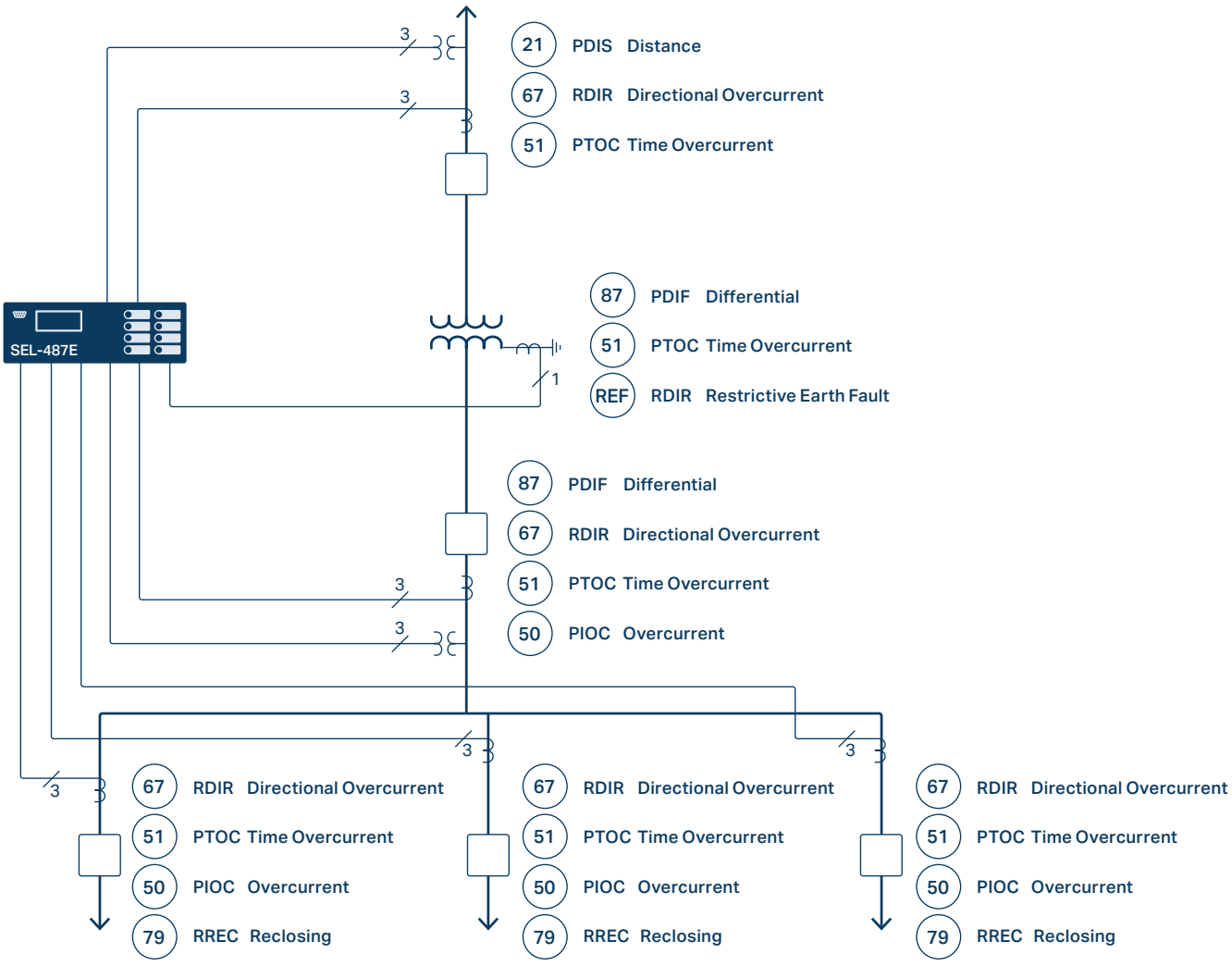
Centralized Protection and Control Solution Using SEL-487E

Apply centralized protection and control (CPC) schemes with the SEL-487E

- Simultaneously protect transformers, buses, lines, and feeders using differential, overcurrent, and distance elements available in a single device.
- Simplify pad-mounted switchgear protection by using a single device for up to six-way applications.
- Reduce device count and complexity by replacing multiple application-specific devices with one relay.
- Simplify CPC applications by using the familiar SEL-487E Transformer Protection Relay in new configurations.
- Reduce wiring for CPC applications utilizing SEL digital secondary system (DSS) solutions.

