

MIRRORED BITS[®] Communications



High-speed, secure, point-to-point communications

- Exchange up to eight bits of status information for protection-level security, dependability, and speed.
- Eliminate expensive external communications equipment by using an EIA-232 serial port for peer-to-peer data transfer.
- Simplify pilot protection schemes by employing long-distance communications channels.
- Enable comprehensive power system monitoring and report generation with deterministic, time-stamped event and performance data.
- Simplify complex automation schemes by using SEL MIRRORED BITS-compatible logic processors and remote I/O modules.



Overview

Technology

MIRRORED BITS communications is an innovative, low-cost, relay-to-relay communications technology from SEL that sends the internal logic status, encoded in a digital message, from one supported device to another. This technology opens the door to numerous protection, control, and monitoring applications that would otherwise require more expensive external communications equipment wired through contacts and control inputs. Applications for MIRRORED BITS communications include line protection pilot schemes, remote device control and monitoring, relay cross tripping, and more.

MIRRORED BITS communications provides the following advantages:

High Speed

MIRRORED BITS communications exchanges up to eight bits of status information at protection-level speed for pilot schemes in a guaranteed subcycle operation.

Security

MIRRORED BITS communications uses multiple security measures to ensure that the eight Transmit MIRRORED BITS (TMBs) logic status elements transmit correctly from one relay to another:

- All Receive MIRRORED BITS (RMBs) are triple-checked for consistency.
- Each byte is checked for parity, framing, or overrun errors.
- Byte inversion pattern (channel address) must match RX_ID setting (loopback detection).
- At least one message must be received for every three messages sent.

MIRRORED BITS communications meets the IEC 61834-1 teleprotection standard.

Dependability

MIRRORED BITS communications continually monitors the communications channel for errors or dropouts. Unlike a contact-to-control input connection, MIRRORED BITS informs you immediately if the connection is lost or damaged or even if a noise source begins to corrupt the data and enables access to relay channel monitoring reports.

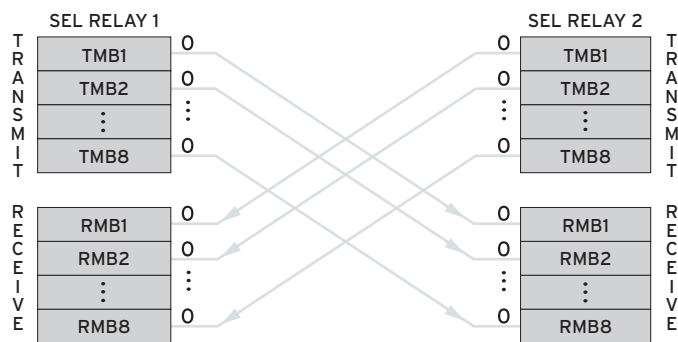
Less-Expensive, Simple Protection Schemes

MIRRORED BITS communications provides a straightforward setup and eliminates the external communications equipment and wiring needed for complex protection and control schemes that rely on conventional communications. MIRRORED BITS sends internal logic status from one device to another using the established relay-to-relay serial communications channel.

Operation

Older communications methods that rely on hard contacts to transfer system status data are complicated, expensive, and have limited capabilities.

MIRRORED BITS communications eliminates those challenges. In a system using MIRRORED BITS, the RMBs of one relay track the status of the respective TMBs sent from another relay. You can use the RMBs in programmable logic to implement transfer tripping, blocking, and interlocking; permissive schemes; direct control; or any function that would otherwise be performed with a programmable contact input. Each of the relays in the scheme repeatedly sends and receives the digital logic message while continually monitoring the received message integrity. An internal monitoring point asserts when a good message is received and deasserts immediately on detection of a bad message. If a message is compromised, the system will alarm operators and enable them to access relay channel monitoring reports.



MIRRORED BITS communications creates a virtual connection between the two SEL relays as the RMB of one SEL device follow the status of the respective TMB sent from the other SEL device.



