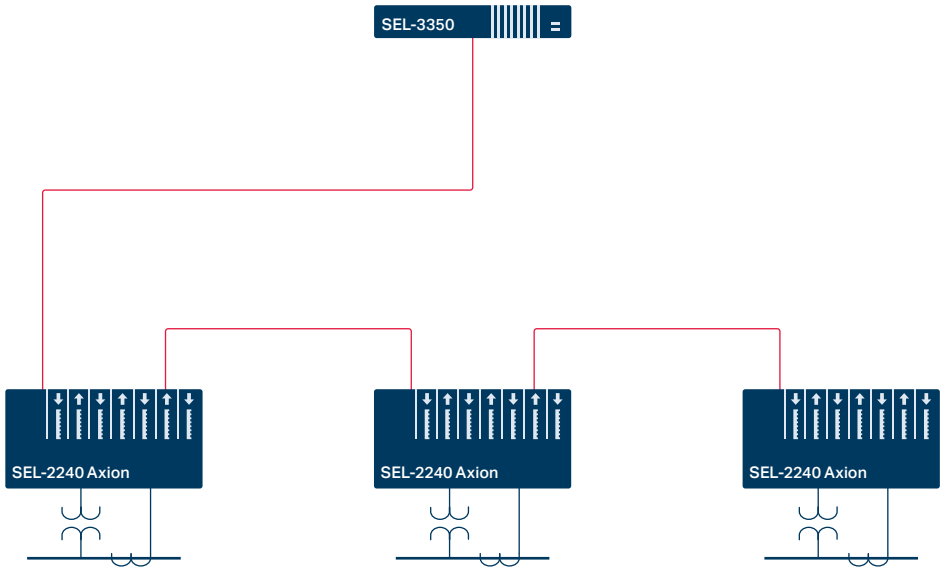
SEL Advanced Digital Fault Recorder (DFR) Solutions

Comprehensive substation data collection, monitoring, and visualization

- Capture system events at 24 kHz, record dynamic disturbance data, log Sequence of Events (SOE) data, and locate faults.
- Leverage IED data to investigate disturbances, monitor assets, and exceed NERC PRC-002 standards.
- Stream and record continuous oscillography data at 3 kHz.
- Calculate and stream energy packets.
- Use the powerful Real-Time Automation Controller (RTAC) logic engine to monitor critical substation assets and networks.
- Analyze event reports, visualize streaming data, and centralize data collection with advanced software.

Direct Measurement Solutions

Direct measurement DFR solutions combine the SEL RTAC with the SEL-2240 Axion® modular I/O platform to sample currents and voltages, generate event reports, continuously record dynamic disturbance data, and log SOE data.



Scalable

Apply up to 16 protection-class CT/PT modules supporting 96 analog inputs in one Axion system for recording fault data at up to 24 kHz. Merge digital status tags from Axion I/O modules with multiple CT/PT module fault records using the Recording Group configuration to create system-level event reports.

