SEL Time-Domain Link (TiDL®) Technology

The simple, fast, and secure digital secondary system solution

- Increase safety by removing high-energy cables from areas where personnel typically work.

- Reduce the costs associated with copper wiring installation, commissioning, and documentation.

- Implement state-of-the-art protection with the SEL-2240 Axion® node's synchronous sampling and the proven protection technologies in SEL-400 series relays.

- Achieve strong cybersecurity by using a point-to-point architecture with an isolated network and no Ethernet switch.

- Eliminate complexity—TiDL technology requires no network engineering or external time reference.

Save Copper. Save Time. Save Money. Save Lives.

SEL TiDL technology is an innovative digital secondary system solution engineered with simplicity in mind. This technology requires no external time reference, has strong cybersecurity, and is easy to implement with no network engineering required. It includes a modular node that digitizes analog signals into deterministic fiber communications that directly connect to SEL relays located in the control house. TiDL eliminates high-energy signals where personnel typically work and reduces the costs associated with using copper cables. TiDL saves copper, saves time, saves money, and saves lives.

In a TiDL system, SEL-2240 Axion nodes located close to primary equipment in the yard act as field modules. TiDL's simple point-to-point architecture transports the data over fiber-optic cable to a TiDL-enabled SEL-400 series relay in the control house. The Axion's synchronous sampling improves the accuracy of the protection signals, and its modular architecture allows you to select the number of analog and digital input modules to match any application. Relay settings remain the same as those in other SEL-400 series models, providing consistency and simplicity.

Because TiDL uses a point-to-point architecture, implementation is simple and requires zero network engineering. TiDL maintains relative time; therefore, it does not rely on an external time reference for protection. All remote Axion nodes sample synchronously with each other regardless of the number of Axions connected to the network or the fiber length.

TiDL technology combines the protection of the SEL-400 series relays with the modularity and flexibility of the Axion, providing a scalable and flexible solution. Implement a digital secondary system using SEL's TiDL technology for a simple, fast, and secure solution.

Key Features

Proven Protection

Use the proven SEL-400 series relays with the same protection algorithms, schemes, and configurations that you are used to. The SEL Axion samples data and transmits them to the SEL-400 series relay, providing uncompromised protection.

Simplified Networking

Use TiDL's point-to-point fiber connections to eliminate the need for switches and complex network engineering in order to achieve reliable protection. By using TiDL's preconfigured analog mapping topologies, you can easily map signals from the remote Axion nodes to internal relay logic, reducing the complexity of configuring the system.

Built-In Time Synchronization

Synchronize the sampling of all the remote Axion nodes by using the point-to-point fiber connections. Remote nodes will sample synchronously regardless of the number of Axion nodes connected or the fiber length. This ensures that protection is available in the relay regardless of whether or not an external time signal is available.

Strong Cybersecurity Posture

Keep mission-critical systems secure using TiDL's dedicated, deterministic communications network. The isolated network and the absence of switches and routers reduce the electronic security perimeter and keep attack points limited. This security-minded architecture prevents remote access, and its simplicity eliminates the need for managing port access.

Fast Commissioning Times and Troubleshooting

Commission relays in the field quickly by using the tools in SEL's TiDL system. You can preconfigure the relay in a test setting and then reconnect it in the yard and use the status LEDs on the back of the relay to identify wiring errors.

Supported Relay Models and Applications

SEL relays enabled with TiDL technology have settings and applications that are identical to traditional models. Instead of standard copper wiring connections, the relay has eight 100BASE-FX fiber ports for acquiring digitized analog data. In addition, the relay has a traditional I/O board for local use in the control house with the rest of the inputs and outputs allocated to the remote Axion nodes.

SEL-421: Line Distance Protection

Protect important lines with the SEL-421 Protection, Automation, and Control System using a combination of phase and ground distance elements with directional, instantaneous, and inverse-time overcurrent elements. For critical lines, deploy the optional high-speed, subcycle distance elements and series compensation logic.

SEL-451: Feeder Protection

Provide comprehensive feeder protection with the SEL-451 Protection, Automation, and Bay Control System. The relay features multiple instantaneous and time-overcurrent elements along with optional high-impedance fault detection capabilities. In addition, take advantage of the dual CT inputs for applications with dual-breaker implementations.

