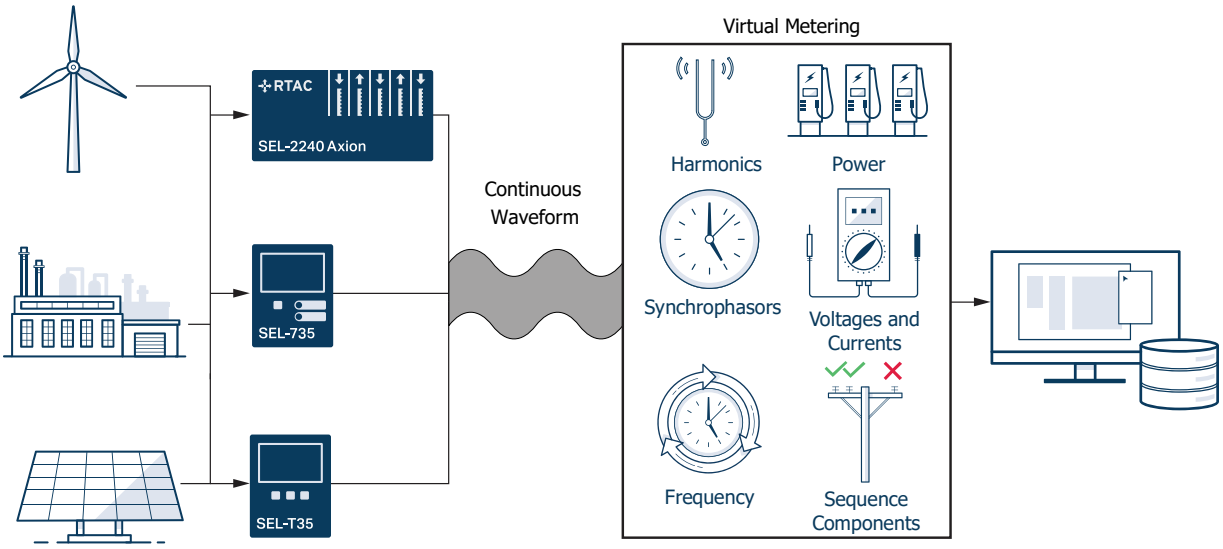
Virtual Meter

Virtual Metering for Advanced Power System Analysis



Key Features and Benefits

Virtual Meter transforms continuous waveform streaming data into actionable metering quantities, power quality indicators, and warning notifications to solve difficult power system problems.

- **Easily Visualize Data.** View waveform data and calculated quantities graphically in real time by using the Monitoring or Operations application.
- **Faster Calculations.** Take advantage of faster update rates, with all meter quantities updating every 1/2 cycle.
- **Meter Aggregation.** Use custom calculations to aggregate multiple metering points, simplifying meter data management.
- **Power Quality Notifications.** Generate notifications based on real-time power quality conditions to quickly and easily identify disturbances.
- **Simplify Compliance.** Satisfy all your power quality compliance requirements with a single metering device, including IEC 61000-4-30, IEC C37.118, IEEE 519-2018, IEEE 2800, NERC PRC-002-2, and NERC PRC-028-1.

One Software, Two Flexible Solutions

Monitoring software comes in two ordering options to meet your application and budget. *Table 1* lists the applications and solutions provided in each software package. These package options can also be purchased as part of the Power Quality or Energy and Power Monitoring software bundle. See your SEL Synchrowave Instruction Manual for details on application features and calculation specifics.

Table 1 Monitoring Software Options

	Trending and Archiving	Power Monitoring
Phasor Measurement Unit Receiving	Yes	Yes
Continuous Waveform Streaming Receiving	Yes	Yes
Time-Series Historian	Yes	Yes
Calculations	Yes	Yes
Virtual Metering	Yes	Yes
Visualization	Yes	Yes
Data Export	Yes	Yes
Notifications/Alarms	—	Yes
Oscillation Detection	—	Yes
Disturbance Detection	—	Yes
PT Failure Detection	—	Yes
Threshold Monitoring	—	Yes

Virtual Meter provides all your power quality metrics in a simple software solution. The following features are provided to meet or exceed the IEC 61000-4-30 requirements.

