple or Complex Arrangements

When the SEL-352 trip input is asserted, the breaker failure pickup timer starts. The trip input is latched and may be deasserted after a single quarter-cycle assertion. The breaker failure timer output asserts a settable time after a trip input asserts and remains asserted for a settable dropout time. A breaker failure condition is declared if the timer output is high and the phase 50FT element is asserted.

Scheme 5: Scheme for Simple or Complex Arrangements

When the trip input is asserted, the breaker failure timer starts. If 50FT is asserted when the timer expires, a breaker failure condition is declared. If the trip input deasserts or 50FT drops out before the timer expires, the logic resets.

This scheme is similar to Scheme 3 because the trip input must remain asserted while current still flows in the protected breaker.

Protection While Tripping Load or Line-Charging Current

Two different schemes detect breaker failures when tripping the breaker under load or line charging current conditions. While the schemes share elements and timers, each is independent. You may enable only one protection scheme at a time or customize the logic.

Both schemes require that the breaker is closed, and the relay received a trip input. The difference between the two schemes is how they determine a closed breaker condition.

Scheme 1 determines a closed breaker condition by comparing the phase current with the 50LD setting. Because this logic is very sensitive, the trip input must be asserted for two consecutive quarter-cycles before this logic acknowledges the input.

In some applications, current through the closed breaker may be below the minimum setting of the 50LD element. Scheme 2 uses the same logic as Scheme 1 but adds the 52A monitoring condition as an additional means for determining an open or closed breaker.

Thermal Protection of Close and Trip Resistors

If the protected breaker is equipped with trip and close resistors and three-phase potentials are available on both sides of the breaker, you can use the SEL-352 thermal protective elements to protect breaker resistors. Occasionally, a trip or close resistor can be left in service following a breaker operation. The SEL-352 can detect that condition, model the energy accumulated in the resistor, and trip the protected breaker or 86 lockout relay when resistor energy reaches a preset level.

A "Close Resistor Thermal Failure" or "Trip Resistor Thermal Failure" is declared when any close or trip resistor thermal model has reached the failure energy level and current is flowing in the hot resistor phase.

The relay models cooling of the breaker resistors using settable time constants. The thermal elements do not drop out until the resistor thermal models have cooled below the element thresholds. This function helps prevent hot resistors from being returned to service.

Voltage Nulling

The thermal protection and flashover protection both require a measurement of the transient voltage difference across the circuit breaker. Voltage nulling logic removes the steady state voltage difference that appears across the breaker. With the steady state voltage difference nulled from the voltage difference measurement, any difference is due to transient conditions.

Protection for Current Through an Open Breaker (Flashover)

Two schemes to detect circuit breaker flashover are provided. While the schemes share elements and timers, each is independent. You may enable only one flashover detection scheme at a time, or you can customize the logic.

Scheme 1 uses voltage across the circuit breaker and the current through the breaker to detect flashover. Scheme 2 uses a single set of voltages on one side of the breaker, the current through the breaker, and the breaker monitor input to detect flashover.

Protection for Failure to Close

The SEL-352 includes logic which detects a failure of one or two breaker poles to close. Because the logic operates based on current flowing in the breaker poles, protection is not dependent upon the operation of auxiliary contacts. Thus, this logic is not subject to misoperation due to mechanical failure in the breaker or contacts.

Loss of Dielectric Protection

The SEL-352 loss of dielectric protection logic uses dc input from pressure switches. Breakers equipped with dielectric gas pressure switches close contacts when the pressure drops below a preset level. One input that indicates current transformer dielectric failure can be used for alarming or tripping. Two additional inputs that monitor two thresholds of the dielectric gas pressure of the interrupter can be used for alarming, tripping, or breaker failure tripping.

Control Logic

The SEL-352 provides the following control logic:

- Staggered Closing
- POW Closing, which includes:
  - Synchronism Checking
  - Zero-Crossing Detection
  - Trapped Charge Polarity Detection
  - High-Resolution Controlled Close Output Timers
  - Ambient Temperature Compensation (SEL-352-2 and SEL-352-3)
  - DC Control Voltage Compensation (SEL-352-3)
- POW Opening, which includes:
  - Zero-Crossing Detection
  - High-Resolution Controlled Open Output Timers
  - Ambient Temperature Compensation (SEL-352-2 and SEL-352-3)
  - DC Control Voltage Compensation (SEL-352-3)
- Circuit Breaker Retrip Logic
- Breaker Failure Trip and Reset Logic

Staggered Close

Scheme 1 of the controlled close logic is a staggered close scheme that allows the user to close each pole of a circuit breaker pole at a settable time. The pickup time for each phase timer is settable to allow the user to select the delay between each phase.

POW Close

The second closing scheme that the SEL-352 provides is a POW close. Scheme 2 controls at what point on the voltage waveform the circuit breaker closes. The POW close logic is designed to provide a closing scheme that minimizes breaker wear and system impact when the breaker closes. Pow closing includes synchronism checking, zero-crossing detection, and output timers. Use the ambient temperature compensation available in the SEL-352-2 and SEL-352-3 and dc control voltage compensation in the SEL-352-3 to provide consistent POW closing results over a wide range of operating conditions.

Synchronism Checking

Angle and frequency differences between the X-side and the Y-side voltage are compared against two sets of settings. For example, one set of settings may be used to supervise automatic reclosing you programmed in SELOGIC control equations, and the other set of settings may be used to supervise manual closing through an output contact.

Zero-Crossing Detection

The SEL-352 determines when a zero crossing of the measured voltage will occur. The POW close logic closes the breaker based on this detection and the close output timers.

Trapped Charge Detection

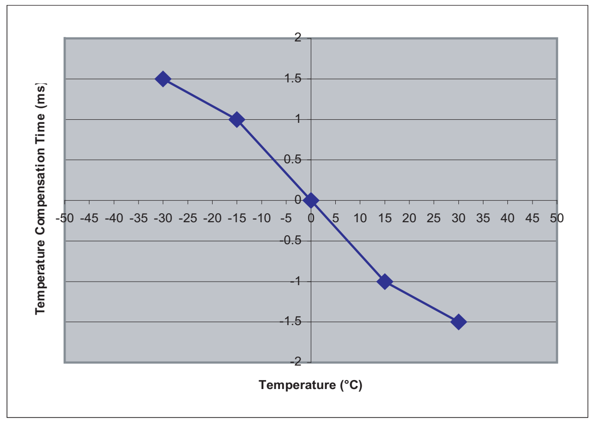
When the SEL-352 detects a positive or negative charge on the line after the breaker opens, the POW close logic will close on a positive or negative voltage condition, respectively. This minimizes the voltage difference as the breaker closes, minimizing breaker wear.

Controlled Close Output Timers

The output timer logic allows you to set the SEL-352 according to actual breaker operate times. Pow closing has better than 200 µs accuracy for all three phases.

POW Opening

Controlled opening of the breaker is useful in helping to reduce re-ignition across the breaker contacts in specific applications. Re-ignition takes place when the arcing time is too short and the contact separation is small. This presents a low dielectric boundary to the recovery voltage after the arc is extinguished, and re-ignition occurs across the open contacts of the breaker. Re-ignition is especially prevalent in applications, such as shunt-connected reactive loads, where there is a high transient recovery voltage and low load current present at the time the breaker contacts open. The SEL-352-2 and SEL-352-3 relays are capable of providing POW opening control logic. This logic allows the synchronization of maximum breaker contact separation to occur at the voltage peak or zero-crossing point, with additional high-resolution timers and voltage and temperature compensation (SEL-352-3) to provide highly repeatable results over a wide range of operating conditions.



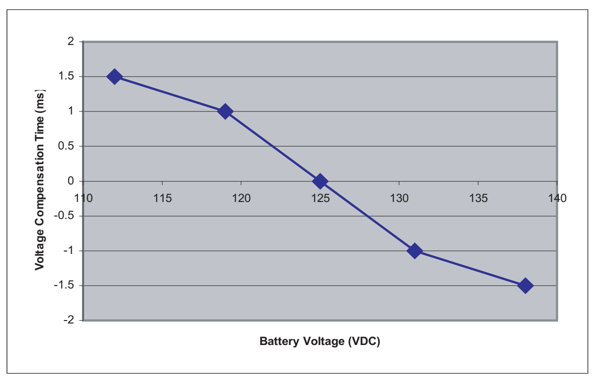


Figure 3 Temperature and Voltage Compensation

Retripping

Retrip your breaker instantaneously or with a time delay. The two available schemes can also be modified to conform to your specifications for qualifying a retrip condition.