Overview

The SEL-487E delivers a CPC solution that offers complete protection for small substations and is highly adaptable, maximizing the benefits of any given application. Connect to conventional instrument transformers using traditional copper connections or as part of a DSS solution, such as IEC 61850-9-2 Sampled Values (SV) or Time-Domain Link (TiDL®) technology. In these DSS applications, merging units acquire data close to the instrument transformers and send the data to remote SEL-487E relays to provide the required information.



Key Features

Multiple Analog Inputs

Connect to multiple instrument transformers and provide substation-wide protection using the SEL-487E relay CT and PT inputs. The SEL-487E supports up to 18 CT inputs, which can be ordered in combinations of 5 A and 1 A CTs. There are six PT inputs that can be ordered as conventional or low-energy analog (LEA) inputs.

Comprehensive Differential Protection

Implement fast, sensitive, dependable, and secure differential protection with a differential element characteristic that automatically adapts to internal or external fault conditions. The adaptive differential element responds to internal fault conditions in less than 1.5 cycles. The SEL-487E includes two differential elements: one intended for protecting transformers and the other intended for protecting busbar applications.

Configurable Distance Protection

Apply up to four zones of phase and ground distance protection using mho or quadrilateral characteristics. The SEL-487E distance elements can be applied as a primary transmission line or as backup transformer protection.

Dependable Overcurrent Protection

Provide protection for up to six terminals with one device using phase-, negative-, and zero-sequence overcurrent elements and 20 configurable time-overcurrent elements. In breaker failure protection applications, reduce breaker failure coordination time when subsidence current is present with fast open-phase detection. Secure feeder overcurrent protection using the optional per-terminal second-harmonic-blocking feature.

Diverse Protection Applications

Simultaneously protect multiple assets—such as transformers, buses, lines, and feeders—in centralized protection applications. Protect large transformers and autotransformers with double breakers in the high- and low-side buses of the power transformer.

You can also configure the SEL-487E for a typical two-winding transformer application and use the remaining three-phase current inputs for feeder or line backup protection. The SEL-487E can provide complete feeder protection for up to six feeders.

The SEL-487E is a good fit for pad-mounted switchgear protection. A single SEL-487E protects up to six-way applications. Protect each terminal with directional, instantaneous, and time-delay overcurrent elements. Per-terminal harmonic blocking secures the system from downstream in-rush current resulting from transformer energization.

DSS Technology

Modernize your substation by applying a DSS solution such as SEL TiDL or SEL SV technology. DSS solutions replace copper wires with fiber-optic cables to increase safety, reduce costs, and limit the impact of electromagnetic interference in secondary circuits.

SV systems combine a flexible Ethernet communications network with the interoperability of an international standard. The SV solution combines protection functionality included in the merging units with the data-sharing capability of the IEC 61850 SV architecture. SEL SV merging units (or other IEC 61850-9-2 SV-compliant units) digitize signals and transmit them via fiber-optic-based Ethernet to an SEL-487E-5 SV relay in the control house.

The TiDL solution is a secure and easy-to-implement point-to-point solution that does not require an external time source or network engineering. SEL-TMU TiDL Merging Units placed in the yard digitize signals and transmit them over fiber-optic cables to the SEL-487E-5 TiDL relay in the control house.

SV Technology

For CPC schemes that require both the flexibility of a network and standard-compliant interoperability, SEL offers an IEC 61850-compliant SV solution.