High-Speed Fault Recording With Axion I/O

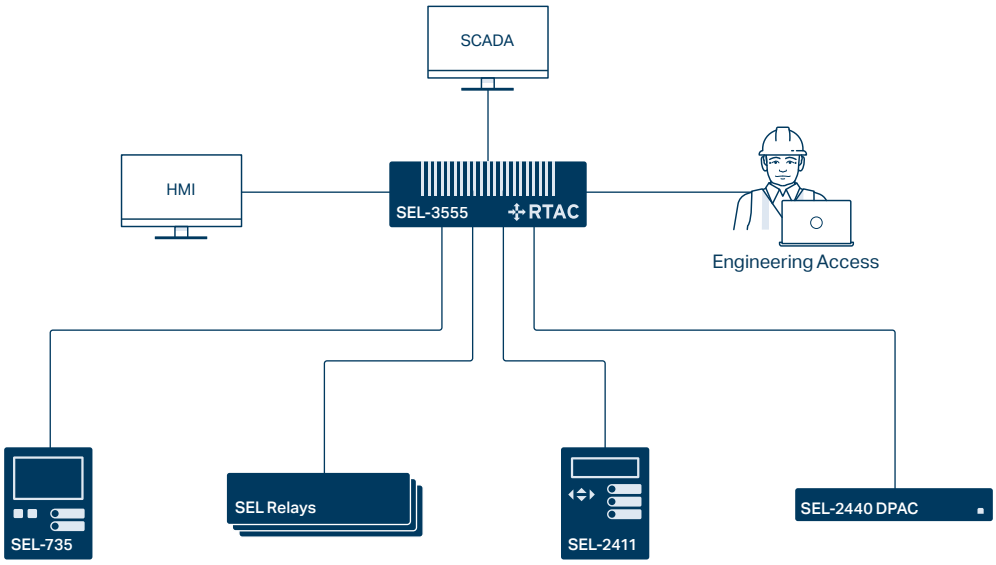
Customize fault recording by choosing from 1 to 24 kHz reports varying from 1 to 576 seconds. With up to 2 TB available for fault record storage, you can locally store up to 10,000 reports and continuously record at 3 kHz.

Use the advanced SELOGIC® engine in the Axion to trigger events. Cross-trigger other fault recorder systems or relays using IEC 61850 GOOSE messages or MIRRORED BITS® communications. The Recording Triggers extension in ACSELERATOR RTAC® SEL-5033 Software lets you configure triggers without writing a single line of code.

With SYNCHROWAVE® Event Viewer, you can perform detailed analysis, like fast Fourier transform (FFT) and spectral analysis, to find harmonic content in the power system.

Integrated Solutions

Integrated DFR solutions use the RTAC to collect event reports and SOE data from IEDs and continuously record dynamic disturbance data streamed by IEDs. Leverage existing systems with SEL relays and other IEDs to perform dynamic disturbance and fault recording that exceeds standards such as NERC PRC-002.



Applications

Record Disturbances and Exceed NERC PRC-002 Requirements

Capture power system data to support event analysis and locate faults. Easily exceed requirements for standards such as NERC PRC-002. Our advanced DFR solutions generate and collect event reports, capture synchrophasors for dynamic disturbance data, record SOE data, and calculate fault locations using an impedance-based algorithm.

Stream and Record Continuous Oscillography

Advanced DFR solutions support continuous oscillography streaming and recording at 3 kHz—providing significantly more visibility into power system behavior than intermittent event reports.

Our solutions use the Axion Wave Server for oscillography streaming and the powerful RTAC logic engine for oscillography recording. With 2 TB of local storage, the RTAC supports continuous oscillography recording at 3 kHz for 10 consecutive days or more.

Since this method does not rely on triggers, it guarantees that power system events will never be missed. It also streamlines deployment, allowing you to exceed compliance with standards such as NERC PRC-002—even without configuring triggers. You can easily export data to CSV and COMTRADE data formats to support compliance activities.

Our advanced DFR solutions also support many months of recording for other analog data, such as synchrophasors from any phasor measurement unit (PMU) clients.

Proactively Monitor Substation Assets

In addition to performing core DFR functions, the RTAC logic engine supports advanced monitoring for substation assets, such as CTs/PTs and networks. You can also configure custom logic to support applications such as monitoring breaker wear.

