SEL-352
Breaker Failure and Monitoring Relay
Complete Breaker Protection, Monitoring, and Control

Apply the SEL-352 Relay to ring-bus, breaker-and-a-half, or multiple-bus configurations.

Features and Benefits

Protection
Select one of five preconfigured breaker failure schemes for ring-bus, breaker-and-a-half, or double-bus applications. Or, build your own for custom applications.

Control
Configure timers, programmable latches, and variables in a wide range of control applications. Use the synchronism check element to build a reclose function and the point-on-wave closing to reduce charging currents when switching in capacitor banks.

Monitoring
Apply breaker monitor information such as breaker pole flashover, loss-of-dielectric pressure, and breaker resistor status to your reliability-centered maintenance (RCM) program.

Reporting
Analyze Sequential Events Recorder (SER) and oscillographic event reports for rapid commissioning, testing, and post-fault diagnostics.

Communications
DNP3 Level 2 Outstation, ASCII, and binary protocols are available for communications with SCADA, local HMI, or modems.

Making Electric Power Safer, More Reliable, and More Economical®
**Functional Overview**

**Breaker Failure Use Protection**

The breaker failure function protects against the following conditions:

- During fault current conditions
- During load or line charging current conditions
- During breaker flashover conditions
- During pole disagreement conditions

Apply any one of five preconfigured schemes, or modify them to suit your application. Schemes available include those that prevent misoperation or sequential timing during unfavorable current distribution in breaker-and-a-half or ring-bus systems.

For Fault F, Breaker 2 doesn’t depend on Breaker 1 opening to initiate breaker failure (no fault current through Breaker 2 when Breaker 1 is closed). Instead, Breaker 2 initiates breaker failure on receipt of the trip pulse.

Innovative subsidence logic recognizes a “breaker open” condition by inspection of the ac current waveform. This logic produces the fast dropout of overcurrent detection elements required for secure breaker failure protection.

**SEL-352 Relay**

- SEL® Control Equations
- Event Reports
- Sequential Events Recorder
- Breaker Operation and Wear Monitors
- Remote and Local Control Switches
- Local Display
- SEL® Control Equations Analog Compares
- Point-on-Wave Closing
- Trapped Line Charge Detection
- Flashover Protection
- Breaker Isolation Control
- Single-Pole Fail-to-Close Detection
- DNP3 Level 2 Outstation Protocol*  

*Optional Function
Control

The SEL-352 Relay provides you with the tools and permits you the flexibility to create control schemes as diverse and varied as there are applications. Tools include 29 settable timers, 44 latches, 22 comparators, 16 local bits, 16 remote bits, and numerous elements.

29 Settable Timers

<table>
<thead>
<tr>
<th>Timer</th>
<th>Input</th>
<th>pu</th>
<th>Output</th>
</tr>
</thead>
</table>

44 Programmable Latches

<table>
<thead>
<tr>
<th>Latch</th>
<th>Input</th>
<th>S</th>
<th>O</th>
<th>R</th>
</tr>
</thead>
</table>

22 Programmable Comparators

<table>
<thead>
<tr>
<th>Comparator</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>

SEL Logic control equations provide the flexibility to configure the tools using AND, OR, NOT, parenthesis, and analog compare operators. For example, use the synchronous condition element as a basis to create a complete single- or three-pole reclosing scheme.

Synchronous Control

When synchronizing two systems, the relay first calculates the frequency difference (slip frequency) between the two systems. Next, including the mechanical closing time of the breaker, the relay calculates the optimum instance to issue the close command.

Point-On-Wave Closing

Reduce the inrush current when energizing your capacitor bank by using the point-on-wave element.

Breaker Monitoring

Extensive breaker monitoring provides valuable information to assess the breaker condition. Use this information to schedule reliability-centered maintenance when required, instead of time-based maintenance.

Example Breaker Operations and Alarms

<table>
<thead>
<tr>
<th>#</th>
<th>DATE</th>
<th>TIME</th>
<th>OPERATION OP. TIME (ms)</th>
<th>ENERGY</th>
<th>CURRENT (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>09/26/09</td>
<td>16:24:37.401</td>
<td>TRIPA 29 16 0.03</td>
<td>5472</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>09/26/09</td>
<td>16:24:37.401</td>
<td>TRIB 29 16 0.01</td>
<td>5454</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>09/26/09</td>
<td>16:24:37.401</td>
<td>TRIC 29 16 0.01</td>
<td>5457</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>09/26/09</td>
<td>16:22:03.651</td>
<td>CCA 8 12 0.02</td>
<td>1248</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>09/26/09</td>
<td>16:22:03.651</td>
<td>CCB 8 12 0.01</td>
<td>1239</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>09/26/09</td>
<td>16:22:03.651</td>
<td>CCC 10 12 0.00</td>
<td>1236</td>
<td></td>
</tr>
</tbody>
</table>