- Two-hour aggregation
- Power frequency
- Magnitude of the supply voltage
- Flicker
- Supply voltage interruptions, dips, and swells
- Supply voltage symmetrical components
- Voltage harmonics
- Voltage interharmonics
- Rapid voltage change (RVC)
- Magnitude of current
- Current symmetrical components
- Harmonic currents
- Interharmonic currents

Features

Continuous Waveform Recording

Never miss a disturbance again by recording continuous waveform streaming data. Export the data directly to COMTRADE or CSV without the limitations of trigger-based events. Get more out of the data with archiving, virtual metering, load profile trending, subsynchronous oscillation detection, equipment failure analysis, and more.

Figure 1 Continuous Waveform Streaming

Power Quality Monitoring

- Visualize real-time waveforms and export recordings directly to COMTRADE at its native sample rate.
- Measure and record fundamental and rms current, voltage, power, power factor, and frequency.
- Aggregate multiple metering point measurements into a single combined quantity.
- Perform fast acquisition load profile recording at variable rates.

- Measure harmonic magnitudes and phase angles for voltage and current.
- Measure total harmonic distortion (THD), interharmonics, and harmonic groups.
- Identify voltage monitoring to identify sags, swells, and interruptions.
- Identify rapid voltage changes.
- Calculate maximum instantaneous, short-term, and long-term flicker.
- Calculate symmetrical components.
- Calculate synchrophasors.

Disturbance-Driven Notifications

Generate notifications with advanced detection algorithms to identify oscillations, voltage sag, swell, and interruption (VSSI) events, instrument transformer failure, and other power system disturbances. Create custom notifications driven from calculated signals exceeding the defined magnitude and time thresholds to identify anomalies unique to your application.