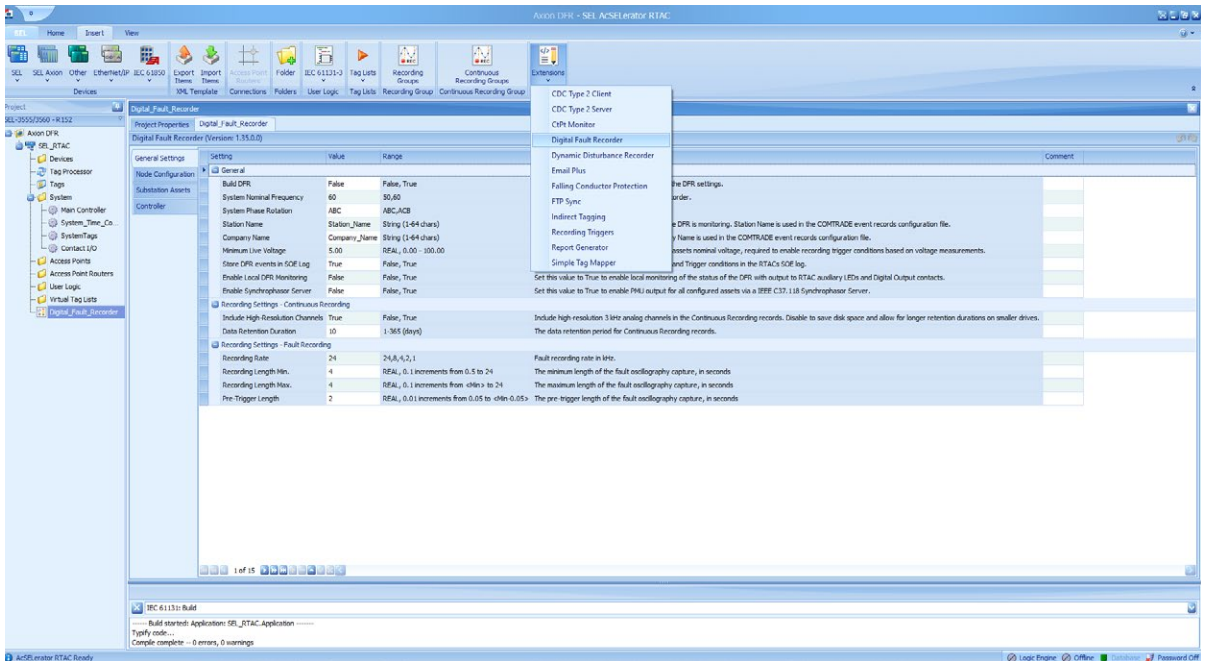
Measure Energy With Greater Precision

Traditional phasor-based measurements rely on steady-state conditions. Industry-exclusive energy packet technology from SEL precisely reports the energy flow under all system conditions, regardless of the frequency, angle, or distortion. Process Axion Wave Server samples in the RTAC logic engine to calculate, stream, and record energy packets.

Supporting Software

Simple Configuration

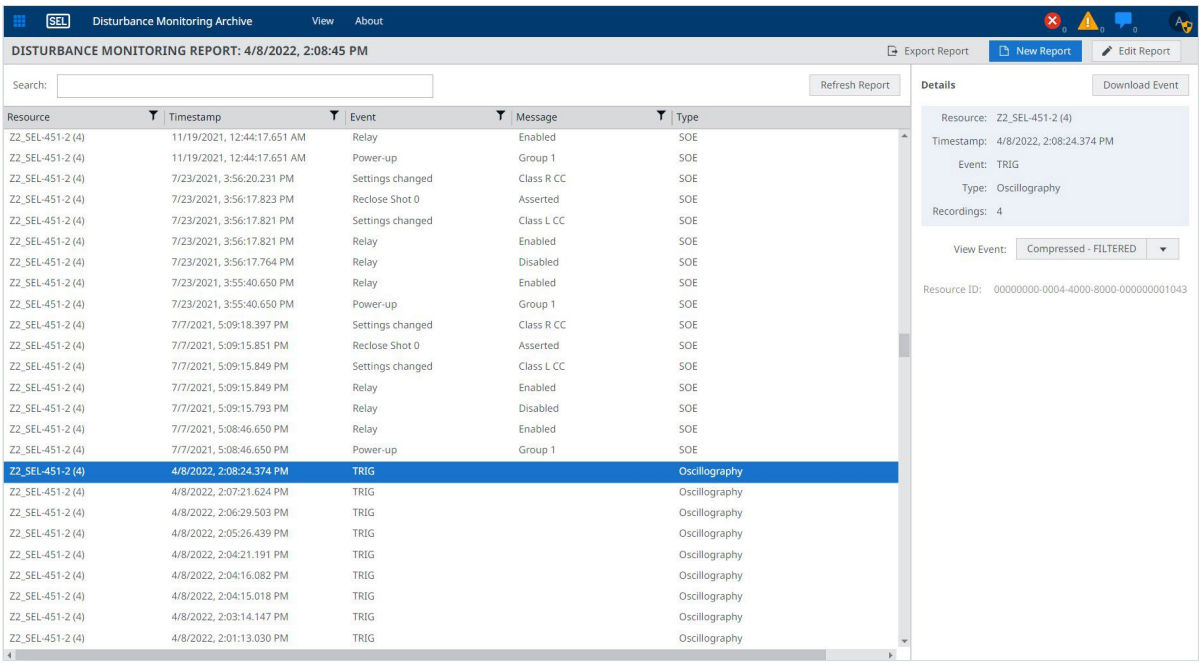
ACSELERATOR RTAC is a graphical, easy-to-use software tool for configuring the SEL RTAC. Its DFR library extension allows you to build an advanced DFR system in minutes using a simple settings form.



