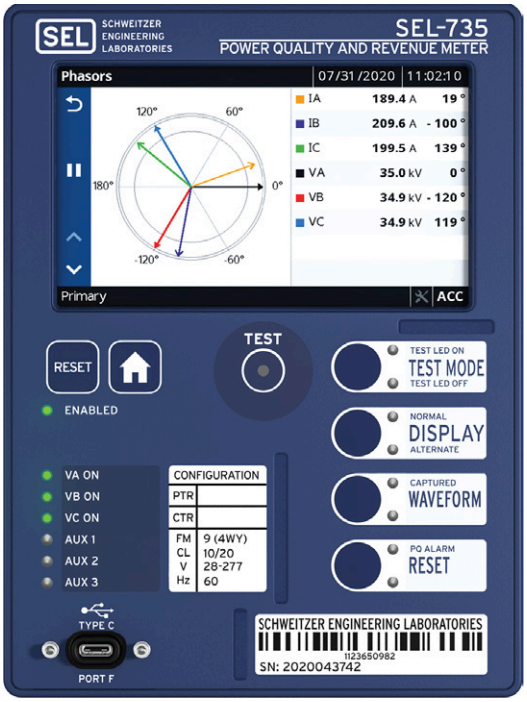
SEL-735 Power Quality and Revenue Meter

Precise Metering for High-Value Power Systems



Five-inch, color touchscreen display model

Formattable 1- and 3-line monochromatic LCD display model

Key Features and Benefits

The SEL-735 Power Quality and Revenue Meter combines leading power quality capabilities with exceptional revenue metering accuracy at an economical price.

- **Easily access data.** An optional touchscreen interface displays real-time waveforms, metered data, alarms, notifications, and settings.
- **Accurately allocate energy costs.** The SEL-735 outperforms ANSI and IEC accuracy standard requirements with a 0.06 percent Wh guarantee. It exceeds ANSI C12.20 0.1 and IEC 62053-22 0.1 S accuracy class requirements over its entire service life, eliminating costs associated with field calibration.
- **Capture every power quality disturbance.** Power quality reports with IEC 61000-4-30 Class A compliance and as much as 1 GB of onboard storage help visualize system conditions and store years of data. Optional continuous waveform streaming precisely samples voltage and current signals at 3 kilosamples per second (ksps) and sends the data to SEL Synchrowave® software for visualization.
- **Share critical information securely.** Simultaneously communicate with as many as ten other devices by using industry standard protocols, including DNP3, IEEE C37.118 synchrophasor measurements, Modbus, and IEC 61850. Port security settings allow three permission levels that provide controlled read and write access to the ports.

- **One meter for multiple applications.** Standardize on one meter across multiple applications with wide current and voltage measurement ranges, field upgradability, retrofit options, and software-based wiring form changes.
- **Software Integration.** Use SEL software for easy access to metering data. Integrate with optional SEL Synchrowave software for real-time and historic visualization across local and wide-area systems.

One Package, Three Flexible Solutions

Three SEL-735 variants provide a meter for any application and any budget. *Table 1* and *Table 2* list the available ordering options.

For more information about IEC 61000-4-30 testing and measurement, see *Section 5: Metering* in the SEL-735 Instruction Manual.

Table 1 SEL-735 Power Quality and Recording Options

PQ and Recording	SEL-735 Basic	SEL-735 Intermediate	SEL-735 Advanced
Memory	128 MB	256 MB	1 GB
Max Harmonic Order	15th	63rd	63rd
Interharmonic Quantities	No	No	Yes
Harmonic Angles	No	No	Yes
Power Harmonics	No	No	Yes
Waveform Capture Event Reports			
Samples Per Cycle	16	16, 128	16, 128, 512
Duration (cycles)	15	15–600	15–600
Number of Events	256	33–6,200	101–10,000
COMTRADE Reports	Y	Y	Y
Load Profile Recorder			
Recorders x channels	1 x 16	12 x 16	32 x 16
Acquisition rates	1–120 minutes	3–59 s, 1–120 minutes	3–59 s, 1–120 minutes
Storage duration for 10 minute interval data			
16 channels	10 years	20 years	20 years
192 channels	N/A	1.5 years	9.5 years
512 channels	N/A	N/A	3.5 years
Voltage Sag, Swell, Interruption (VSSI) Recorder			
Typical number of summary events	260	260	600
Number of detailed rows	60,000	60,000	130,000
Minimum disturbance duration	1/4 cycle	1/4 cycle	1/4 cycle
Sampling rate	4 samples/cycle–1 sample/day, adaptive	4 samples/cycle–1 sample/day, adaptive	4 samples/cycle–1 sample/day, adaptive
Sequential Events Recorder			
Number of events	>80,000	>80,000	>80,000
Number of channels monitored	≤72	≤72	≤72