86BF Trip and Reset

Lockout relay trip and reset logic is provided for installations with and without automatic breaker isolation schemes.

Use Scheme 1 for breaker failure tripping and "Safe to Reset Lockout Relay" conditions.

Use Scheme 2 to automatically isolate the failed breaker with MODs. The SEL-352 trips the MOD when current drops below a settable threshold. This scheme can also be used to indicate "Safe to Disconnect" conditions for manual disconnect switches.

Inputs/Outputs

The SEL-352 has many configurations of input and output options. The basic relay has a main board that includes inputs and outputs, but you may add up to two interface boards for expanded input and output capability.

Main Board

The main board includes seven programmable output contacts, one ALARM contact, and six optoisolated inputs. A jumper allows Output 7 to follow the ALARM.

Interface Boards

Table 1 lists the interface boards that expand the dc input and output capability of your SEL-352 to meet your specific needs. Contact the SEL Customer Service Department for ordering options.

Table 1 SEL-352 Relay Optional Interface Board Configurations

	Outputs		Inputs	
Board Type	Number	Type	Number	Type
1	16	Standard, Shared Terminals	8	Standard
2	12	Standard, Independent Terminals	8	Standard
4	4	Standard, Independent Terminals	16	Standard
6	8	Fast Hybrid (High-Current Interrupting)	8	Standard
5	12	Hybrid (High-Current Interrupting)	8	Standard

Data Recording

Event Report

The SEL-352 saves an event report in nonvolatile memory when any of the following occur:

- The relay trips
- User-selected relay elements, input, or outputs assert
- User executes the **TRIGGER** command

Event reporting has three user-selectable configurations:

Event Length	# of Events Stored
15 Cycles	72
30 Cycles	36
60 Cycles	18

The header of each event gives the date and time stamps of the trigger condition and relay identification. Each event report contains all unfiltered analog measurements, all digital inputs and outputs, and selected digital relay logic elements. The event type, system frequency, and voltage nulling calculations are reported just before the settings. The settings are listed at the end of the report for verification.

The relay stores 64 samples per cycle of unfiltered data. Display options allow the user to view the event in a 4-, 8-, or 64-sample per cycle format and to select the number of event report cycles to display.

Sequential Events Recorder

The SEL-352 stores 512 changes of state for user-selected relay elements, inputs, and output contacts. Each record is time tagged to within two milliseconds. The **SER** command allows the user to display a specific range of events based on the date and time stamp.

Metering

The meter function shows the values of ac current through the breaker, voltage across and on both sides of the breaker, and three-phase real and reactive power of the system at the breaker.

Breaker Operation Records

The SEL-352 stores 512 breaker operation records in nonvolatile memory. The event records contain breaker operation data: event date and time, operation type, electrical and mechanical operating times, interrupted energy, and interrupted current. This information is reported on a per-pole basis.

Breaker Operation Summary

A breaker operation summary report uses data from the breaker operation records to provide breaker information: average and last electrical operating times, average and last mechanical operating times, total interrupted energy, and total interrupted current. The SEL-352-2 and SEL-352-3 add a percent wear estimation to the summary. Use this information to monitor breaker wear and more effectively schedule routine maintenance.

Breaker Alarms

The BALRM (Breaker Alarm) setting is available for indicating specific breaker alarm conditions. Depending on its setting, the BALRM bit indicates dangerous or abnormal conditions related to operation of the circuit breaker.

Breaker alarm occurrences are stored in memory; the memory resets when settings are changed or a loss of power condition occurs. You can set a programmable output contact to close and indicate when the relay detects a breaker alarm condition.

The default relay settings for BALARM set the BALRM bit for one second and store a message in the alarm message buffer when any of the following conditions are detected:

Failed CB trip resistors put in service	Potential transformers dis-agree
Failed CB close resistors put in service	Current after MOD trip
52A contradicts voltage	MOD contradicts current
Current while open	Volts across closed CB
Trip while open	Slow trip
CD did not close	Slow close

A history of the breaker alarms is available with the **BREAKER** command.

Oscillography

Optional software is available to display the SEL-352 event reports in an oscillographic format. Contact the Customer Service Department for more information about the ACSELERATOR Analytic Assistant® SEL-5601 Software.

Additional Features

Serial Interface

The SEL-352 is equipped with three EIA-232 serial ports and one isolated EIA-485 serial port. Each serial port operates independently of the other serial ports.

For connecting devices more than 100 feet, fiber-optic transceivers are available. The SEL-2800 and SEL-2810 provide fiber-optic links between devices for electrical isolation and long distance signal transmission. Contact the SEL Customer Service Department for further information.

Direct SEL-2600A RTD Module Communications

Program any serial port on the SEL-352-2 or SEL-352-3 to accept fiber-based communications from the SEL-2600A RTD Module. Use an SEL-2600A with the SEL-2800 fiber-optic transceiver on the selected port to provide up to 12 temperature inputs to the relay. Use these temperature inputs for ambient temperature compensation for POW open and close operations, and as many as 24 individual thermal elements.

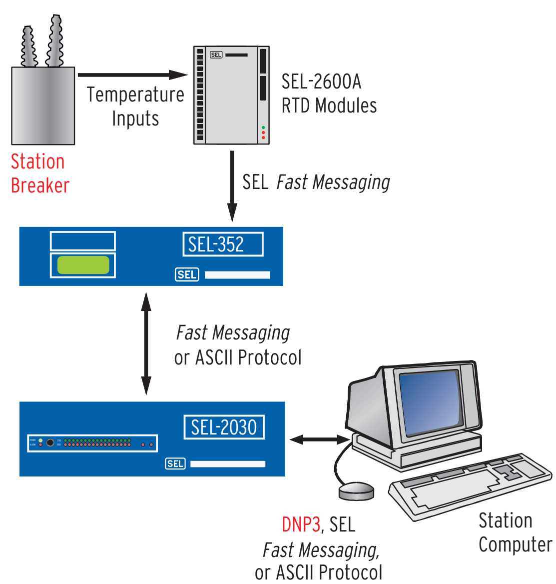


Figure 4 Communications with the SEL-2600A RTD Module (SEL-2800 not shown)

Front Panel

The SEL-352 front panel includes a 2-line, 16-character LCD display; 16 LED target/indicators; and 8 pushbuttons. The LCD display shows event information, metering information, and self-test status. The display is controlled with 8 multifunction pushbuttons.

Targeting

The target LEDs on the front panel illuminate based on various relay conditions. View these targets remotely by issuing the **TARGET** command to one of the serial ports. Front-panel targets illuminate for the conditions shown in *Table 2*.

Table 2 Front-Panel Target LED Indication (Sheet 1 of 2)

Target LED	Condition for Illumination	Target LED	Condition for Illumination
Top Row:		Bottom Row:	
EN	Normal Operation	A	Phase A Breaker Failure
PF	Breaker Pending Failure	B	Phase B Breaker Failure
86BFT	Lockout Relay Trip	C	Phase C Breaker Failure
86RS	Lockout Relay Reset	FAULT	Fault Current Protection

Table 2 Front-Panel Target LED Indication (Sheet 2 of 2)

Target LED	Condition for Illumination	Target LED	Condition for Illumination
TRIP	Breaker Trip Received	LOAD	Load Current Protection
CLOSE	Breaker Close Received	UBAL	Current Unbalance Protection
52A	52A Status Input Assertion	FLASH	Flashover Protection
MOD	MOD Status Input Assertion	THERM	Thermal Failure Protection

Time Clock Synchronization (IRIG-B)

The SEL-352 accepts a demodulated IRIG-B format signal for synchronizing its internal clock to some external source such as the SEL-2030 or SEL-2020 Communications Processor or SEL-IDM.