ACSELERATOR RTAC software

Automated Data Collection

Use the Data Management and Automation (DMA) application suite on the SEL Blueframe® application platform to automate and centralize the collection of event reports and SOE data from multiple DFR deployments.

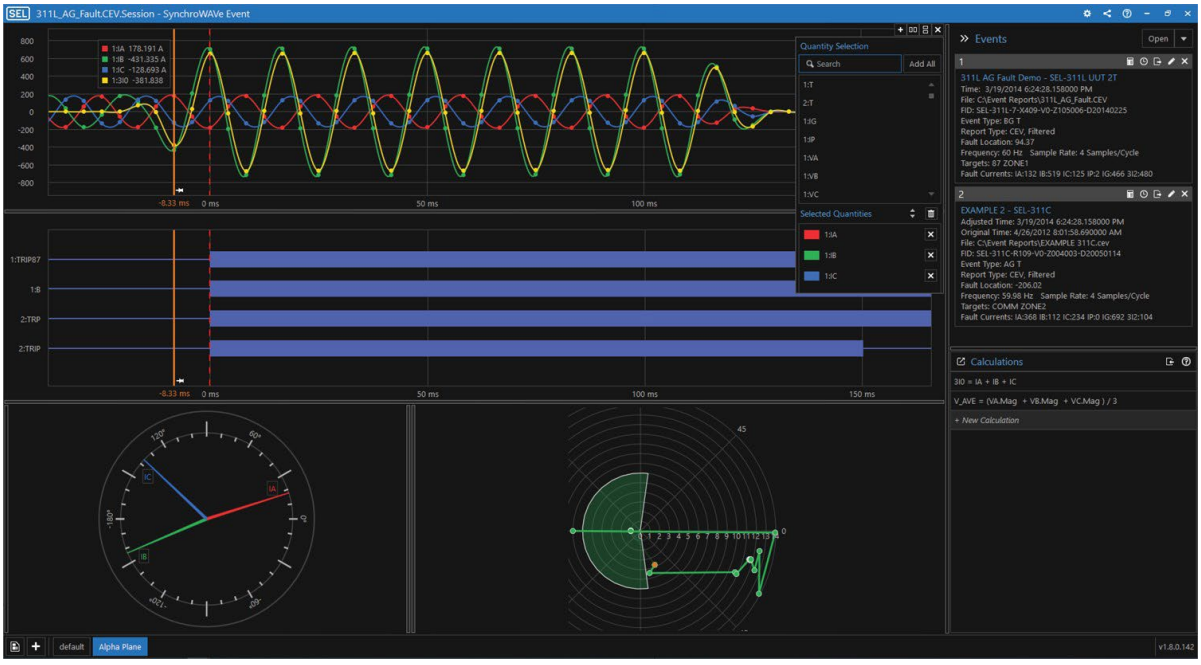


DMA Disturbance Monitoring applications on SEL Blueframe

Data Visualization and Analysis