PQ and Recording	SEL-735 Basic	SEL-735 Intermediate	SEL-735 Advanced
Protocols			
Continuous Waveform Streaming Protocol[a]	N	Y	Y
Other Features			
Wave View Oscillography	N[b]	N[b]	Y

[a] Available with the purchase of a device software bundle or as a standalone meter upgrade.
[b] Color touchscreen app available on all models from the front panel. QuickSet HMI screen only available on advanced power quality models.

Table 2 SEL-735 Compliance With IEC 61000-4-30 Power Quality Standard[a]

IEC 61000-4-30 Requirement	SEL-735 Basic PQ	SEL-735 Intermediate PQ	SEL-735 Advanced PQ
General			
150/180-cycle, 10-min. aggregation	—	A	A
2-hour aggregation	—	A	A
Real-time clock uncertainty	A	A	A
Power Quality Parameters			
Power frequency	A	A	A
Magnitude of the supply voltage	A	A	A
Flicker	—	A (10 min, 2 hr updates)	A (1 min, 10 min, 2 hr updates)
Supply voltage interruptions, dips, and swells	A	A	A
Supply voltage unbalance	A	A	A
Voltage harmonics	A	A	A
Voltage interharmonics	—	—	A
Magnitude of current	A	A	A
Harmonic currents	A	A	A
Interharmonic currents	—	—	A
Current unbalance	A	A	A

[a] "A" in the table refers to IEC 61000-4-30:2015 Class A Compliance.