Model Variations

SEL-352-1 Relay

The SEL-352-1 has provided sophisticated and reliable service for many years. It continues to satisfy the needs of most of our customers. However, we recommend using the SEL-352-2 and SEL-352-3 for new designs because of the additional features they provide.

SEL-352-2 Relay

The SEL-352-2 provides the following additional features:

- Overcurrent elements for detecting rms overcurrent conditions on a per-pole or three-phase basis (50R, 50RA, 50RB, and 50RC).
- Percent wear function for estimating the amount of breaker contact wear per pole.
- **BREAKER W** command for preloading the number of operations, total current, total energy, and percent wear fields in the operation summary on a per-pole basis.
- Direct SEL-2600A RTD module communications
- Ambient temperature compensation for POW breaker opening and closing operations.

SEL-352-3 Relay

The SEL-352-3 provides the following features in addition to those shown for the SEL-352-2 Relay:

- Battery Voltage Monitoring—up to four setpoints for monitoring station dc battery system health.
- DC Voltage compensation for POW breaker opening and closing operations.

Conventional Terminal Blocks

This model includes hardware that supports three current inputs, six voltage inputs, six optoisolated inputs, seven programmable output contacts, one alarm contact, three EIA-232 ports, one EIA-485 port, and IRIG-B time code. It uses terminal blocks that support #6 ring terminals. This robust package meets or exceeds numerous industry standard type tests.

This relay is available in a 3.50" (2U), 5.25" (3U), or 7.00" (4U) rack-mount package or 4.9", 6.65", or 8.40" panel-mount package. Additional optoisolated inputs and programmable output contacts are available with the larger packages.

Plug-In Connectors (Connectorized®)

This model includes hardware that supports all of the features of the conventional terminal blocks model. It differs in its use of plug-in connectors instead of terminal blocks. In addition, it provides:

➤ Quick connect/release hardware for rear-panel terminals
➤ Level-sensitive optoisolated inputs

This robust package meets or exceeds numerous industry standard type tests. It is available in a 5.25" (3U) rack-mount package or a 4.9" panel-mount package.

Wiring Diagrams

AC Diagram

Connect the SEL-352 to the breaker current transformers for current-only, breaker-failure detection. Obtain voltage monitoring with the addition of three voltages on one side of the breaker. Supply at least one voltage on each side of the breaker to obtain synchronism checking. By connecting current and supplying three voltages on each side of the breaker, you can obtain thermal protection in addition to breaker-failure detection, voltage monitoring, and synchronism checking.

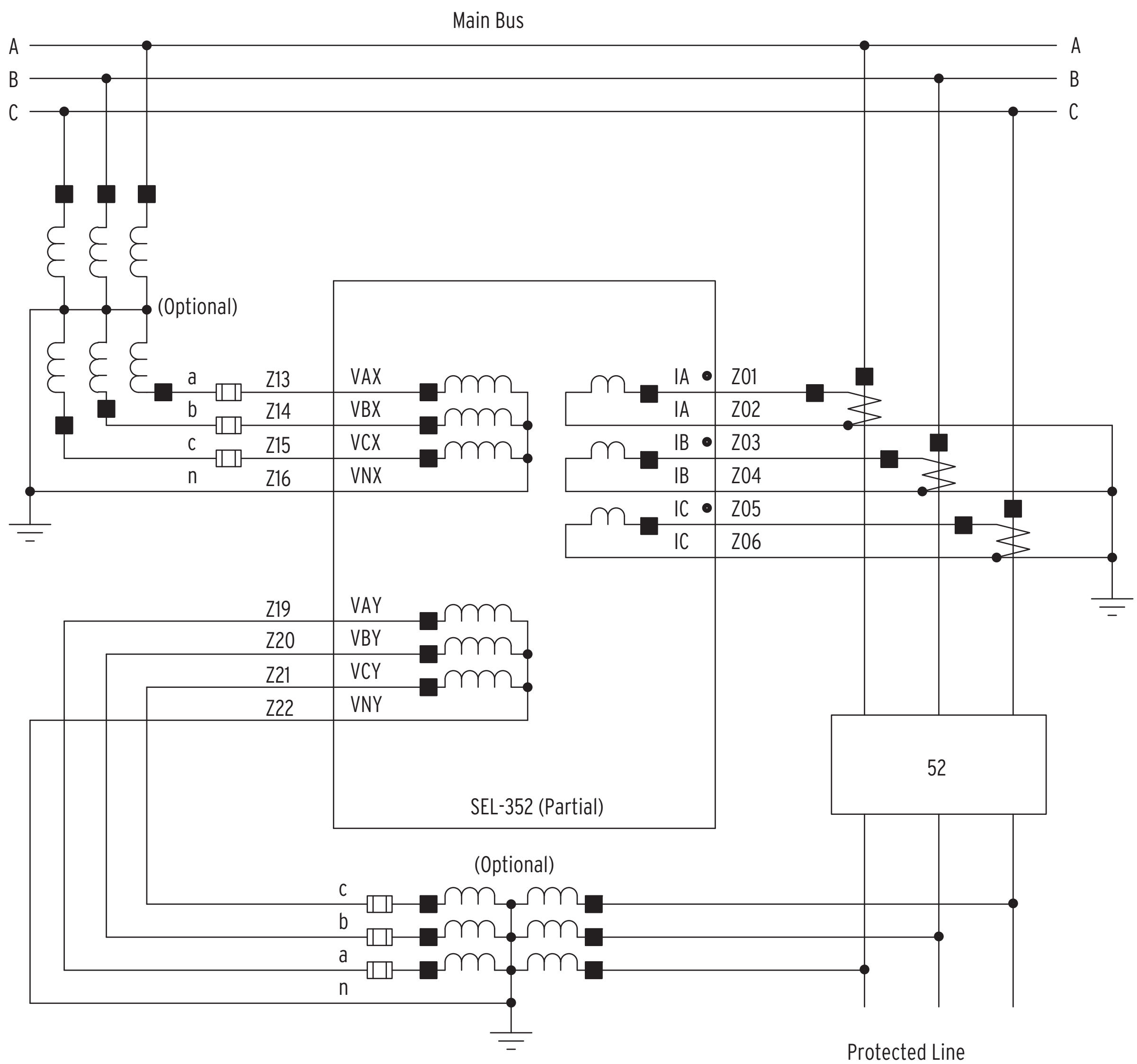


Figure 5 Typical External AC Connections

DC Diagram

The following diagrams give a simple example of how the SEL-352 can be connected. Inputs and outputs of the SEL-352 are fully programmable for application flexibility. Optional interface boards provide additional outputs and inputs, as described in *Table 1*.