SEL-487E: Transformer Protection

Protect large power system transformers with the SEL-487E Transformer Protection Relay, which has five 3-phase current CT inputs and three restricted earth fault (REF) zones. In addition, the relay offers an array of inrush protection features, including harmonic restraint and blocking, as well as a waveform detection algorithm for newer transformers with lower harmonic content.

### SEL-487B: Low-Impedance Bus Differential Protection

Use up to 21 current inputs from remote Axion units in a low-impedance bus protection scheme with up to a 10:1 CT mismatch ratio by applying the SEL-487B Bus Differential and Breaker Failure Relay. The relay's three independent check zones and patented open CT detection logic provide powerful bus protection.

Preconfigured Topologies

To simplify the mapping of remote current and voltage inputs to internal relay logic, TiDL systems support preconfigured topologies. When you connect Axion nodes to predetermined TiDL ports, the SEL relay will validate the topology and automatically map remote currents and voltages to internal logic. Topologies are designed to reduce the amount of copper needed for an installation and to minimize the number of Axion nodes needed. Some examples are shown below. You can find supported topologies for any given relay in its instruction manual.
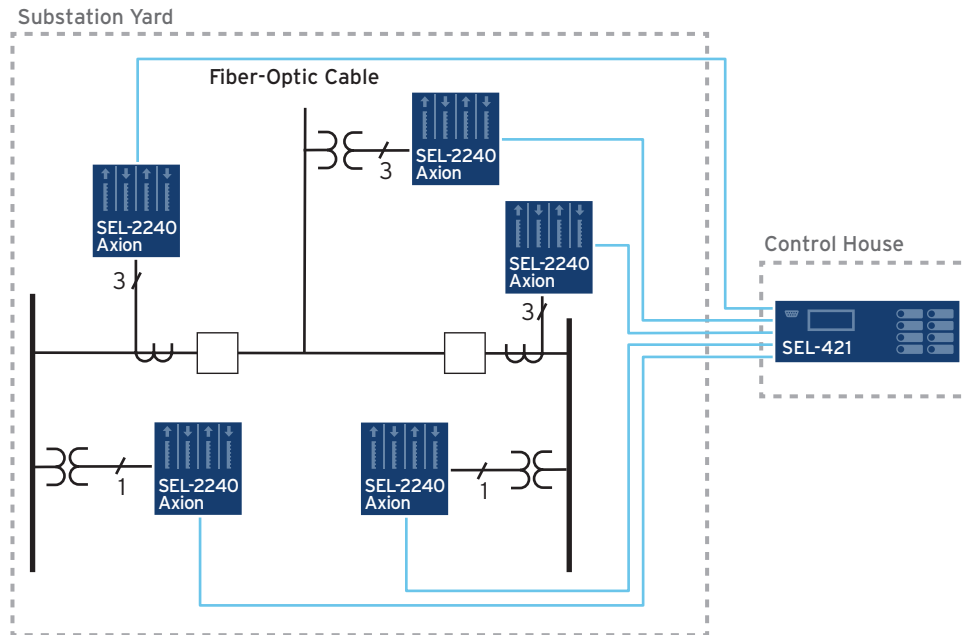
Maximize copper reduction with multiple Axion nodes.
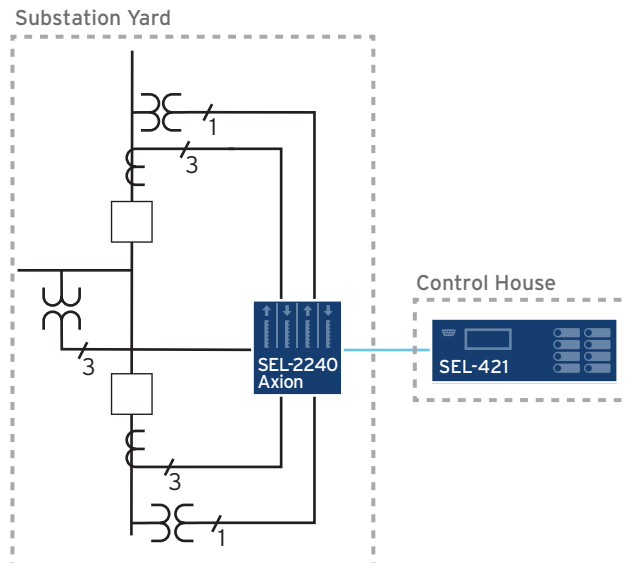
Minimize the device count with a single Axion node.