Product Overview

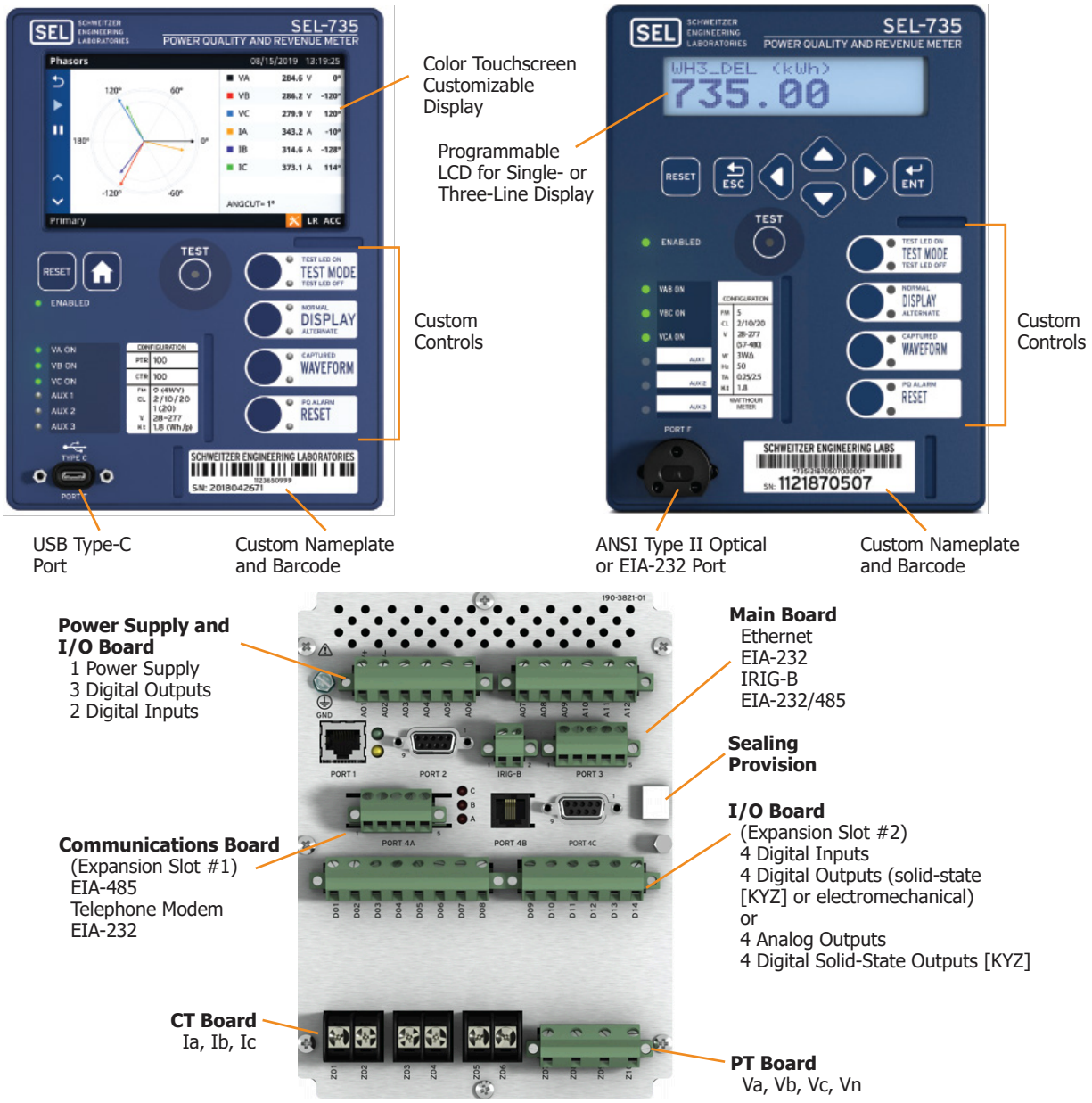
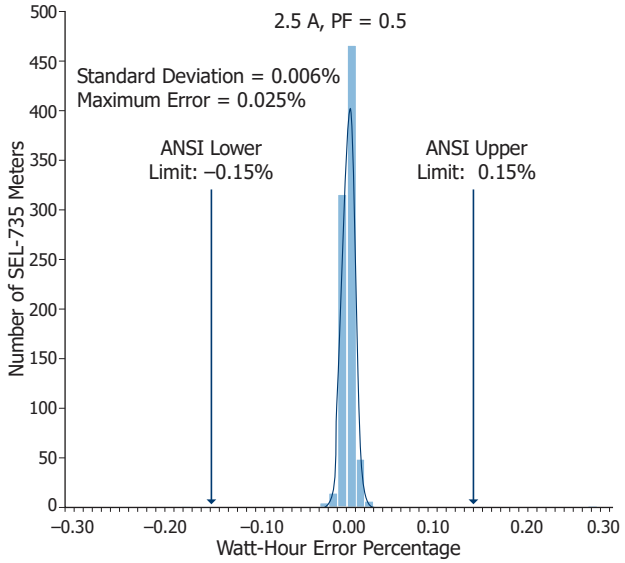


Figure 1 Product Features

Features

High-Accuracy Metering

The SEL-735 exceeds ANSI 0.1 and IEC 0.1 S class accuracy requirements over a wide current range. The meter outperforms the new non-sinusoidal requirements of ANSI C12.20 and provides guaranteed accuracy over the life of the meter. All meters ship with individual calibration certificates.



Accuracy-test results of approximately 1,000 SEL-735 Meters report a maximum error of 0.025 percent, outperforming ANSI 0.1 and IEC 0.1 S accuracy class requirements.

Figure 2 Accuracy Test

Uninterrupted Communications

Advanced communications deliver critical and historical information in real time to virtually any communications system. Simultaneously communicate with as many as ten other devices that use protocols including DNP3, Modbus, and IEC 61850. Improve real-time situational awareness of system conditions with IEEE C37.118.1a-2014 synchrophasors or continuous waveform streaming data.