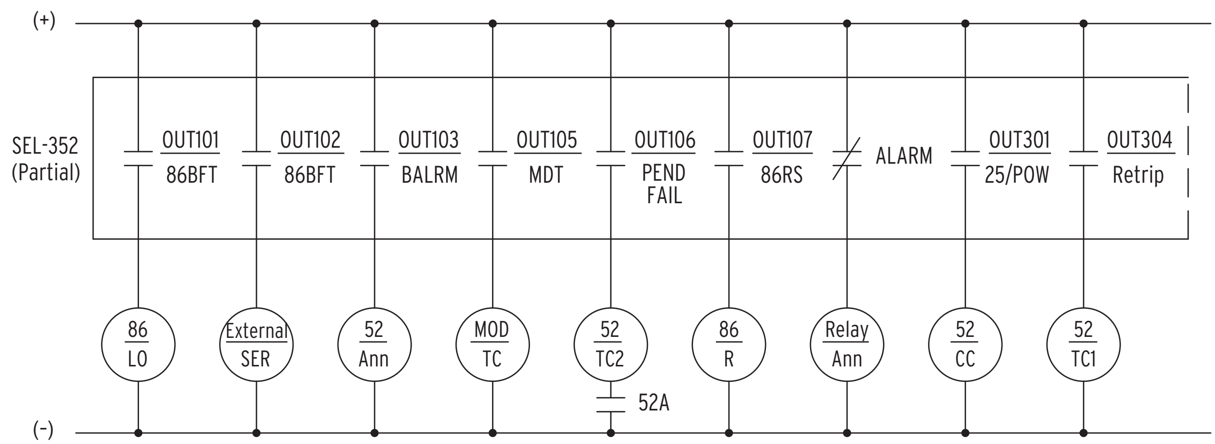


Figure 6 Example DC Output Contact Connections

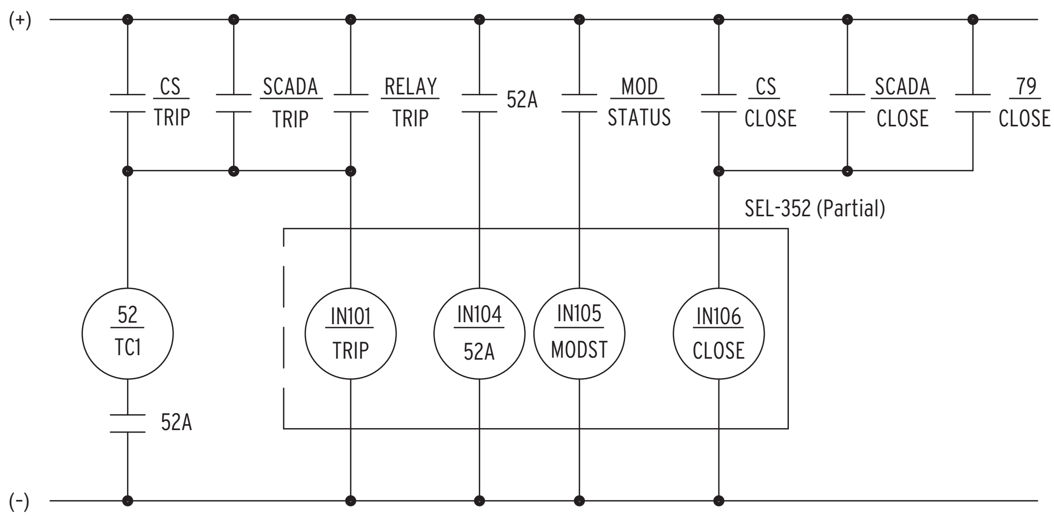
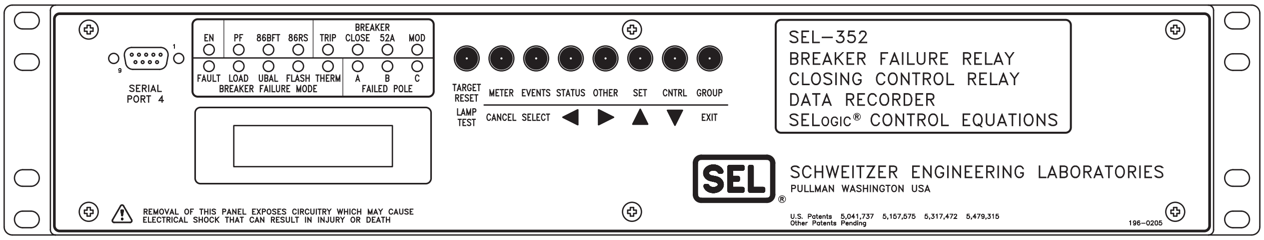


Figure 7 Example DC Input Connections

Front- and Rear-Panel Diagrams



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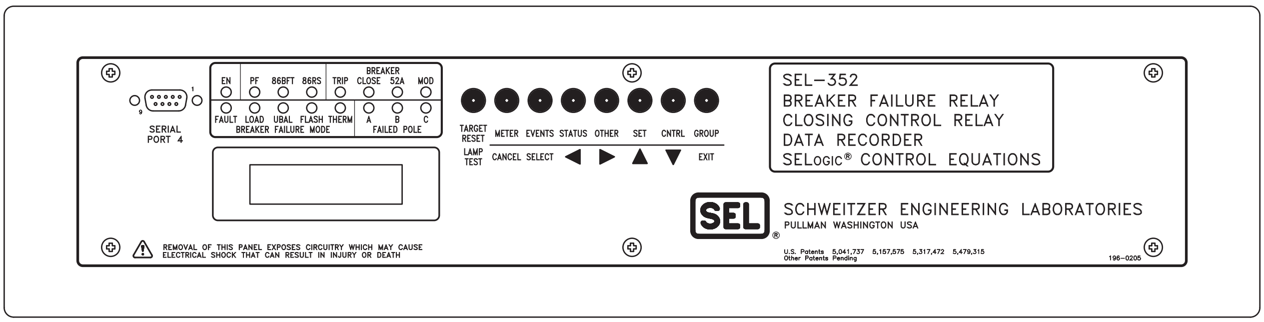

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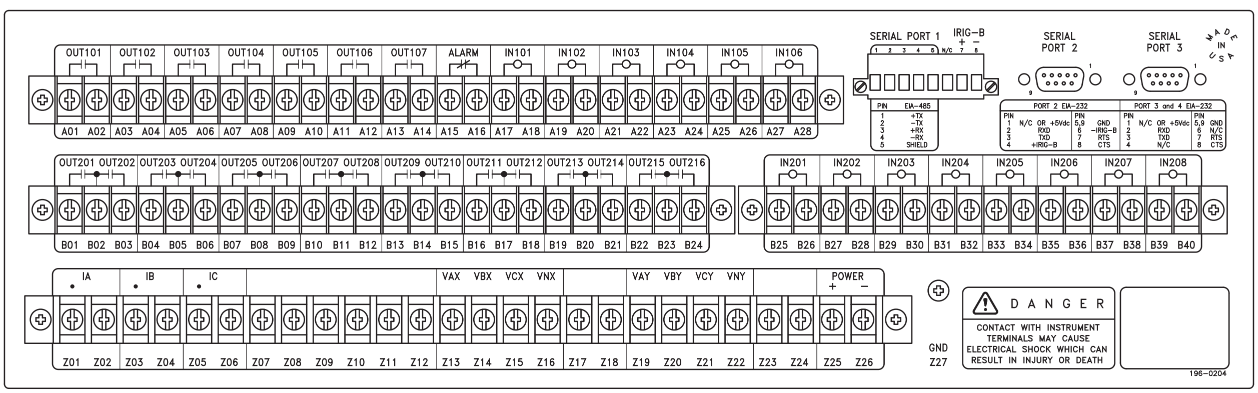
Figure 8 SEL-352 Front-Panel Diagrams



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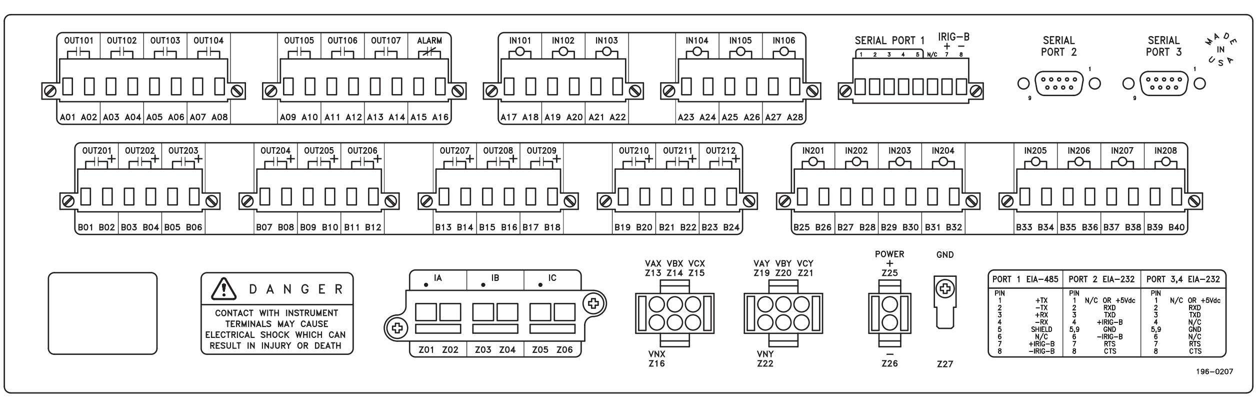