Self-Monitoring of the Communications Link

The MIRRORRED BITS communications log takes the guesswork out of your communications system's performance. When the MIRRORRED BITS channel is active, a communications summary report specific to the performance of that channel is enabled. The example below demonstrates the type of data available for event analysis. In addition to the log, a separate Sequence of Events report contains time tags for the assertion and deassertion of any of the reported communications failures.

```
=>COM A L <Enter>

SEL-311L                               Date: 10/12/99   Time: 16:24:01.623
EXAMPLE: BUS B, BREAKER 3

FID=SEL-311L-R100-V0-Z001001-D20010625   CID=FF27
Summary for Mirrored Bits channel A

For 10/05/99 17:18:12.993 to 10/10/99 18:37:36.123

    Total failures      4                Last error
    Relay Disabled      2
    Data error          0                Longest Failure      2.835 sec.
    Re-Sync             0
    Underrun            1                Unavailability      0.000003
    Overrun             0
    Parity error        1
    Framing error       0                Loop-back           0
    Bad Re-Sync        0

    Failure              Recovery
    #   Date   Time      Date   Time      Duration Cause
    1   10/05/99 18:36:09.279 10/05/99 18:37:36.114   2.835
    2   10/06/99 13:18:09.236 10/06/99 13:18:09.736   0.499 Parity error
    3   10/07/99 11:43:35.547 10/07/99 11:43:35.637   0.089 Underrun
    4   10/09/99 17:18:12.993 10/09/99 17:18:13.115   0.121

=>
```

Communications log example.

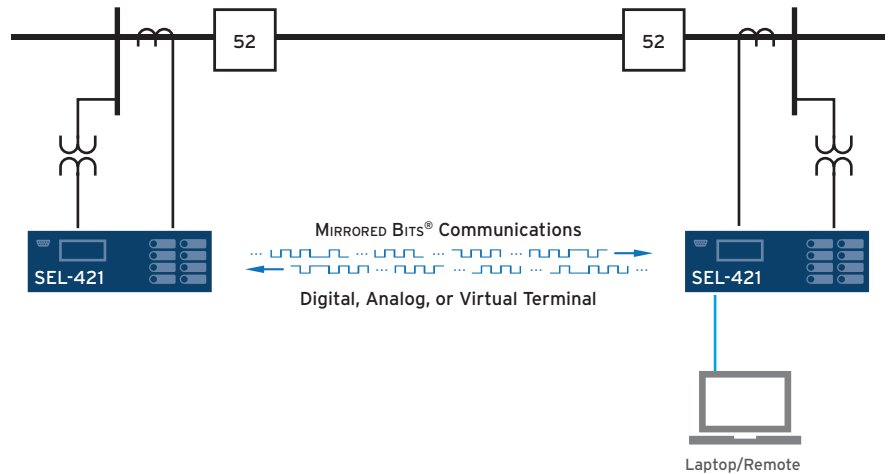
Field-Proven Solution

MIRRORRED BITS communications has been in service since 1996, providing fast, secure, dependable communications. Visit selinc.com for papers, application guides, and other information to learn more about field-proven MIRRORRED BITS applications.

Applications

Enhanced Communications in SEL-400 Series Relays

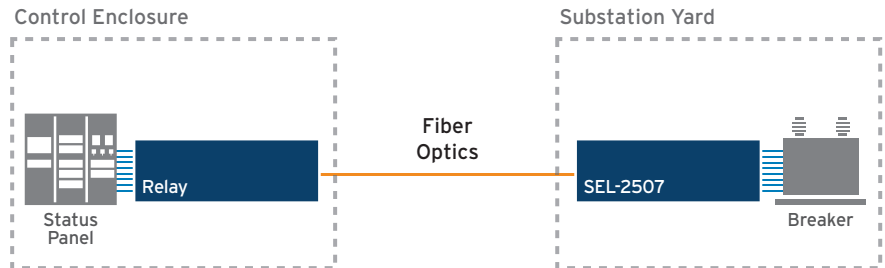
SEL-400 series relays offer enhanced MIRRORRED BITS communications that transmits both analog and digital values, unlike other protocols that limit users to either analog or digital. You can also use MIRRORRED BITS to establish an engineering connection with a remote relay via a virtual terminal for easier access. For accurate event logging, MIRRORRED BITS lets you synchronize internal clocks in other relays.