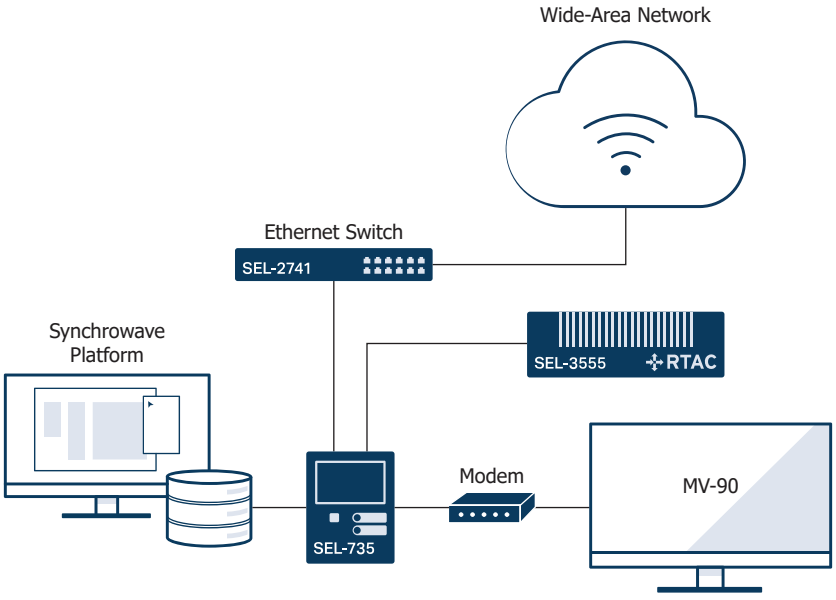


Figure 3 Flexible Communications Options

Power Quality Monitoring[1]

- Measure and record IEC 61000-4-30 Class A-compliant current, voltage, power, frequency, supply voltage interruptions, dips and swells, harmonics, interharmonics, flicker, and unbalance
- Measurement aggregation in 50/60 Hz, 3-second, 10-minute, and 120-minute intervals
- View real-time waveforms with the Continuous Waveform Streaming protocol or Wave View application.
- High-speed load profile recording with 3-second resolution
- Harmonic phase angles for voltage and current
- High-resolution, 512-samples/cycle waveform capture
- Total harmonic distortion (THD), crest factor, and K-factor metering with as much as 63rd harmonic content
- Voltage sag, swell, interruption
- Symmetrical components
- System unbalance

Advanced On-Board Logging

Capture and log years of data with 512 logging channels, 10,000 event reports, and more than 130,000 voltage events with 1 GB of storage. Trend averages, minimums, maximums, changes, and snapshots at a rate of once every 3 seconds with independent load profile recorders.

Cyber Secure

Four password levels provide controlled access to metering data and ensure protection of critical meter configuration and data. Port security settings allow three permission levels that provide controlled read and write access to the ports. The meter verifies the authenticity and integrity of firmware files during upgrades by using a checksum and cryptographic signature.

Transformer/Line-Loss Compensation

When the contractual billing point differs from the meter location, use transformer and line-loss compensation (TLLC) to optimize the metering location and reduce the instrument transformer costs. Both compensated and uncompensated values are stored in the meter to simplify site verification.

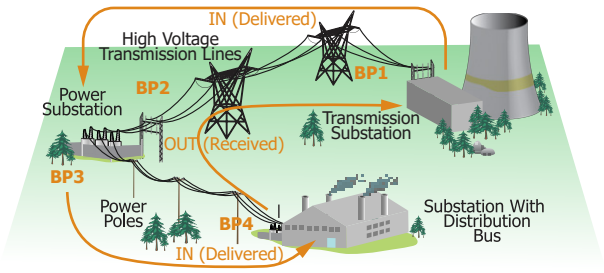


Figure 4 Choose From Four Billing and Metering Points With TLLC

[1] Includes optional features. See Table 1 and Table 2 for details.

Configurable Meter Form

Internal connections of meter elements (CT and PT pair) can be changed in the field depending on the type of service. The FORM terminal command configures the meter as Form 5, 9, or 36.