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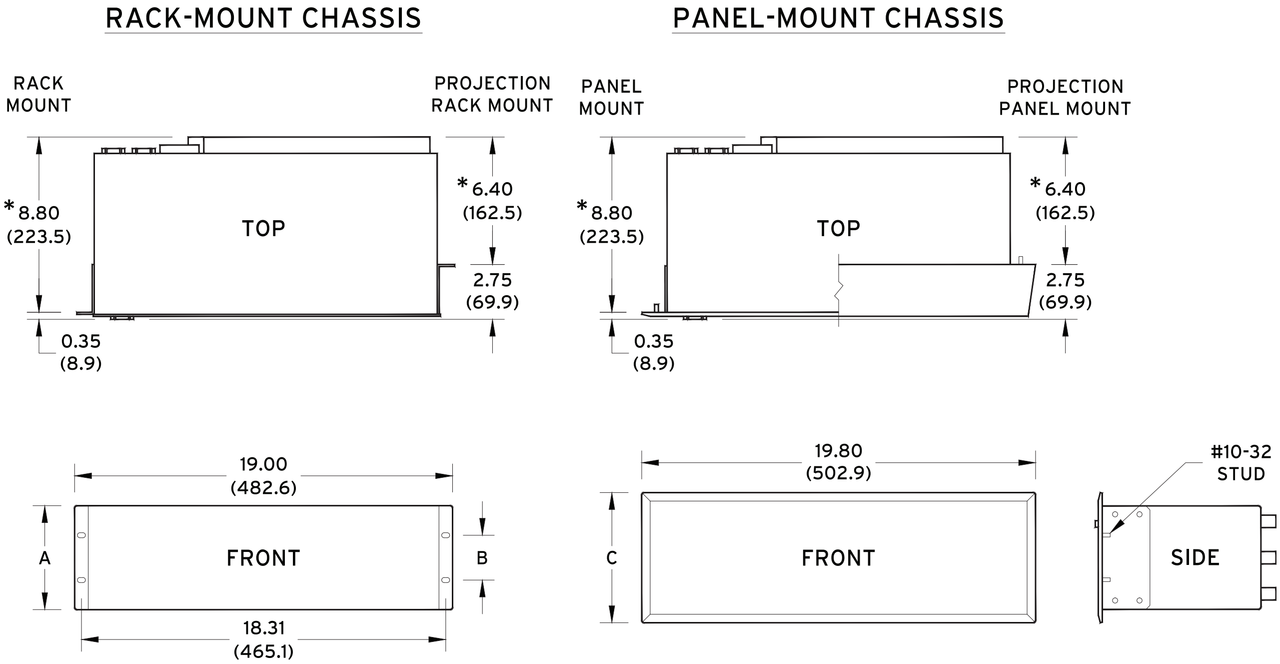
Figure 9 SEL-352 Rear-Panel Diagrams

Relay Dimensions



DIMENSION	MAIN BOARD ONLY (2U)	ONE I/O BOARD (3U)	TWO I/O BOARD (4U)
A	3.47 (88.1)	5.22 (132.6)	6.97 (177.0)
B	3.00 (76.2)	2.25 (57.2)	4.00 (101.6)
C	4.90 (124.5)	6.65 (168.9)	8.40 (213.4)
D	3.60 (91.4)	5.35 (135.9)	7.10 (180.3)

* ADD 0.65 (16.5) FOR CONNECTORIZED RELAYS

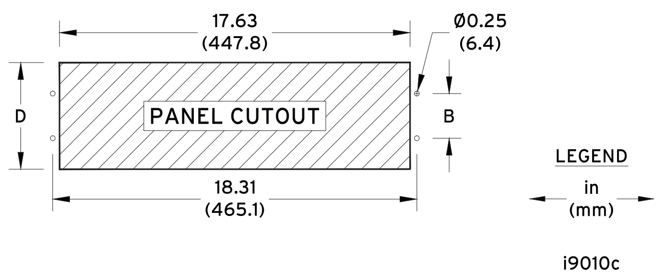


Figure 10 SEL-352 Dimensions for Rack- and Panel-Mount Models

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system
UL Listed to U.S. and Canadian safety standards (File E212775; NRGU, NRGU7)
CE Mark
UKCA Mark
RCM Mark
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 is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

General

Terminal Connections

Note: Terminals or stranded copper wire. Ring terminals are recommended. Minimum temperature rating of 105ºC.

Tightening Torque, Terminal Block

Minimum:	9 in-lb (1.1 Nm)
Maximum:	12 in-lb (1.3 Nm)

Tightening Torque, Connectorized

Minimum:	5 in-lb (0.6 Nm)
Maximum:	7 in-lb (0.8 Nm)

AC Current Inputs

5 A Nominal:	15 A continuous, 500 A for 1 s, linear to 100 A symmetrical 1250 A for 1 cycle
Burden Rating	0.27 VA at 5 A, 2.51 VA at 15 A
1 A Nominal:	3 A continuous, 100 A for 1 s, linear to 20 A symmetrical, 250 A for 1 cycle.
Burden Rating	0.13 VA at 1 A, 1.31 VA at 3 A

AC Voltage Inputs

120 V_{L-N}, three-phase, four-wire connection
150 V_{L-N} continuous (connect any voltage up to 150 Vac)
365 Vac for 10 s

Burden:	0.13 VA @ 67 V; 0.45 VA @ 120 V

Power Supply

24/48 Vdc

Rated Voltage:	24–48 Vdc
Operational Voltage Range:	20–60 Vdc polarity-dependent
Vdc Input Ripple:	5%
Interruption:	30 ms at 48 Vdc
Burden:	<25 W

125/250 Vdc or Vac

Rated Voltage:	125–250 Vdc or Vac
Operational Voltage Range:	85–350 Vdc or 85–264 Vac
Vdc Input Ripple:	100%
Interruption:	30 ms at 125 Vdc
Burden:	<25 W

Note: Interruption and Ripple per IEC 60255-11 [IEC 255-11]:1979

Output Contacts

Standard

Make:	30 A per IEEE C37.90:1989
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
1 s Rating:	50 A
MOV Protection:	270 Vac, 360 Vdc, 40 J
Pickup Time:	<5 ms
Dropout Time:	<5 ms, typical

Breaking Capacity (10,000 Operations) per IEC 60255-23:1994

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 (10,000 Operations) per IEC 60255-23:1994
Rate: 2.5 cycles/second

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

High-Current Interrupting Option

Make:	30 A per IEEE C37.90:1989
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
1 s Rating:	50 A
MOV Protection:	330 Vdc, 130 J
Pickup Time:	<200 µs
Dropout Time:	<8 ms, typical

Breaking Capacity (10,000 Operations) per IEC 60255-23:1994

24 V	10.0 A	L/R = 40 ms
48 V	10.0 A	L/R = 40 ms
125 V	10.0 A	L/R = 40 ms
250 V	10.0 A	L/R = 20 ms

Cyclic Capacity (10,000 Operations) per IEC 60255-23:1994
Rate: 4 cycles in 1 second, followed by 2 minutes idle for thermal dissipation

24 V	10.0 A	L/R = 40 ms
48 V	10.0 A	L/R = 40 ms
125 V	10.0 A	L/R = 40 ms
250 V	10.0 A	L/R = 20 ms

Note: Do not use high-current interrupting output contacts to switch ac control signals. These outputs are polarity-dependent.

Fast High-Current Interrupting Option

Make:	30 A per IEEE C37.90:1989
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
1 s Rating:	50 A
MOV Protection:	330 Vdc, 40 J
Pickup Time:	<200 µs
Dropout Time:	<8 ms, typical

Breaking Capacity (10,000 Operations) per IEC 60255-23:1994

24 V	10.0 A	L/R = 40 ms
48 V	10.0 A	L/R = 40 ms
125 V	10.0 A	L/R = 40 ms
250 V	10.0 A	L/R = 20 ms

Cyclic Capacity (10,000 Operations) per IEC 60255-23:1994

Rate: 4 cycles in 1 second, followed by 2 minutes idle for thermal dissipation

24 V	10.0 A	L/R = 40 ms
48 V	10.0 A	L/R = 40 ms
125 V	10.0 A	L/R = 40 ms
250 V	10.0 A	L/R = 20 ms

Note: Fast High-Current Interrupting Option output contacts are not polarity-dependent.