Remote Data Collection Using the SEL Axion Platform

For remote data acquisition, use SEL's rugged Axion platform. You can mix and match different modules to fit your specific application. Chassis options include half-rack and full-rack versions to support 4 or 10 modules. The following Axion modules are available.
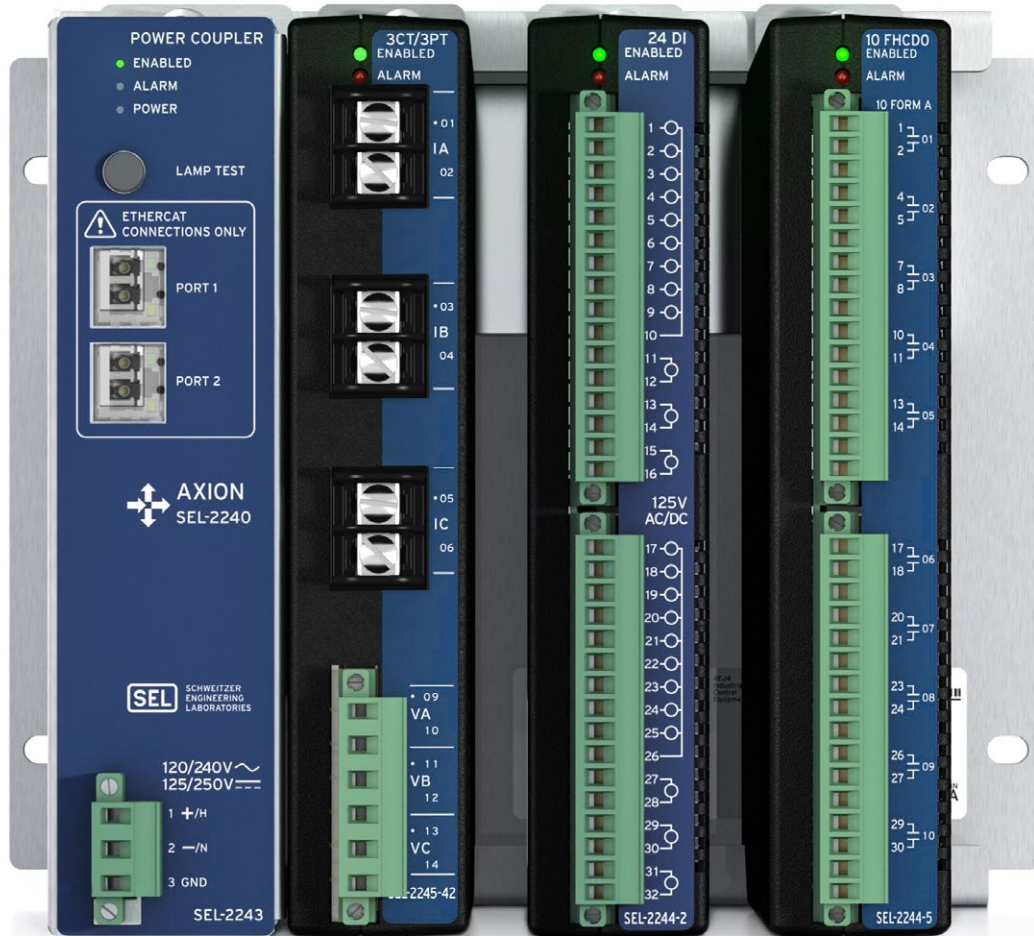
SEL-2243 Power Coupler

You can provide power to all of the modules on your Axion backplane and can connect the module to a relay through the built-in fiber-optic port. The module supports six different voltage level options for application flexibility.

SEL-2245-42 AC Protection Module

Three current and three voltage inputs are rated for protection applications and sample synchronously.

SEL-2244-2 Digital Input Module

This module features digital inputs with individual LED indicators for each contact. There are up to six input voltage ratings, ranging from 24 to 250 Vdc/Vac, to match your application.