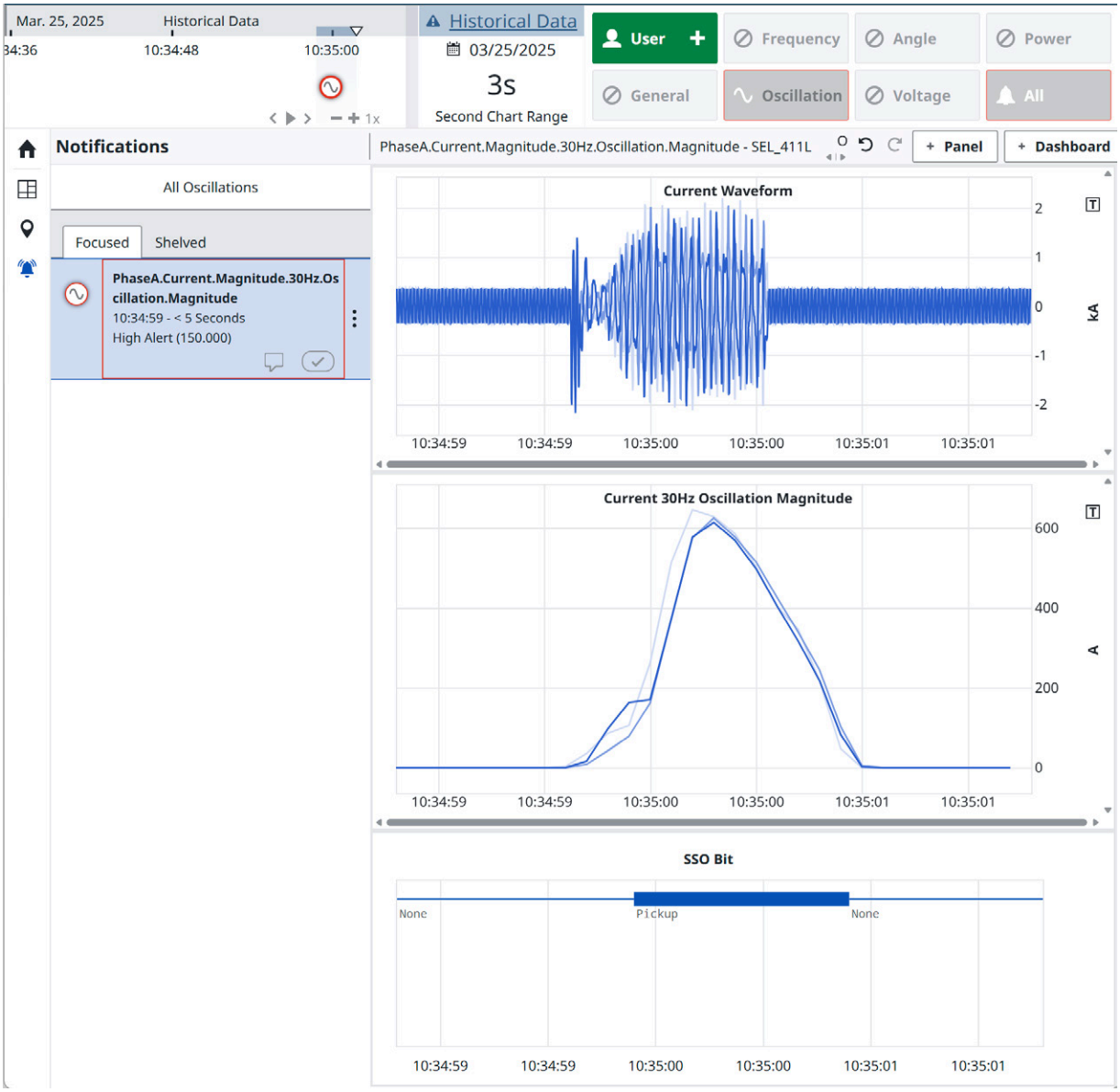


Figure 2 Oscillation Detection

Real-Time Visualization

Quickly and easily create personalized dashboards that feature the data most important to you. View your data as time-series trends, phasor diagrams, numeric tables, histograms, bar charts, and more.

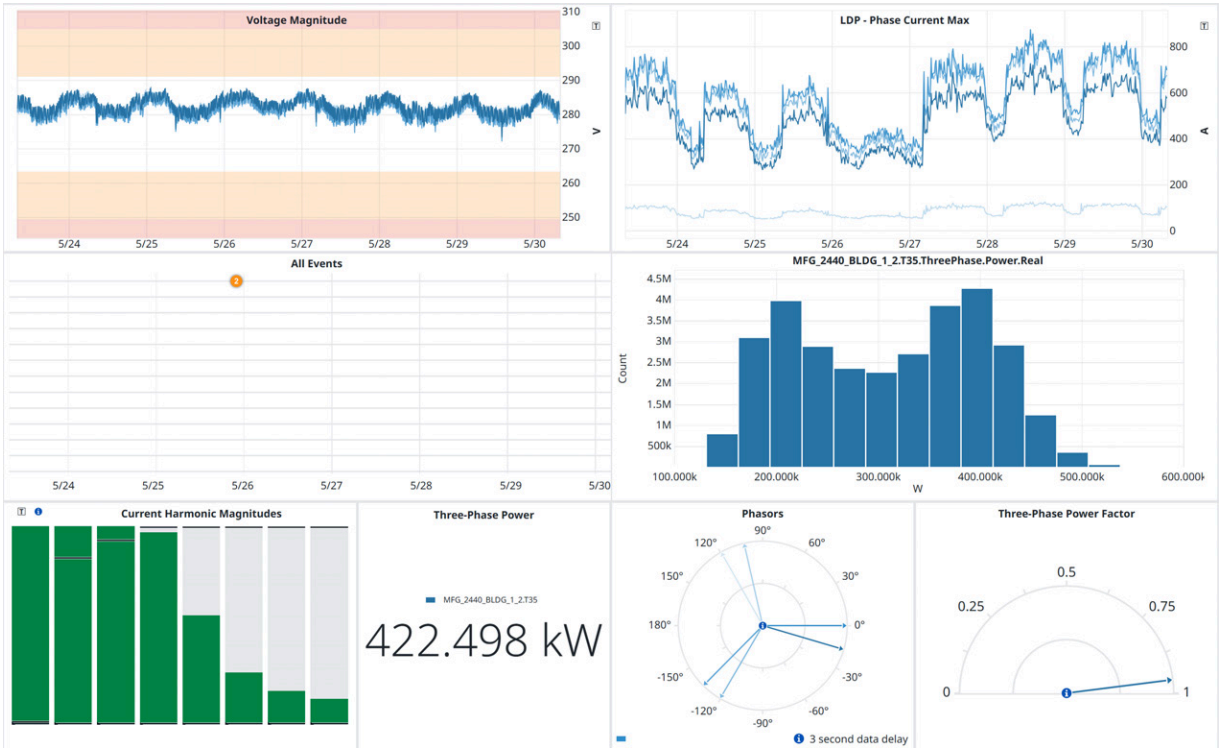


Figure 3 Synchrowave Dashboards

Cyber Secure

Use modern security features for granular role-based access control (RBAC) and user management through a company Lightweight Directory Access Protocol (LDAP) server. Protect the Synchrowave web gateway with HTTPS and TLS certificates to encrypt communications.