OPERATION SUMMARY

FROM 09/26/09

<table>
<thead>
<tr>
<th>TRIPA</th>
<th>TRIB</th>
<th>TRIC</th>
<th>CLOSEA</th>
<th>CLOSEB</th>
<th>CLOSEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>249</td>
<td>236</td>
<td>239</td>
<td>248</td>
<td>454</td>
<td>457</td>
</tr>
</tbody>
</table>

BREAKER ALARMS

<table>
<thead>
<tr>
<th>ALARM</th>
<th>TOTAL COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTRS</td>
<td>0</td>
</tr>
<tr>
<td>FCRS</td>
<td>0</td>
</tr>
<tr>
<td>S2ACV</td>
<td>1</td>
</tr>
<tr>
<td>CWO</td>
<td>0</td>
</tr>
<tr>
<td>TRO</td>
<td>1</td>
</tr>
<tr>
<td>BCMC</td>
<td>0</td>
</tr>
<tr>
<td>CMNC</td>
<td>0</td>
</tr>
<tr>
<td>MCC</td>
<td>0</td>
</tr>
<tr>
<td>ST</td>
<td>0</td>
</tr>
<tr>
<td>SC</td>
<td>0</td>
</tr>
<tr>
<td>PDT</td>
<td>2</td>
</tr>
</tbody>
</table>

Reporting

SER With Programmable Element Names

The programmable Sequential Event Recorder (SER) records the latest 512 events, which helps you diagnose breaker or system problems. Settable element names make the SER user-friendly.

Example SER Event Reports

=>SER<ENTER>

Example Circuit Breaker Date: 09/26/09 Time: 13:22:35.297

FID=SEL-352-R100-D090926

Example Report Label

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Time</th>
<th>Element</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>09/26/09</td>
<td>13:22:04.004</td>
<td>50FAULT</td>
<td>Asserted</td>
</tr>
<tr>
<td>2</td>
<td>09/26/09</td>
<td>13:22:04.033</td>
<td>TRIP</td>
<td>Asserted</td>
</tr>
<tr>
<td>3</td>
<td>09/26/09</td>
<td>13:22:04.050</td>
<td>RETRIP</td>
<td>Asserted</td>
</tr>
<tr>
<td>4</td>
<td>09/26/09</td>
<td>13:22:04.100</td>
<td>BFR_TRIP</td>
<td>Asserted</td>
</tr>
<tr>
<td>5</td>
<td>09/26/09</td>
<td>13:22:04.116</td>
<td>TRIP</td>
<td>Deasserted</td>
</tr>
<tr>
<td>6</td>
<td>09/26/09</td>
<td>13:22:04.125</td>
<td>50FAULT</td>
<td>Deasserted</td>
</tr>
</tbody>
</table>

=>
SEL-352 Breaker Failure and Monitoring Relay

Digital Fault Recorder
- Event report length of 15, 30, or 60 cycles
- Ten seconds of nonvolatile event storage
- Data reported at 4, 8, 16, or 64 samples per cycle
- Programmable prefault time
- SEL-5601 compatible

Capture system current and voltages during fault conditions.

General Specifications

AC Voltage Inputs
- 120 V<sub>lin</sub>, three-phase, four-wire connection
- 150 V<sub>lin</sub>, continuous (connect any voltage up to 150 Vac)
- 365 Vac for 10 seconds
- Burden: 0.13 VA @ 67 V; 0.45 VA @ 120 V

AC Current Inputs
- 5 A nominal: 15 A continuous, 500 A for 1 second, linear to 100 A symmetrical, 1250 A for 1 cycle
- Burden: 0.27 VA @ 5 A; 2.51 VA @ 15 A
- 1 A nominal: 3 A continuous, 100 A for 1 second, linear to 20 A symmetrical, 250 A for 1 cycle
- Burden: 0.13 VA @ 1 A; 1.31 VA @ 3 A

Frequency and Phase Rotation
- 60/50 Hz system frequency and ABC/ACB phase rotation are user-settable

Standard Control Input and Output Ranges
- 24, 48, 110, 125, or 250 Vdc
Standard configuration provides 6 inputs and 8 outputs,
<5 ms pickup/dropout times with 30 A make, 6 A continuous duty. Additional I/O boards may be selected with standard inputs and outputs, a combination of standard inputs and high-current interrupting outputs, or a combination of standard inputs and high-speed, high-current interrupting outputs.

Serial Communications
- Two rear-panel and one front-panel EIA-232 serial ports
- One rear-panel EIA-485 serial port with 2.1 kVdc isolation
- Data speed: 300, 1200, 2400, 4800, 9600, 19200 (per port)

Time-Code Input
- Demodulated IRIG-B accepted at EIA-232 Port 2 and the EIA-485 port

Power Supply Ratings
- 24/48 V: 20–60 Vdc; <15 W
- 125/250 V: 85–350 Vdc or 85–264 Vac; <15 W
- 12 W maximum for all supplies

Operating Temperature
- –40° to +85°C (–40° to +185°F)