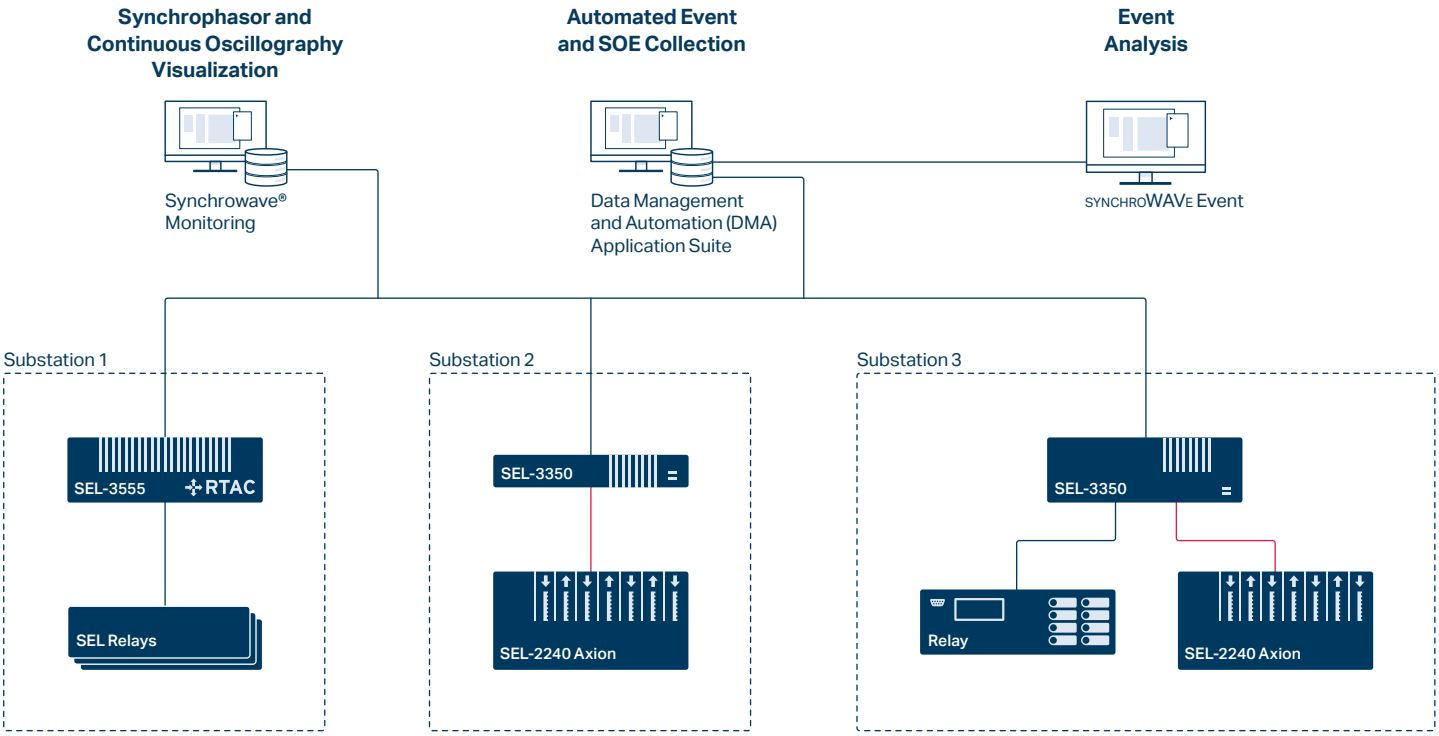
View and analyze 3 kHz continuous oscillography data and synchrophasor data in real time using SEL-5703 Synchrowave Monitoring software. Access and analyze event reports with SEL-5601-2 SYNCHROWAVE Event software. Synchrowave software provides comprehensive visualization capabilities, such as viewing multiple event files simultaneously and time-aligning synchrophasor data with event reports.