Virtual Metering

High-Accuracy Remote Metering

Take advantage of SEL high-accuracy measurement devices, including the SEL-735, SEL-T35, and SEL Axion, to calculate metering quantities from continuous waveform streaming data. This includes fundamental and rms voltage, current, and power values, as well as frequency, one-cycle harmonics, and power factor. Add virtual meter quantities to a load profile recorder to help identify trends.

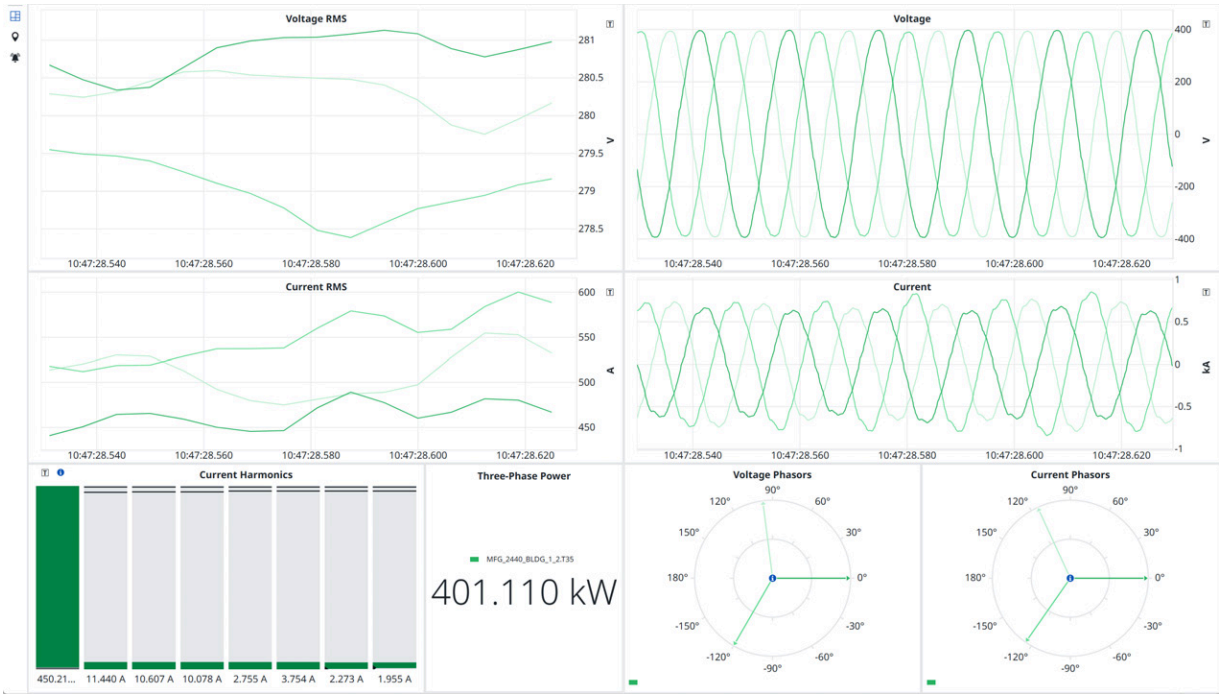


Figure 4 Virtual Metering

Fast Acquisition Load Profile Trending

The Load Profile application aggregates signals by using various functions including minimum, maximum, average, change-over-interval (COI), end-of-interval (EOI), count, sum, rms, and cubic root mean (CRM). Load Profile application enables calculations as fast as 50 ms with intervals as long as 2 hours. Export the data directly to a CSV or COMTRADE format.