Advanced Merging Units With Built-In Protection

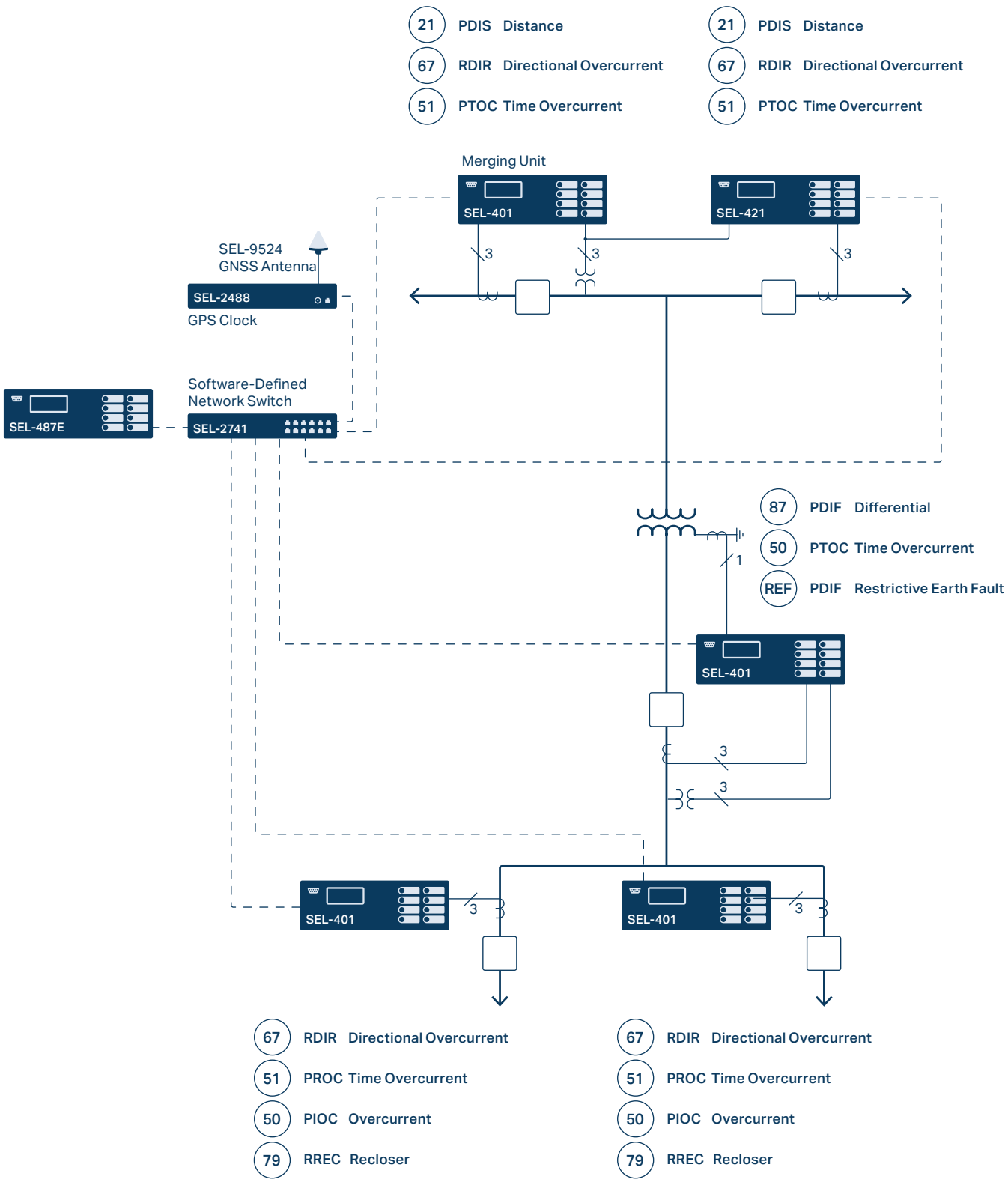
Use SEL SV merging units with varying protection specialties to digitize analog signals from CTs and PTs. The SEL-401 includes overcurrent and breaker failure protection, while other SEL merging units can offer full local protection, depending on the device and scheme.

A Robust, Deterministic Network

Build a more robust Ethernet network using SEL operational technology (OT) software-defined networking (SDN) technology. SDN uses predetermined, engineered traffic flows to provide both deterministic performance and high-speed recovery in case of a failed link. Use the Parallel Redundancy Protocol (PRP), the High-Availability Seamless Redundancy (HSR) protocol, or failover functionality to increase system availability.