Synchrowave Operations software



SYNCHROWAVE Event software

Complete Solution With Supporting Software



Example 24-Channel DFR Solution Components*

Product	Part No.
SEL-3350 RTAC Processor: Quad-core 1.6 GHz RAM: 8 GB Storage: 2 TB Continuous Recorder license	3350#4MD8
SEL-2240 Axion Preassembled Axion with 19" rack-mount backplane, Power Coupler with Ethernet, four AC Protection Modules (12 current and 12 voltage channels), and one Digital Input Module (24 digital input channels)	2240#T4E2
SEL-5601-2 SYNCHROWAVE Event Event analysis software	5601153WX0
Additional Options	
SEL-5703 Synchrowave Monitoring Synchrophasor and continuous oscillography visualization and archiving software	5703#FB79
SEL DMA Disturbance Monitoring Application Package Automated event and SOE collection software	Available on SEL computing platform hardware or virtual machine deployments. Contact your sales representative for ordering information.

*Available for systems ranging from 6 to 96 channels

Specifications

General

Analog Inputs Per CT/PT Module	3 Voltages: 6.7—240 V_{LN} 3 Currents: 0.1—20.0 A_{rms}
I/O Modules	Digital input: 24 contact inputs (24, 48, 110, 125, 220, and 250 Vac/Vdc) Standard digital output: 16 standard control outputs All Form A, all Form B, or mixed
Configuration	Use the DFR library extension in ACSELERATOR RTAC software to configure hardware, channels, fault recording triggers, SOE logging, dynamic disturbance recording, fault locating, and more.
Fault Recording	Sampling rates: 1, 2, 4, 8, and 24 kHz, software-selectable **Transient Fault Record Length** Prefault time: 0.05 s — (max. event length — 0.05 s) Individual records as long as: 24 seconds for 24 kHz 72 seconds for 8 kHz 144 seconds for 4 kHz 288 seconds for 2 kHz 576 seconds for 1 kHz Data format: IEEE C37.111-2013 COMTRADE File naming: IEEE C37.232 COMNAME Store up to 10,000 COMTRADE events.
Cross-Triggering	Cross-trigger multiple SEL Axions using digital I/O with SEL-2244 modules or serial or Ethernet communication links between SEL RTACs.
SOE Recording	Store up to 500,000 records with 1 ms accuracy.
Axion Wave Server	Stream continuous oscillography analog data at 3,000 samples per second to Synchrowave Operations or Synchrowave Monitoring.
Continuous Recorder	Record currents, voltages, and frequency inputs up to 250 times a second for dynamic disturbance records. Record continuous oscillography analog data at 3,000 samples per second. Store up to 2 TB of data (more than 10 days of continuous oscillography with 96 channels).
Synchrophasors	Conformance: IEEE C37.118.1-2011 as amended by IEEE C37.118.1a-2014, IEEE C37.118.2-2011 Accuracy: Level 1 as specified by IEEE C37.118 Message rates: 1 to 120 Hz Measurements: Software-selectable (P or M class) Phase voltages Phase currents Positive-sequence current, frequency, df/dt
Fault Location	Determine the distance to the fault using the SEL RTAC impedance-based fault location library.
Time Synchronization	IRIG-B Precision Time Protocol (PTP)
Operating Temperature	SEL-3350 RTAC: —40° to +85°C (—40° to +185°F) SEL-3555 RTAC: —40° to +75°C (—40° to +167°F) Axion modules: —40° to +85°C (—40° to +185°F)

For additional specifications, please refer to the Axion, SEL-3350, and SEL-3555 datasheets. For more information about streaming and recording continuous oscillography and energy packets, please see the Continuous Waveform Recording flyer and application guide AG2023-19.

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