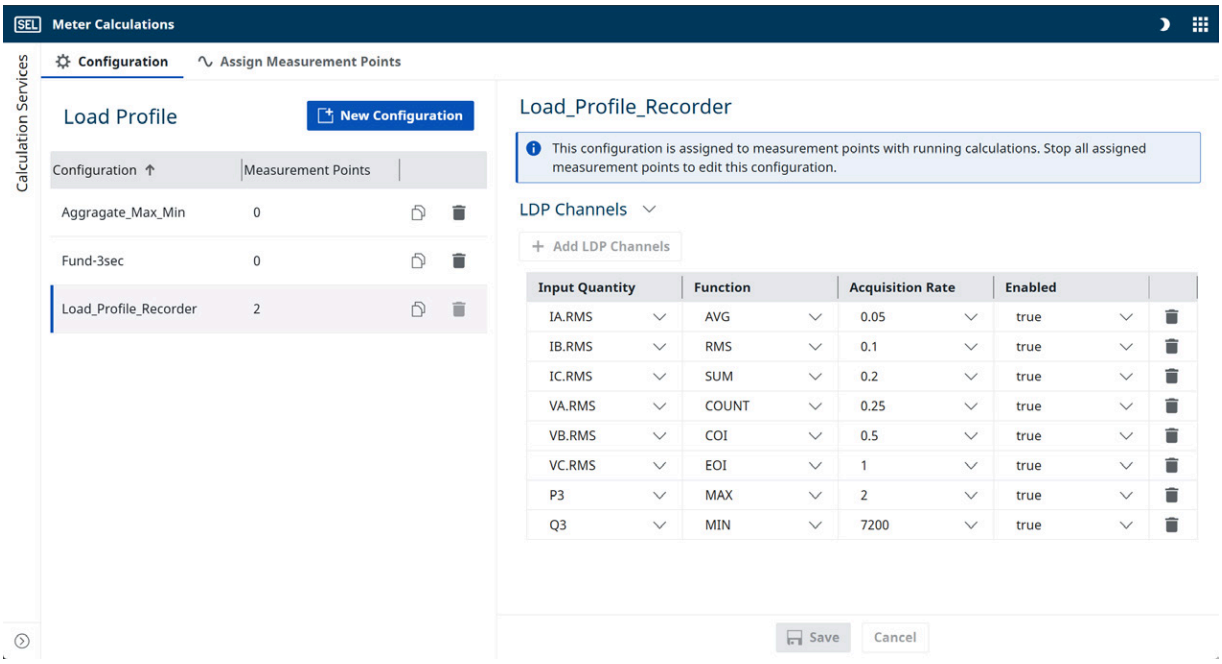


Figure 5 Load Profile Recorders

Virtual Disturbance Monitoring

Identify VSSI and rapid voltage changes with up to a half-cycle resolution and record them indefinitely. The application generates events that capture data for the duration of the disturbance. Settings include customizing trigger thresholds, hysteresis, and dynamic voltage base.