Breaker Control and Monitoring

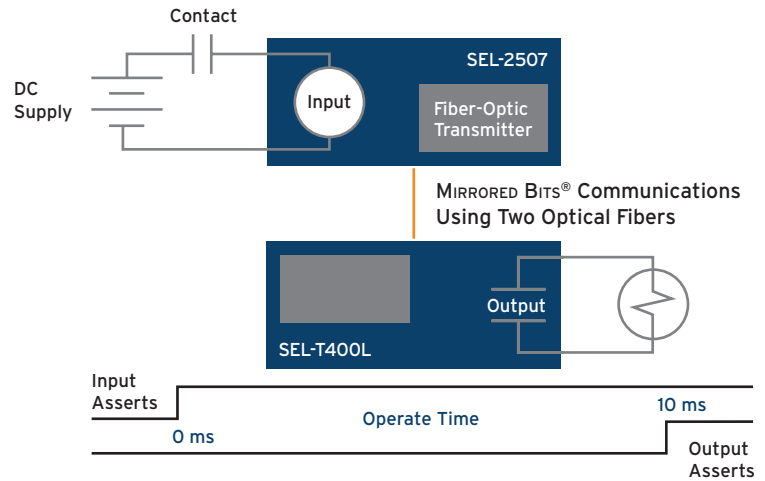
MIRRORRED BITS communications in the SEL-2507 High-Speed Remote I/O Module simplifies and reduces the cost of breaker control and monitoring. Using a relay-to-relay fiber-optic channel, MIRRORRED BITS lets you eliminate control wiring between a circuit breaker and its associated relay. Fiber optics eliminates dc ground loops and hazardous induced voltages caused by ground potential rise.

MIRRORRED BITS also enables SCADA systems to track the breaker position and condition for improved system performance.



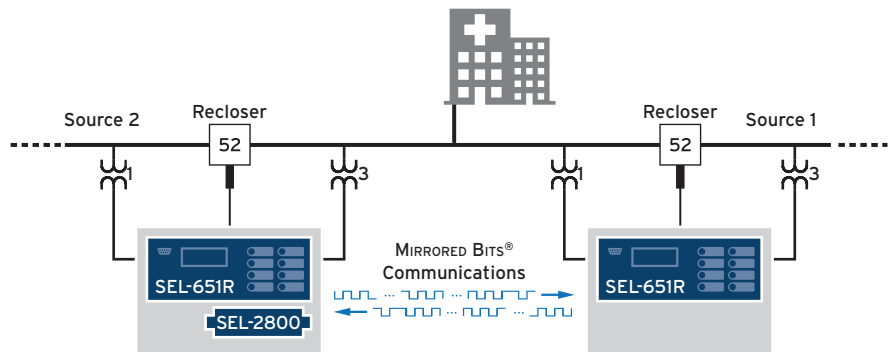
High-Speed Remote I/O With the SEL-T400L Time-Domain Line Protection

Connect the SEL-2507 to the SEL-T400L or another SEL-2507 at 115.2 kbps to provide ultra-high-speed remote I/O. Millisecond MIRRORED BITS messages transmit every 500 microseconds in these configurations—a four-fold increase over other SEL-2507 remote I/O applications.