System-Wide Time Synchronization

Synchronize every device on your system using the SEL-2488 Satellite-Synchronized Network Clock. The SEL-2488 can supply time in either IRIG-B or the IEEE 1588 Precision Time Protocol (PTP) to provide high-accuracy time that is suitable for SV applications. The optional oven-controlled crystal oscillator provides high holdover accuracy in case of satellite signal loss.


21 PDIS Distance
67 RDIR Directional Overcurrent
51 PTOC Time Overcurrent
21 PDIS Distance
67 RDIR Directional Overcurrent
51 PTOC Time Overcurrent
Merging Unit
SEL-401
SEL-421
SEL-9524
GNSS Antenna
SEL-2488
GPS Clock
Software-Defined
Network Switch
SEL-487E
SEL-2741
3
3
3
87 PDIF Differential
50 PTOC Time Overcurrent
REF PDIF Restrictive Earth Fault
1
SEL-401
3
3
SEL-401
SEL-401
3
3
67 RDIR Directional Overcurrent
51 PROC Time Overcurrent
50 PIOC Overcurrent
79 RREC Recloser
67 RDIR Directional Overcurrent
51 PROC Time Overcurrent
50 PIOC Overcurrent
79 RREC Recloser

TiDL Technology

When it comes to creating distribution substation protection and control schemes, SEL TiDL-based solutions are easy to deploy and include software to simplify the commissioning process.

Simple, Intuitive Installation

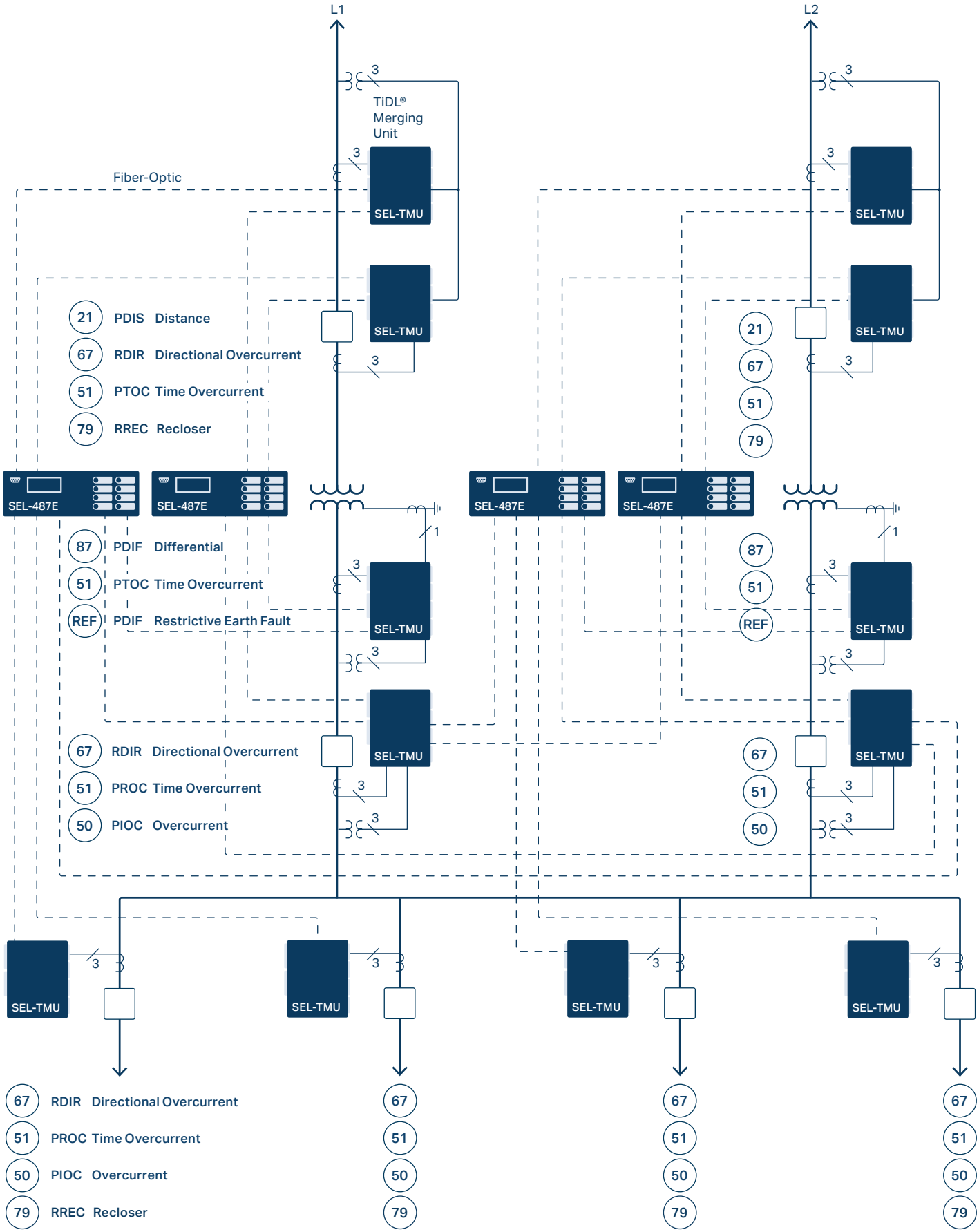
Compact TiDL merging units easily fit into existing cabinets. Flexible I/O options include digital I/O and allow for 4 PT/4 CT or 8 CT configurations. Each merging unit can serve up to four different TiDL-enabled relays and simplifies device management by not requiring settings.