Optoisolated Inputs

	Pickup	Dropout
250 Vdc	200–300 Vdc	150 Vdc
125 Vdc	105–150 Vdc	75 Vdc
110 Vdc	88–132 Vdc	66 Vdc
48 Vdc:	38.4–60 Vdc	28.8 Vdc
24 Vdc	15.0–30 Vdc	

Note: 24, 48, 125 Vdc optoisolated inputs draw approximately 4 mA of current, 110 Vdc inputs draw approximately 8 mA of current, and 250 Vdc inputs draw approximately 5 mA of current. All current ratings are at nominal input voltage.

Substation Battery Voltage Monitor

Pickup Range: 20–300 Vdc

Pickup Accuracy: ±2% of setting

Routine Dielectric Strength

AC Current and Voltage Inputs: 2500 Vac for 10 s

Power Supply, Optoisolated Inputs, and Output Contacts: 3100 Vdc for 10 s

Frequency and Rotation

System Frequency: 50 or 60 Hz

Phase Rotation: ABC or ACB

Frequency Tracking

NFREQ = 60: Tracking range is 55–63 Hz

NFREQ = 50: Tracking range is 45–55 Hz

Communications Ports

EIA-232: 1 front and 2 rear

EIA-485: 1 rear, 2100 Vdc isolation

Baud rate: 300–19200 baud

Time-Code Input

Relay accepts demodulated IRIG-B time-code input at Port 1 or 2. Relay is time synchronized to within ±5 ms of time source input.

Operating Temperature

–40° to +85°C (–40° to +185°F)

Weight

2U Rack Unit Height: 15 lb (6.8 kg)

3U Rack Unit Height: 17.75 lb (8 kg)

Processing Specifications

64 samples per power system cycle

Type Tests

Electromagnetic Compatibility Emissions

Emissions: Canada ICES-001 (A) / NMB-001 (A)

Radiated Emissions:
EN 60255-25:2000
EN 55011:1998 + A1:1999 + A2:2002
CISPR 11:1997 (Mod) + A1:1999 + A2:2002
Severity Level: Class A

Conducted Emissions:
EN 60255-25:2000
Severity Level: Class A

Electromagnetic Compatibility (EMC) Immunity

Radiated Immunity:
EN 61000-4-3:2006 + A1:2008
10 V/m_{RMS};
80 MHz – 1 GHz; 1.4 GHz – 2.7 GHz: Swept;
80, 160, 380, 450, 900, 1850, & 2150 MHz: Spot (> 15 V/m_{RMS} s/80% AM 1 kHz sine wave)

IEEE C37.90.2-2004
20 V/m_{RMS}; 80 MHz – 1 GHz: Swept Frequency;
80, 160, 450, 900 MHz: Spot Frequency (> 35 V/m_{RMS} w/80% AM 1 kHz sine wave)

Conducted Immunity:
EN 61000-4-6:2007
10 V_{RMS}; 150 kHz – 80 MHz: Swept Frequency
27 MHz & 68 MHz: Spot Frequency (w/80% AM 1 kHz sine wave)

Electrostatic Discharge Immunity:
EN 61000-4-2:2009
IEEE C37.90.3 - 2001
Severity Level: 2, 4, 6, & 8 kV contact; 2, 4, 8, & 15 kV air

Fast Transient/Burst Immunity:
EN 61000-4-4:2004
Zone A:
Power Input; I/O; ± 4.0 kV; 5 kV
Communication Ports: ± 2.0 kV; 5 kV

Surge Immunity:
EN60255-22-1:2008
Zone B:
± 0.5, 1.0 kV (line-to-line)
± 0.5, 1.0, 2.0 kV (line-to-earth)
± 0.5, 1.0 kV (communication ports)

Slow Damped Oscillatory Wave:
EN 60255-22-1:2008
Common Mode:
Power Input, CT, PT, & I/O: ± 2.5 kV
Communication Ports: ± 1.0 kV
Differential Mode:
Power input; PT & I/O: ± 1.0 kV

IEEE Surge Withstand Capability:
IEEE C37.90.1-2002
Damped Oscillatory (1 MHz):
Power Input, CT, PT, & I/O: ± 2.5 kV (CM & DM)
Communications Ports: ± kV (CM only)
Fast Transient (2.5 kHz):
Power Input, CT, PT, & I/O: ± 4.0 kV (CM & DM)
Communications Ports: ± 4.0 kV (CM only)

Power Supply Immunity:
EN 60255-11:2010
Voltage dips, interruption, & ripple
EN 61000-4-11:2004
AC dips & interruptions
EN 61000-4-29:2000
DC dips & interruptions
EN 61000-4-17:1999 + A1:2004
15% ripple on dc power input

Environmental

Cold:
EN 60068-2-1:2007
Cold profile ad; -40°C ≥ 16 hrs, operational

Dry Heat:
EN 60068-2-2:2007
Dry heat profile db; +85°C ≥ hrs, operational

Damp Heat, Cyclic:
EN 60068-2-30:2005
Damp heat, profile db, –25°C to +55°C, relative humidity ≥ 93%, 6 cycles

Vibration:
EN 60255-21-1:1995
Class 1 vibration endurance
Class 2 vibration response

Shock & Bump: EN 60255-21-3:1995
Class 1 shock withstand
Class 2 shock response
Class 1 bump

Seismic: EN 60255-21-3:1995
Class 2 quake response

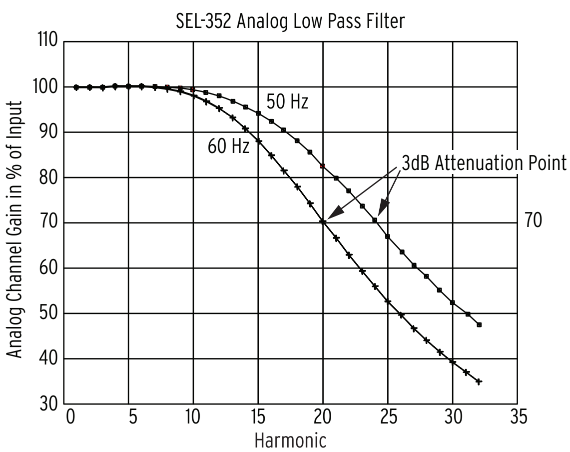
Safety

Insulation Coordination: EN 60255-5:2001
IEEE C37.90-2005
Hi-Pot:
3.1 kV_{dc} power supply
2.5 kV_{ac} contact I/O & analog inputs
2.2 kV_{dc} EIA-485 & IRIG
Impulse: 0.5 J, 5 kV, 1.2/50 uS

Signal Processing Specifications

Analog Data Acquisition

–3dB cutoff at 1200 Hz, 64 samples per cycle, see *Figure 2*.



Harmonic	Correction Factor (60 Hz)	Correction Factor (50 Hz)
Fundamental through 8th		
9th	1.01	1
10th	1.02	1.01
11th	1.03	1.01
12th	1.05	1.02
13th	1.07	1.03
14th	1.10	1.04
15th	1.14	1.06
16th	1.18	1.08
17th	1.23	1.11
18th	1.28	1.14
19th	1.35	1.17
20th	1.42	1.21
21st	1.50	1.25
22nd	1.59	1.30
23rd	1.68	1.36
24th	1.78	1.42
25th	1.89	1.48
26th	2.01	1.56
27th	2.14	1.63
28th	2.27	1.72
29th	2.40	1.80
30th	2.55	1.89
31st	2.70	1.99
32nd	2.86	2.09

Relay Measurement • Correction Factor = Input Signal Level

Figure 2 Analog Filter Curve

Digital Filtering

Half-cosine filter for the 50FT overcurrent element
Cosine filter for all other elements

Processing Intervals

1/8-Cycle: Event Report Triggers
Targets
Optoisolated Inputs
Local Bits
Remote Bits
SELOGIC Control Equation SET A Elements
Fault Current Protection Elements
86BF Trip and Reset Elements
Contact Output Elements
SELOGIC Control Equation Analog Compares

1/4-Cycle: All other elements

Relay Element Specifications

Overcurrent Elements

50FT Fault Current Element with Subsidence Current Logic

Setting Ranges: 0.50–45.00 A secondary, 0.01-A steps ($I_{NOM} = 5$ A)
0.10–9.00 A secondary, 0.01-A steps ($I_{NOM} = 1$ A)