SEL-2244-5 Fast High-Current Digital Output Module

You can use the high-current tripping capacity (10 A) and fast rise time (<16 µs at 125 V) outputs in the module to drive trip contacts in a breaker.

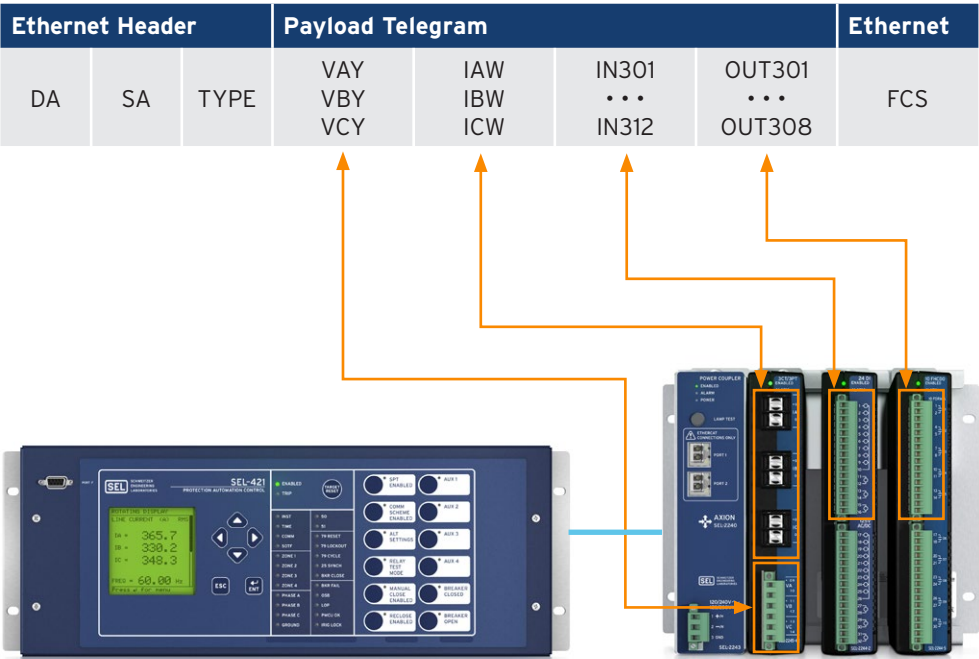# Data Transfer Using Point-to-Point Fiber

SEL's TiDL technology uses point-to-point fiber to send analog and digital data between an Axion node and a relay. This connection uses a predefined packet that is established during commissioning to provide the following benefits.

Low Latency and Low Jitter

Using point-to-point connections without switches or other network devices between the publisher and subscriber leads to low latency and low jitter. Axion nodes sample within ±100 ns of each other, ensuring analog sampling coherency.

Local Time Synchronization

Synchronize the entire TiDL system locally using point-to-point connections. Relative local time can be maintained between the relay and all of the Axion nodes without the need for an external time signal, such as that from a GPS clock.

Ethernet Header			Payload Telegram				Ethernet
DA	SA	TYPE	VAY VBY VCY	IAW IBW ICW	IN301 • • • IN312	OUT301 • • • OUT308	FCS

Analog and digital signals have a predetermined place in the packet.

Easy Setup and Commissioning

Simple Commissioning

To commission a TiDL system, simply connect the fiber ports on the Axion Power Coupler Module to the SEL-400 series relay in a valid configuration and press the commissioning button. The relay will automatically discover the Axion nodes and only accept the configuration if it is valid.

Easy Troubleshooting

Find problem cables without the need for network analysis by using the built-in status tools in the TiDL system. In addition to the overall status LED, each port has an individual LED indicator to speed up troubleshooting if communications are disrupted.

Tools for Testing and Commissioning

Preconfigure and commission the relay in a test environment, and then use the status LEDs to indicate wiring errors at the installation site. The relay stores the last valid configuration in memory to ensure the nodes are connected identically to when it was commissioned.

Centralized Field Upgrades

Upgrading the Axion field modules is easy and does not require you to physically access each node individually. Simply access the relay in the control house to provide firmware upgrades to all remote Axion nodes.