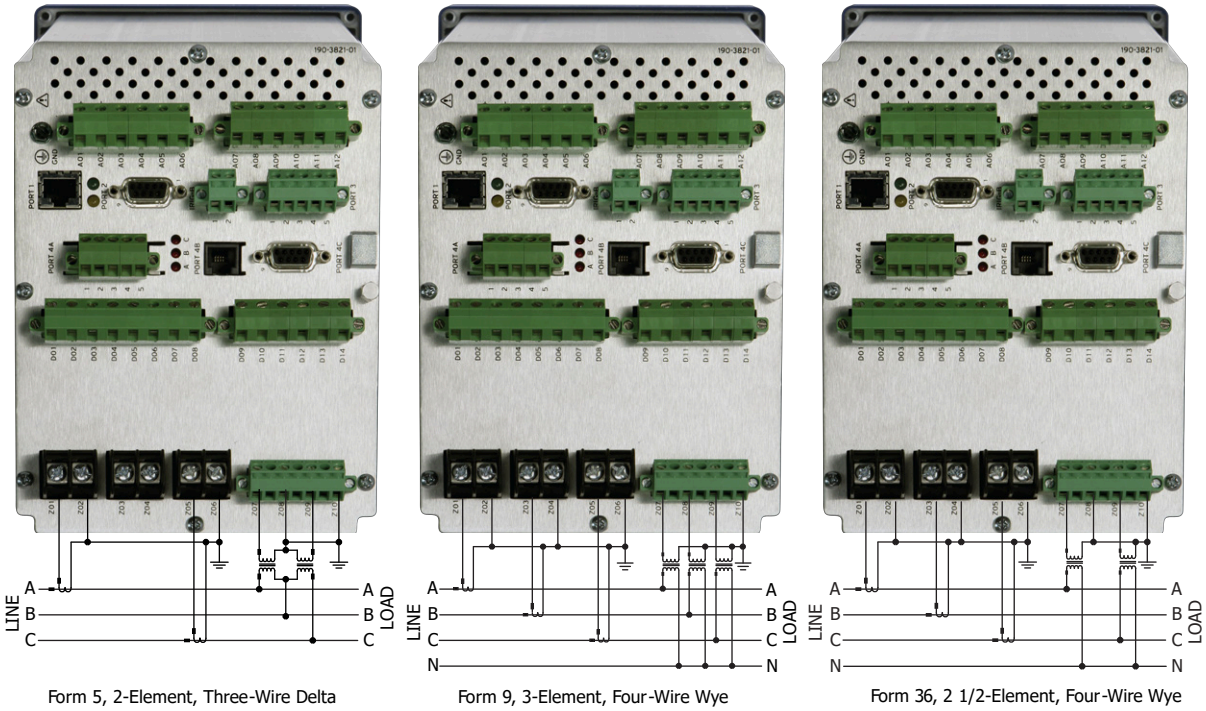


Figure 5 Software-Configurable Metering Form

Touchscreen Features

A real-time display on an 800 x 480 color touchscreen display provides visual indication of power quality and waveform signatures by using a menu-based interface.

Real-Time Oscilloscope

Wave View displays voltage and current waveforms in real time, creating oscilloscope-like functionality.

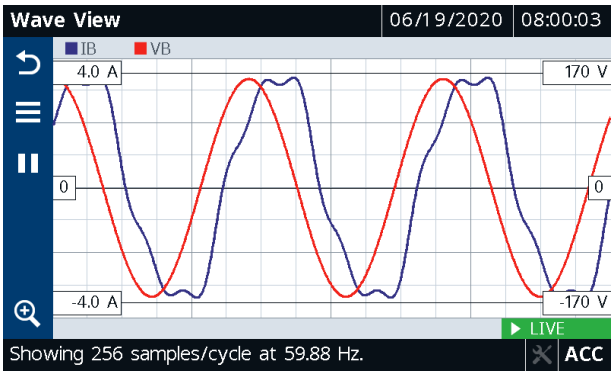


Figure 6 Wave View Display

Phasor Display

Easily access metering phasors for commissioning, troubleshooting, and power system monitoring with real-time phasors. The color display is specially designed to support color-blindness.