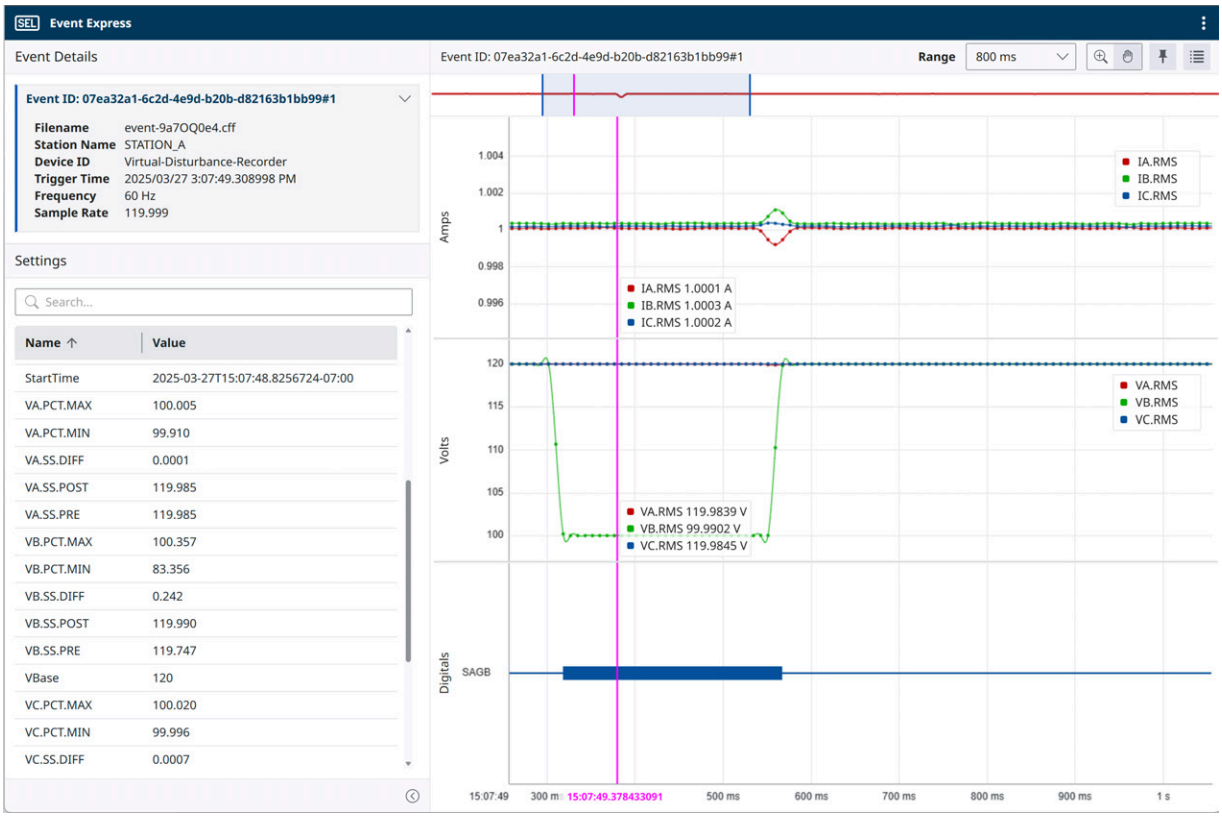


Figure 6 Virtual Disturbance Recorder

Flicker and Harmonics Monitoring

Monitor and record harmonic values as high as the 100th order with individual harmonic magnitudes and angles as well as THD. Calculate 200 ms interharmonics as component, group, or subgroup for IEC 61000-4-30 compliance. Calculate 1-cycle harmonics for fast THD calculations. Export the waveforms into COMTRADE format and import them into SEL-5601-2 SYNCHROWAVE Event Software for additional waveform analysis.

Monitor maximum instantaneous and short-term flicker values. Trend flicker with LDP application for variable long-term flicker. Flicker is an indicator of fluctuation of voltage magnitude in the 8–10 Hz frequency band. Flicker can interfere with the human eye and brain from flickering light bulbs and affect sensitive electrical equipment.