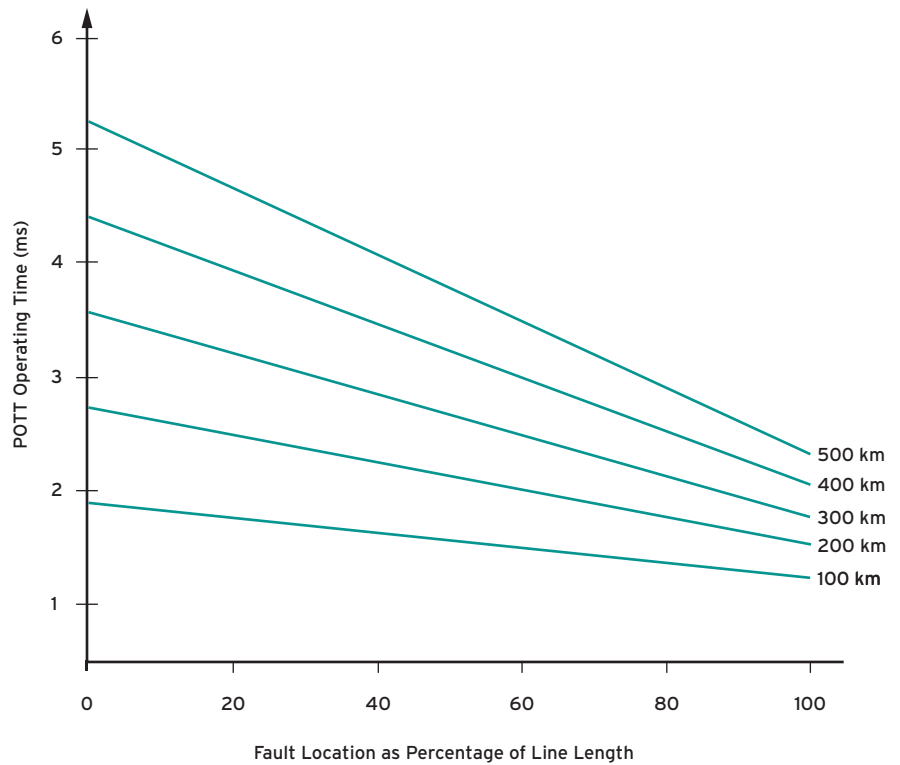
Distribution System Automation

MIRRORED BITS allows simpler and cheaper implementation of distribution system automation. It enables secure sharing of the recloser status, the source status, and other logic information between SEL-651R Advanced Recloser Controls. It also provides voltage and synchronism check after reclosing.



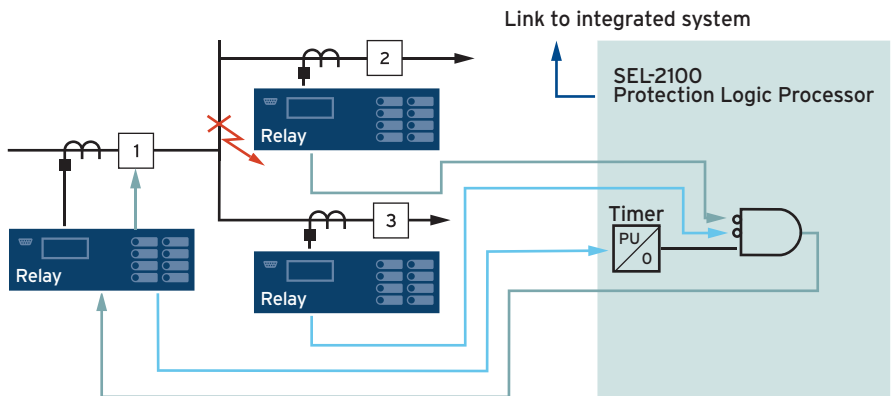
Permissive Overreaching Transfer Trip (POTT) Protection Scheme

The POTT scheme over a fiber-optic SEL Millisecond MIRRORED BITS communications port uses ultra-fast and sensitive directional elements for fault direction discrimination. The traveling-wave directional element (TW32) operates in 0.1 ms, and the incremental quantity directional element (TD32) operates in 1 to 2 ms, depending on system conditions. Sending phase-segregated permissive trip signals, the POTT scheme has excellent performance for evolving and intercircuit faults.