Pickup Time: <0.55 cycle at 2 multiples of pickup

Dropout Time: <0.75 cycle

Pickup and Dropout: ±0.025 A secondary ± 5% of setting

Transient Overreach: ±14% of setting

50MD/50LD MOD and Load/Line Current Elements

Setting Ranges: 0.10–45.00 A secondary, 0.01-A steps ($I_{NOM} = 5$ A)
0.02–9.00 A secondary, 0.01-A steps ($I_{NOM} = 1$ A)

Pickup Time: < 0.9 cycle at 2 multiples of pickup

Dropout Time: <1.35 cycles

Pickup and Dropout: ±0.03 A secondary ± 5% of setting

Transient Overreach: ±5% of setting

50MN Minimum Current Element

Current Threshold (Fixed): 0.10 A secondary ($I_{NOM} = 5$ A)
0.02 A secondary ($I_{NOM} = 1$ A)

Pickup Time: <0.9 cycle at 2 multiples of pickup

Dropout Time: <1.35 cycles

Pickup and Dropout: ±0.03 A secondary

Transient Overreach: ±5% of setting

50N Ground Overcurrent Element

Setting Ranges:	0.10–45.00 A secondary, 0.01-A steps (I_{NOM} = 5 A) 0.02–9.00 A secondary, 0.01-A steps (I_{NOM} = 1 A)
Pickup Time:	<0.9 cycle at 2 multiples of pickup
Dropout Time:	<1.35 cycles
Pickup and Dropout:	±0.025 A secondary ± 5% of setting
Transient Overreach:	±5% of setting

50RMS RMS Overcurrent Element
(Only available in the SEL-352-2 and SEL-352-3 Relays)

Setting Ranges:	0.50–45.00 A secondary, 0.10-A steps (I_{NOM} = 5 A) 0.10–9.00 A secondary, 0.02-A steps (I_{NOM} = 1 A)
Pickup Time:	<0.9 cycle at 2 multiples of pickup
Dropout Time:	<1.125 cycles
Pickup and Dropout:	±0.01 • I_{NOM} A secondary ± 5% of setting
Transient Overreach:	±5% of setting

Pickup/Dropout Curves

Figure 3 through *Figure 6* are based on actual test data at room temperature using various settings. Relay element specifications given previously in this section include the entire temperature range of the relay. Output contact times are not included.

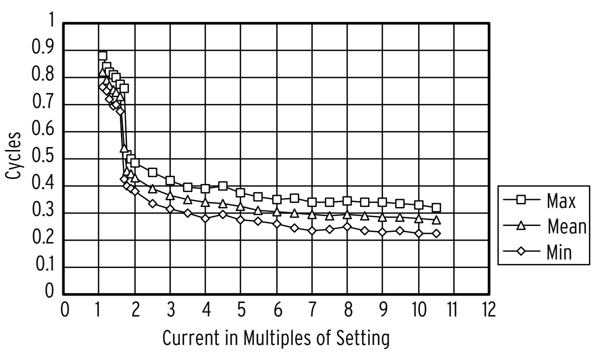


Figure 3 50FT Pickup Curves

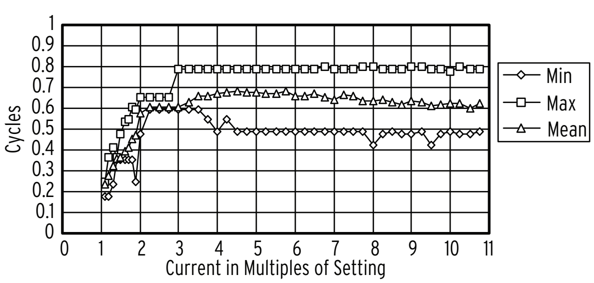


Figure 4 50FT Dropout Curves

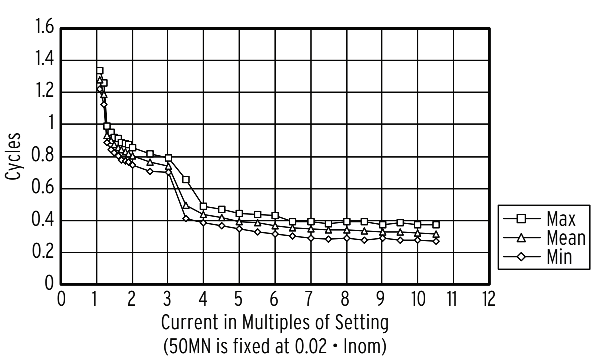


Figure 5 50MN, 50LD, 50MD, 50N Pickup Curves

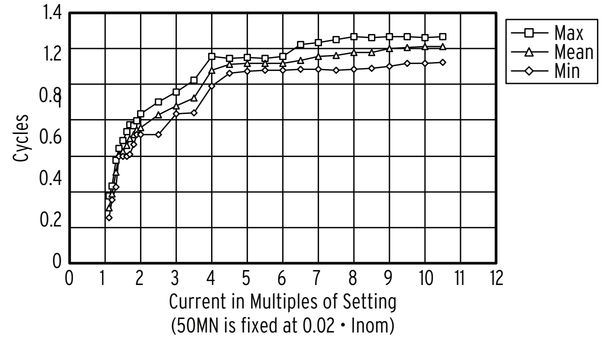


Figure 6 50MN, 50LD, 50MD, 50N Dropout Curves

Voltage Elements

87H/87FO/87TH Voltage Across Breaker Overvoltage Elements

Setting Range:	1.0–150.0 V secondary, 0.1-V steps
Pickup Time:	<1.35 cycles
Dropout Time:	<1.55 cycles
Pickup and Dropout:	±0.09 V secondary ± 5% of setting
Transient Overreach:	±5% of setting

X47Q/Y47Q Negative-Sequence Overvoltage Element

Setting Range:	2.0–140.0 V secondary, 0.1-V steps
Pickup Time:	<1.35 cycles
Dropout Time:	<1.55 cycles
Pickup and Dropout:	±0.27 V secondary ± 6% of setting
Transient Overreach:	±5% of setting

X59H High-Set Overvoltage Element

Setting Range:	1.0–130.0 V secondary, 0.1-V steps
Pickup Time:	<1.35 cycles
Dropout Time:	<1.55 cycles
Pickup and Dropout:	±0.09 V secondary ± 5% of setting
Transient Overreach:	±5% of setting

X27D/Y27D Dead Line Undervoltage Element

Setting Range:	1.0–120.0 V secondary, 0.1-V steps
Pickup Time:	<1.35 cycles
Dropout Time:	<1.55 cycles
Pickup and Dropout:	±0.09 V secondary ± 5% of setting
Transient Overreach:	±5% of setting

X59L/Y59L Live Line Overvoltage Element

Setting Range:	10.0–120.0 V secondary, 0.1-V steps
Pickup Time:	<1.35 cycles
Dropout Time:	<1.55 cycles
Pickup and Dropout:	±0.09 V secondary ± 5% of setting
Transient Overreach:	±5% of setting

Synchronism-Check Elements

25SC/25SM Maximum Slip Frequency for Controlled/Manual Close

Setting Range:	0.005–0.500 Hz, 0.001-Hz steps
Pickup and Dropout:	±0.002 Hz ± 2% of setting

25AC Maximum Controlled Close Angle

Setting Range:	32 • (25SC) to 90°, min = 1°, 0.1° steps
Pickup and Dropout:	±0.5° ± 5% of setting

25AM Maximum Manual Close Angle

Setting Range:	32 • (25SC) to 90°, min = 1°, 0.1° steps
Pickup and Dropout:	±0.5° ± 5% of setting

Current Unbalance Element

46P Phase Current Unbalance Element

46P detects phase discordance when the protected breaker closes. For example, A-Phase is unbalanced if phase current is above the 50LD setting in one or more phases and:

$|IA| < (|IA| + |IB| + |IC|) / 46UB$ setting where 46UB setting = 8, 16, 32, or 64.