Streamlined Settings Management

SEL Grid Configurator Software creates settings for the entire system. Use intuitive interfaces to easily create and deploy settings, program custom relay logic, and commission TiDL systems with an intuitive, easy-to-use interface.

Rapid Deployment and Troubleshooting

Use automated commissioning reports and information from the relay to quickly troubleshoot or verify the proper installation of the system. Receive quick feedback, and identify any existing errors by comparing these reports to settings developed during the engineering and commissioning phases.


L1
L2
TiDL®
Merging
Unit
Fiber-Optic
SEL-TMU
SEL-487E
21 PDIS Distance
67 RDIR Directional Overcurrent
51 PTOC Time Overcurrent
79 RREC Recloser
87 PDIF Differential
51 PTOC Time Overcurrent
REF PDIF Restrictive Earth Fault
67 RDIR Directional Overcurrent
51 PROC Time Overcurrent
50 PIOC Overcurrent
67 RDIR Directional Overcurrent
51 PROC Time Overcurrent
50 PIOC Overcurrent
79 RREC Recloser

SEL-487E Specifications

General

AC Current Inputs (18 total)	5 A nominal 1 A nominal 1 A/5 A nominal (Y terminal only [REF])
AC Voltage Inputs (6 total)	0—300 V_{L-N} operational
LEA Voltage Inputs	0—8 V_{L-N} operational
Communications Protocols	FTP, Telnet, SEL ASCII, SEL Fast Message, synchrophasors, DNP3, PRP, HSR, PTPv2, and IEC 61850 Edition 2.1 (optional)
Communications Ports	**Serial Ports** One front-panel and three rear-panel EIA-232 serial ports 300—57,600 bps **Two-Port Ethernet Card** Two 100BASE-FX fiber-optic network ports **Four-Port Ethernet Card** Four 10/100BASE-T twisted-pair network ports, or Four 100BASE-FX fiber-optic network ports, or Two 10/100BASE-T twisted-pair network ports and two 100BASE-FX fiber-optic network ports **Five-Port Ethernet Card** Two 100/1000BASE SFP ports Three 100BASE SFP ports

TiDL Ports	Fiber-optic SFP ports: 8 Range: ~2 km Data rate: 100 Mbps Protocol: SEL T-Protocol
SV Ports	Subscriber: As many as 7 SV data streams Publisher: As many as 7 SV data streams Data rate: 4.8 kHz for 60 Hz system or 4 kHz for 50 Hz system Protocol: IEC 61850-9-2
Precise-Time Input	Demodulated IRIG-B time input and PTPv2
Processing	AC voltage and current inputs: 8,000 samples per second Protection and control processing: 8 times per power system cycle
Power Supply	24—48 Vdc 48—125 Vdc or 110—120 Vac 125—250 Vdc or 110—240 Vac
Operating Temperature	−40° to +85°C (−40° to +185°F)

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