Fast Bus Tripping With the SEL-2100 Protection Logic Processor

Fast bus tripping significantly reduces bus fault-clearing times, reducing arc-flash hazards. The SEL-2100 uses the high-speed MIRRORED BITS protocol to communicate with each substation secondary-voltage protective relay in the system, including the relay monitoring the bus-tie breaker. This enables the fastest tripping speed when an event occurs.



Relay 1 detects a forward fault, and Relays 2 and 3 do not detect a fault, so the SEL-2100 transmits the trip decision to Relay 1. Relay 1 trips to clear the bus fault.

Products With MIRRORED BITS Communications

Line Protection, Automation, and Monitoring

SEL-311C Transmission Protection System

SEL-311L Line Current Differential Protection and Automation System

SEL-T400L Time-Domain Line Protection

SEL-411L Advanced Line Differential Protection, Automation, and Control System

SEL-421 Protection, Automation, and Control System

Distribution and Feeder Protection

SEL-351-6/-7 Protection System

SEL-351RS Kestrel® Single-Phase Recloser Control

SEL-351S-6/-7 Protection System

SEL-451 Protection, Automation, and Bay Control System

SEL-651R Advanced Recloser Control

SEL-651RA Recloser Control

SEL-751 Feeder Protection Relay

Automation Control and SCADA

SEL-2100 Logic Processor

SEL-2240 Axion®

SEL-2411 Programmable Automation Controller

SEL-2411P Pump Automation Controller

SEL-2440 DPAC Discrete Programmable Automation Controller

SEL-2505 Remote I/O Module

SEL-2506 Rack-Mount Remote I/O Module

SEL-2507 High-Speed Remote I/O Module

SEL-2523 Annunciator Panel

SEL-2533 Annunciator

SEL-3505 Real-Time Automation Controller (RTAC)

SEL-3530 Real-Time Automation Controller (RTAC)

SEL-3555 Real-Time Automation Controller (RTAC)

Testing

SEL-2505PB MIRRORED BITS Interface

SEL-4388 MIRRORED BITS Tester

Motor Protection

SEL-710-5 Motor Protection Relay

Substation Protection

SEL-401 Protection, Automation, and Control Merging Unit

SEL-487B Bus Differential and Breaker Failure Relay

SEL-487E Transformer Protection Relay

SEL-487V Capacitor Protection and Control System

SEL-787 Transformer Protection Relay

SEL-2414 Transformer Monitor

Generators and Distributed Generation Protection

SEL-700G Generator Protection Relay

SEL-700GT Intertie Protection Relay

SEL-700GW Wind Generator Relay

Metering

SEL-735 Power Quality and Revenue Meter

SEL Products That Aid in MIRRORED BITS Implementation

SEL-2126 Fiber-Optic Transfer Switch

SEL-2800 Fiber-Optic Transceiver

SEL-2810 Fiber-Optic Transceiver With IRIG-B

SEL-2812 Fiber-Optic Transceiver With IRIG-B

SEL-2814 Fiber-Optic Transceiver With Hardware Flow Control

SEL-2815 Fiber-Optic Transceiver

SEL-2829 Single-Mode Fiber-Optic Transceiver

SEL-2830 Single-Mode Fiber-Optic Transceiver

SEL-2831 Single-Mode Fiber-Optic Transceiver

SEL-2894 Interface Converter

SEL-3094 Interface Converter

SEL-9220 Fiber-Optic Adapter for SEL-300 Series Relays

Fault Indicators and Sensors

SEL-FT50 and SEL-FR12 Fault Transmitter and Receiver System



Making Electric Power Safer, More Reliable, and More Economical
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