SEL-487V
Capacitor Protection and Control System

One relay for all your capacitor bank needs

• Protect grounded and ungrounded, single- and double-wye capacitor bank configurations.
• Keep electrical parameters within set ranges, even without external devices.
• Easily calculate relay settings with software tools.
• Locate defective capacitor units faster, reducing maintenance effort and downtime.
Overview

ANSI Numbers/Acronyms and Functions

- 27 Undervoltage
- 32 Real and Reactive Power
- 37C Undercurrent
- 46 Current Unbalance
- 49 Programmable Thermal Control and Logic
- 50BF Breaker Failure Overcurrent
- 50FO Flashover Overcurrent
- 50 (P, G, Q) Overcurrent (Phase, Ground, Negative Sequence)
- 51 Time Overcurrent (Selectable)
- 59 (P, Q, B) Overvoltage (Phase, Negative Sequence, Bank)
- 60N Neutral Current Unbalance
- 60P Phase Current Unbalance
- 67 (P, Q, O) Directional Overcurrent (Phase, Ground, Negative Sequence)
- 81 (O, U, R) Frequency (Over, Under, Rate)
- 85 RIO SEL Mirrored Bits® Communications
- 87V Phase Voltage Differential
- 87VN Neutral Voltage Differential
- DFR Event Reports
- HMI Operator Interface
- LGC Capacitor Bank Control*
- LOP Loss of Potential
- MET High-Accuracy Metering
- PMU Synchrophasors
- RTU Remote Terminal Unit
- SER Sequential Events Recorder

Additional Functions

- BRM Breaker Wear Monitor
- LDP Load Data Profiling*

*Copper or fiber-optic
*Optional feature
Key Features

Simple, Comprehensive Capacitor Protection
Phase and neutral voltage differential elements and phase and neutral current unbalance elements provide reliable protection for grounded and ungrounded, single- and double-wye configurations. You can simplify relay settings using the application-based Capacitor Bank Assistant in acSELERATOR QuickSet® SEL-5030 Software to quickly calculate bank protection element thresholds.

Multistage Control
Obtain full control of your capacitor banks without the time and wiring to install an additional device. You can select from voltage, power factor, VAR, or time-of-day/day-of-week control schemes for up to three capacitor banks. Instability (hunting) detection helps prevent equipment damage by raising alarms or blocking control operations. Three independent sets of trip logic are available for staged-bank applications. With the SEL-487V-1, you can use the universal sequencer to automatically sequence the insertion and removal of up to three capacitor banks.

Rapid Fault Locating
Faulted phase and section identification logic reduces the time needed to identify faulted capacitor bank units. The fault-locating logic provides discrete indications for the phase and section of the faulted capacitor units.

Advanced Protection Functions
Protect capacitors against abnormal system conditions using current, voltage, and frequency elements. For additional protection and monitoring, the relay has built-in thermal elements (conforming to IEC 60255-149), total harmonic distortion measurement, and harmonic metering through the 15th harmonic.

Flexible Inputs and Indication
The SEL-487V supports multiple digital I/O boards and analog inputs from an SEL-2600 RTD Module and has user-definable pushbuttons and indicator LEDs.

Breaker Monitoring and Protection
A full-function breaker failure system provides logic to detect a reignition or restrike (also called flashover) across any one of the three breaker poles.
Product Overview

- **Easy-to-use keypad** aids simple navigation.
- **EIA-232 front serial port** is convenient for system setup and local access.
- **LCD** allows you to control and view the status of disconnects and breakers.
Programmable operator pushbuttons with user-configurable labels allow front-panel customization.

Front-panel LEDs indicate custom alarms and provide information to assist dispatchers and line crews with rapid power restoration.
Choose from a vertical or horizontal, panel-mount or rack-mount chassis and different size options.

Six current and six voltage channels support applications for grounded and ungrounded, single- and double-wye capacitor configurations.
Power supply options include 48–125 Vdc or 110–120 Vac; or 125–250 Vdc or 110–240 Vac.

Use one front and three rear EIA-232 ports for Mirrored Bits communications, DNP3, SCADA, and engineering access.

Communications protocols include FTP, Telnet, synchrophasors, DNP3 LAN/WAN, the Parallel Redundancy Protocol (PRP), and IEC 61850.

Power supply options include 48–125 Vdc or 110–120 Vac; or 125–250 Vdc or 110–240 Vac.
Applications

Differential Protection

Voltage differential elements detect variations in capacitor bank impedance due to the loss of individual capacitor elements, a single capacitor unit, or a group of units.

Unbalance Protection

Detect faulted capacitor elements with phase and neutral current unbalance elements. Phase current and/or neutral current unbalance elements protect grounded and ungrounded multiple-wye banks.

Voltage Differential
Grounded single-bank capacitor with low-voltage tap.

Phase Current Unbalance
Grounded or ungrounded double-wye capacitor bank.

Neutral Voltage Differential
Ungrounded single-bank capacitor with neutral voltage sensing.

Neutral Current Unbalance
Grounded or ungrounded double-wye capacitor bank.
Capacitor Switching and Control
Obtain full control of your capacitor banks without installing an additional device. Automatic and manual, local and remote deadband control functions let you maintain system voltage, VAR, or power factor (PF) levels. Instability detection prevents equipment damage by raising alarms or blocking control operations. The time-of-day/day-of-week control feature synchronizes capacitor bank insertion with peak VAR demand periods.