Time to stabilize measurement because of transient conditions: < 1.35 cycles

Overpower Elements

37OP Breaker Overpower Element

Setting Range: 0.10–3400.00 W secondary, 0.01-W steps (I_{NOM} = 5 A)
0.02–680.00 W secondary, 0.01-W steps (I_{NOM} = 1 A)

Pickup Time: <2.10 cycles

Dropout Time: <3.00 cycles

Maximum Element Error, Secondary Units: ±2.25 mW ±10.25% (measured input power)
±2.63% (measured voltage)
±9.45% (measured current)

Breaker Resistor Thermal Elements

26CF Close Resistor Failure Element
26CP Close Resistor Pending Failure Element
26TF Trip Resistor Failure Element
26TP Trip Resistor Pending Failure Element

Setting Range: 0.010–1000.000 Joules secondary, 0.001 J-steps (I_{NOM} = 5 A)
0.002–200.000 Joules secondary, 0.001 J-steps (I_{NOM} = 1 A)

Pickup error is based on 37OP element over time.

Settable Timers

SYNCT Synchronizing Time Dropout (SYNCdo)

Setting Range: 0.00–99999.00 cycles, 1/4-cycle steps

Pickup Setting: ±0.25 cycles or ±0.25% of setting

62TT Failure-to-Trip Fault Current Trip Input Timer
62FC Failure-to-Trip Fault Current Failure Timer
62T1 General Purpose Timer 1
62M2 Maximum Bus Clearing Time
62M3 Maximum MOD Operate Time

Setting Range: 0.0–8191.0 cycles, 1/8-cycle steps

Pickup Setting: ±0.25 cycles or ±0.25% of setting

SCT Synchronous Close Timer (CLSdo)
62LD Failure-to-Trip Load Current Failure Timer
62LP Failure-to-Trip Load Current Pending Failure Timer
62AF Failure of Breaker 52A Contact to Indicate Operation Failure Timer
62AP Failure of Breaker 52A Contact to Indicate Operation Pending Failure Timer
62FF Flashover Failure Timer
62FP Flashover Pending Failure Timer
62UC Phase Discordance Close Input Pickup Timer
62OP Trip and Close Resistor Heating Pickup Timer
62L2 Loss-of-Dielectric Timer
62UF Phase Discordance Failure Timer
62UP Phase Discordance Pending Failure Timer
62T3 General Purpose Timer 3
62T4 General Purpose Timer 4
62RT Delayed Trip Time
62RC Staggered Close Time

Setting Range: 0.00–16383.00 cycles, 1/4-cycle steps

Pickup Setting: ±0.25 cycles or ±0.25% of setting

62ZCA A-Phase Zero-Crossing Controlled Close Timer
62ZCB B-Phase Zero-Crossing Controlled Close Timer
62ZCC C-Phase Zero-Crossing Controlled Close Timer
62PCA A-Phase Peak-Crossing Controlled Close Timer
62PCB B-Phase Peak-Crossing Controlled Close Timer
62PCC C-Phase Peak-Crossing Controlled Close Timer
62COApu A-Phase Controlled Open Timer
62COBpu B-Phase Controlled Open Timer
62COCpu C-Phase Controlled Open Timer

Setting Range: 0.00–40.00 ms, 0.01-ms steps

Pickup Setting: ±200 µs

62VN Voltage Nulling Delay Timer

Setting Range: 0.00–240.00 minutes, 0.01-min steps

Pickup Setting: ±0.25 cycles or ±0.25% of setting

Fixed Timers

62F1 Flashover Voltage Time Delayed Dropout Timer
5 cycles ±0.25 cycles

62F2 Load Current Pickup Timer (Flashover Logic)
5 cycles ±0.25 cycles

62F3 Trip or Close Dropout Timer (Flashover Logic)
6 cycles ±0.25 cycles

62M1 86BF Reset Signal Duration Timer
60 cycles ±0.125 cycles

62M4 86BF Reset Time Delay, MOD Logic Enabled
300 cycles ±0.125 cycles

62LT1 Loss-of-Dielectric Input Debounce Timer
60 cycles ±0.25 cycles

62LT3 Loss-of-Dielectric Input Debounce Timer
60 cycles ±0.25 cycles

MCT Manual Close Input Dropout Timer
2 cycles ±0.25 cycles

SEN Synchronism Calculation Enable Pickup Timer
15 cycles ±0.25 cycles

SS Slip Security Pickup Timer
4.5 cycles ±0.25 cycles

Internal Logic Timers

62XZPB B-Phase Positive Zero-Crossing Delay Timer for X Side
62XZNB B-Phase Negative Zero-Crossing Delay Timer for X Side
0.33 cycles

62XZPC C-Phase Positive Zero-Crossing Delay Timer for X-Side
62XZNC C-Phase Negative Zero-Crossing Delay Timer for X-Side
0.66 cycles

62YZPB B-Phase Positive Zero-Crossing Delay Timer for Y-Side
62YZNB B-Phase Negative Zero-Crossing Delay Timer for Y-Side
0.33 cycles

62YZPC C-Phase Positive Zero-Crossing Delay Timer for Y-Side
62YZNC C-Phase Negative Zero-Crossing Delay Timer for Y-Side
0.66 cycles

62T Trapped Charge Trip Input Dropout Timer
4 cycles

62V Trapped Charge Voltage Dropout Timer
7 cycles

TCDpu Trapped Charge Detection Pickup Timer
1 cycle

TCDdo Trapped Charge Detection Dropout Timer
12 cycles

62BALRM Breaker Alarm Dropout Timer
60 cycles

62OI	Operation Input Dropout Timer for Breaker Alarms	
		5 cycles
62BDNC	BDNC Breaker Alarm Close Inputs Pickup Timer	
		3 seconds
62TWO	Trip Input Dropout Debounce Timer	
		0.25 cycles
T1A	Controlled Open Trip Reset Timer	
		10.00 cycles
T2A	Controlled Open Dropout Delay Timer	
		0.75 cycles
T3A	Controlled Open Peak Delay Timer	
		0.25 cycles

Metering

VAX	A-Phase Voltage for the X-Side ac inputs
VBX	B-Phase Voltage for the X-Side ac inputs
VCX	C-Phase Voltage for the X-Side ac inputs
VAY	A-Phase Voltage for the Y-Side ac inputs
VBY	B-Phase Voltage for the Y-Side ac inputs
VCY	C-Phase Voltage for the Y-Side ac inputs

Units:	kilovolts (kV) primary
Accuracy:	±0.67 V secondary

IA	A-Phase current ac input
IB	B-Phase current ac input
IC	C-Phase current ac input

Units:	Amperes (A) primary
Accuracy:	±0.05 A secondary (I_{NOM} = 5 A) ±0.01 A secondary (I_{NOM} = 1 A)

AMB	Ambient Temperature
	–50° to +250°C
Units:	°C
Accuracy:	±2°C

Multiple Setting Groups

SS1	Setting group selection input 1
SS2	Setting group selection input 2

Number of Setting Groups:	3
Setting Group Change Delay:	TGR setting and as long as 3 seconds uncertainty

Data Recording Specifications

Event Records

MER	Event Report Trigger
Pickup Accuracy:	0.000 to 0.125 cycles
Number of Events:	1200 ÷ LER setting (15, 30, or 60 cycles)

SER1	Sequential-Event-Recorder Trigger List 1
SER2	Sequential-Event-Recorder Trigger List 2
SER3	Sequential-Event-Recorder Trigger List 3
Pickup Accuracy:	0.000 to 0.125 cycles
Number of Trigger Elements:	24 per list, 72 total
Number of Events Displayed:	512

Breaker Monitor Reporting

Electrical Operate Time Units:	ms
Mechanical Operate Time Units:	ms
Energy Units:	MJ, primary
Current Units:	A, primary
Breaker Contact Wear***:	%
Number Of Operations Displayed:	512

Other Relay Elements Determine Accuracy

Note: *** SEL-352-2 and SEL-352-3 Relays Only

Serial Port Specifications

Port 1:	EIA-485 with IRIG-B input
Port 2:	EIA-232 with IRIG-B input and +5 Vdc output. Maximum total current draw on +5 Vdc supply through serial ports is 1 A.
Port 3:	EIA-232 with +5 Vdc output
Port 4:	EIA-232

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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