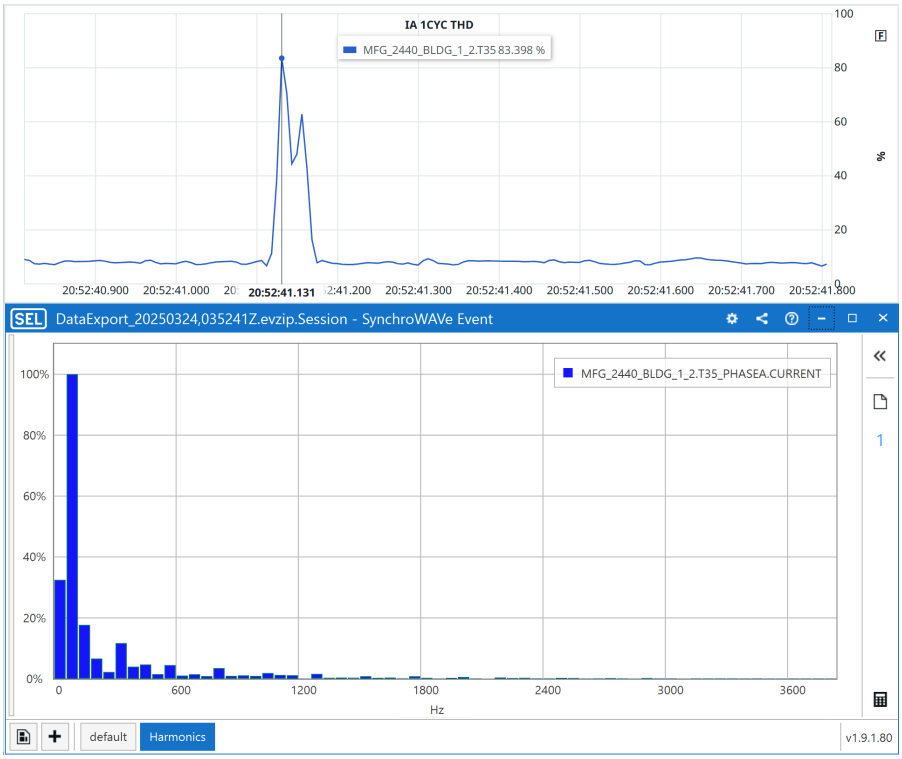


Figure 7 Harmonics Measurements

Virtual PMU

Calculate IEEE C37.118 synchrophasors from the continuous waveform streaming data. This includes voltage phasors, current phasors, frequency, and rate-of-change of frequency (ROCOF) at a rate of 50 or 60 Hz. Visualize and compare the data easily alongside other phasor measurement units (PMUs) in your system.

Application Examples

Synchrowave Virtual Meter supports the following SEL continuous waveform streaming devices:

- SEL-735 Power Quality and Revenue Meter with Continuous Waveform Streaming protocol
- SEL-T35 Time-Domain Power Monitor
- SEL RTAC with the SEL-2242-42 AC Protection Module

Power Quality Monitoring and Troubleshooting

View continuous waveform streaming data to capture all disturbances without programing pickup triggers. Use monitor applications, such as Virtual Disturbance Monitor, Signal Monitor, or Oscillation Monitor, to quickly and easily identify power quality related disturbances. Use the Oscillation Monitor to trigger on oscillations bins up to the Nyquist rate of the signal. Use the signal monitor to create notifications based on defined thresholds and pickup times for any signal in the software. Time-align the notifications to power system operations to identify trip operations, system faults, and equipment schedules.

Characterize Data Center Loads

Measure, identify, and visualize rapid power fluctuations and voltage oscillations commonly observed at data centers involved in AI training and inference.