Advanced Fault Detection
Reduce the time needed to identify faulted capacitor bank units with the faulted phase and section identification logic in the SEL-487V. This logic provides discrete indications for the phase and section of the faulted capacitor units. For voltage differential applications, the phase angle of the differential voltage determines the faulted phase and the sign of the differential voltage determines whether the fault is above or below the tap. For current unbalance applications, the phase angle of the unbalanced current determines the phase and bank where the fault is.

Real-Time Control
Make informed system operational decisions based on actual real-time phasor measurements from across your power system. With built-in time correlation, the SEL-487V combines local and remote messages to make control decisions. Control functions based on phase angles, currents, and voltages provide flexibility for a variety of applications.

Voltage control deadband characteristics.

VAR deadband control characteristics.

PF deadband control characteristics.
Breaker Failure Detection
The SEL-487V includes a full-function breaker failure system. High-speed, open-phase detection logic allows you to set the pickup current below the minimum load for high sensitivity without sacrificing high-speed dropout. Even in cases with subsidence current in the secondary of the CT caused by trapped flux, the SEL-487V achieves high-speed detection of the circuit breaker opening. This feature is essential if breaker failure is initiated on all circuit breaker trips. A reset of less than one cycle reduces coordination times, improving stability.

Breaker Flashover Detection
The SEL-487V uses per-phase fundamental and rms current measurement to quickly detect breaker restrike and flashover across any one of the three breaker poles after the breaker is opened. Because capacitor switching can place significant stress on a breaker, monitoring is crucial. SEL’s enhanced event analysis recording has a resolution from 1 to 8 kHz to capture restrike and other breaker problems.
## Accessibility and Communications

### Application-Based Settings

The SEL-487V saves configuration time by automatically providing the recommended capacitor bank primary protection elements based on nameplate data and other configurable settings. The relay only displays applicable elements (differential voltage, differential neutral voltage, neutral current unbalance, and phase current unbalance protection) for easy setup.

### Ethernet-Based Communications

The Ethernet ports support a variety of protocols, including FTP, DNP3, Manufacturing Message Specification (MMS), and IEC 61850. By using failover, switched mode, or PRP, you can increase your system’s reliability.

### Graphical Logic Editor (GLE)

The GLE in ACSELerator QuickSet lets you view SELogic® control equations graphically and document your settings files for validation and commissioning. You can convert existing SELogic control equations to easy-to-read diagrams and save the diagrams.

The GLE helps reduce design errors, time, and expenses when commissioning relays. The convenient diagram navigation tool, drag-and-drop interface, function block diagrams, and automatic layout function help you design new SELogic control equations. A full element palette makes it easy to manage control diagrams.
## Specifications

### General Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AC Current Inputs</strong></td>
<td>5 A nominal</td>
</tr>
<tr>
<td>(6 total)</td>
<td>1 A nominal</td>
</tr>
<tr>
<td><strong>AC Voltage Inputs</strong></td>
<td>300 V&lt;sub&gt;L-N&lt;/sub&gt; continuous, 600 Vac for 10 seconds</td>
</tr>
<tr>
<td>(6 total)</td>
<td></td>
</tr>
<tr>
<td><strong>Serial</strong></td>
<td>1 front-panel and 3 rear-panel EIA-232 serial ports</td>
</tr>
<tr>
<td></td>
<td>300–57,600 bps</td>
</tr>
<tr>
<td><strong>Ethernet</strong></td>
<td>Communications protocols include FTP, Telnet, synchrophasors, DNP3 LAN/WAN, PRP, and IEC 61850.</td>
</tr>
<tr>
<td></td>
<td>Choose from the following port options:</td>
</tr>
<tr>
<td></td>
<td>Two 10/100BASE-T twisted-pair network ports</td>
</tr>
<tr>
<td></td>
<td>Two 100BASE-FX fiber-optic network ports</td>
</tr>
<tr>
<td></td>
<td>One 10/100BASE-T twisted-pair network port and one 100BASE-FX fiber-optic network port</td>
</tr>
<tr>
<td><strong>Synchrophasors</strong></td>
<td>IEEE C37.118 standard</td>
</tr>
<tr>
<td></td>
<td>Up to 60 messages per second</td>
</tr>
<tr>
<td><strong>Processing</strong></td>
<td>AC voltage and current inputs: 8,000 samples per second</td>
</tr>
<tr>
<td></td>
<td>Primary protection and control processing: 8 times per power system cycle</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>48–125 Vdc or 110–120 Vac</td>
</tr>
<tr>
<td></td>
<td>125–250 Vdc or 110–240 Vac</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>−40° to +85°C (~−40° to +185°F)</td>
</tr>
<tr>
<td></td>
<td>Note: LCD contrast is impaired for temperatures below −20°C (~−4°F) and above +70°C (~158°F).</td>
</tr>
</tbody>
</table>

© 2018 by Schweitzer Engineering Laboratories, Inc.

PF00207 • 20180105

Making Electric Power Safer, More Reliable, and More Economical

+1.509.332.1890 | info@selinc.com | selinc.com

© 2018 by Schweitzer Engineering Laboratories, Inc.