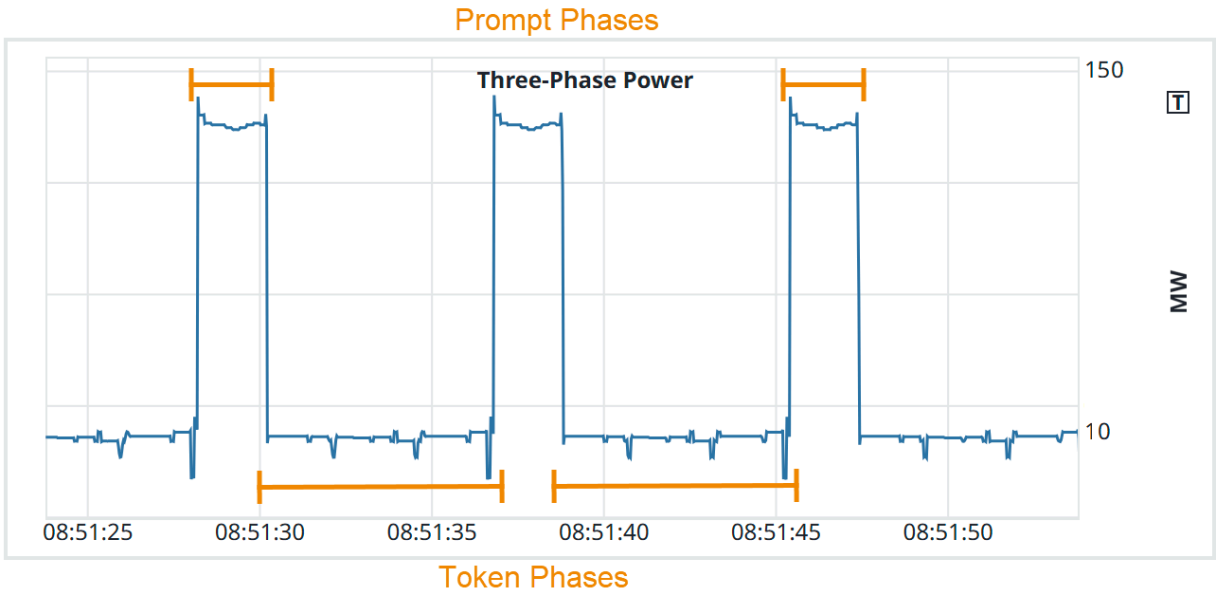


Figure 8 Identify Power Fluctuations

Identify Subcycle Transients

Record waveform streaming data to identify and visualize subcycle transients not detected by triggered event captures. Compare cycle-by-cycle waveform data to detect sudden abnormal waveshapes, voltage and current transients, and rapid voltage changes.

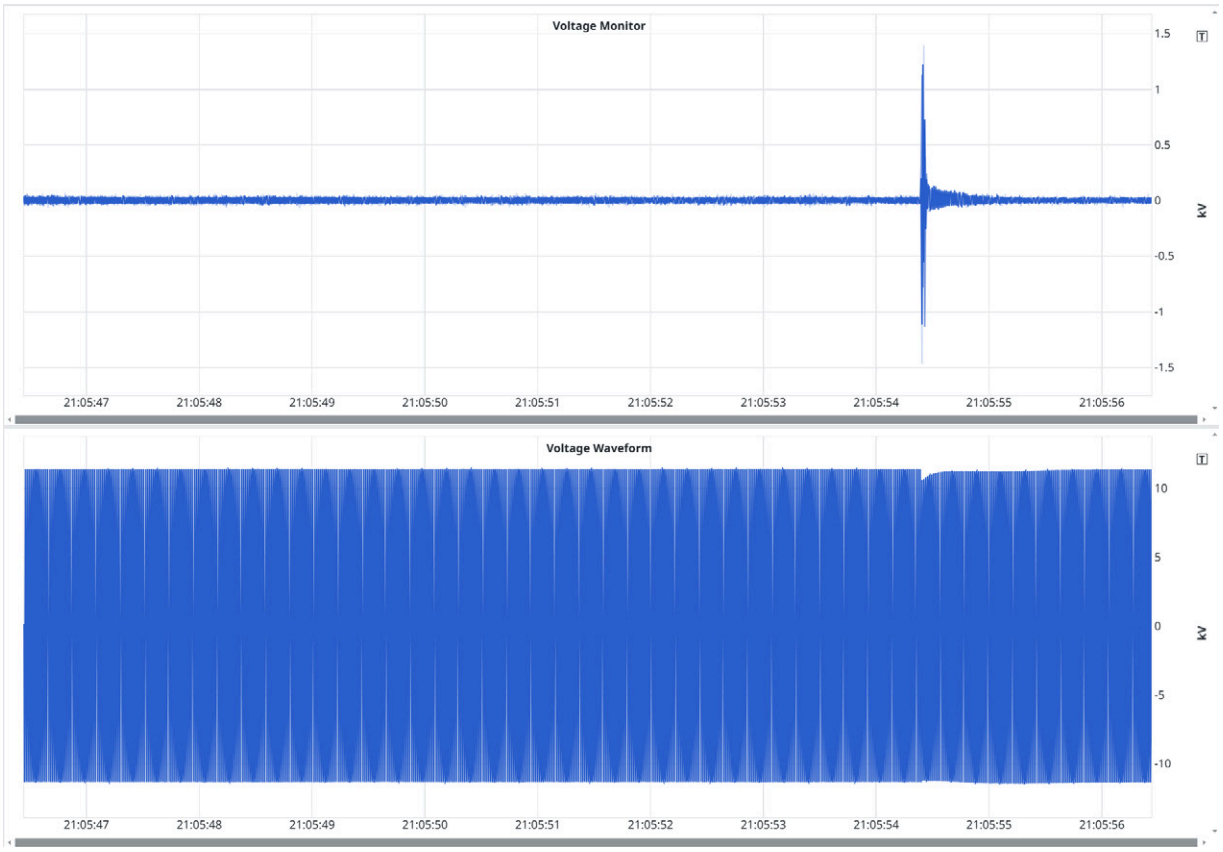


Figure 9 Waveform Disturbance Detection

Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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