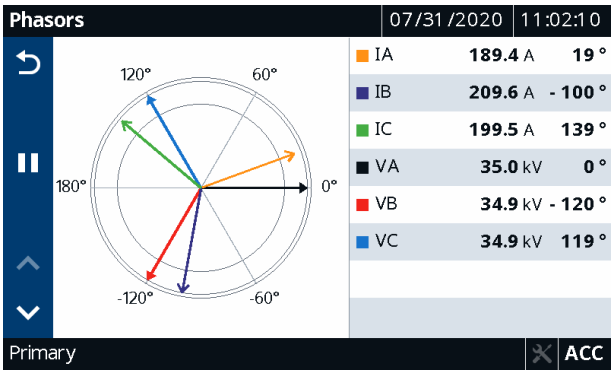


Figure 7 Phasor Display

Test Mode

Simplify accuracy testing with visualization of infrared test pulses, accumulated energy, and instantaneous signals. When in Test Mode, the SEL-735 freezes billing quantities to isolate test input from revenue billing.

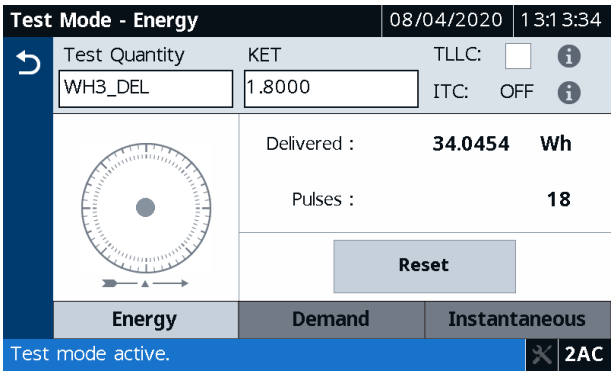


Figure 8 Test Mode Display

Four-Quadrant Metering

The SEL-735 supports four-quadrant metering to monitor power and energy accumulation in each quadrant for bidirectional metering.

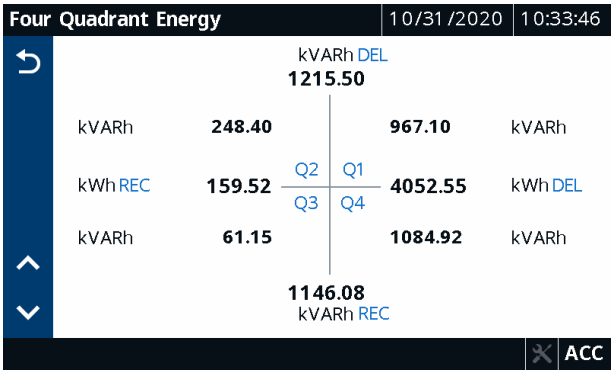


Figure 9 Four-Quadrant Metering

Large Three-Line Display

Customizable screens with useful defaults and large fonts allow continuous monitoring from a distance.

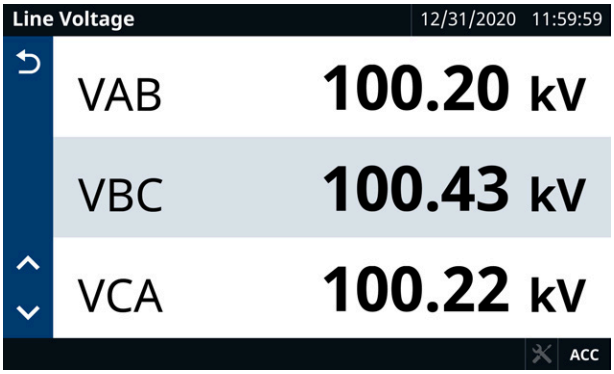


Figure 10 Three-Line Display

Predictive Demand

The predictive demand function monitors accumulated demand and alarms when the demand exceeds a user-defined limit. The SEL-735 can then shut down loads or peak-shave with generation to avoid demand charges, as shown in *Figure 11*. The predictive demand alarm is available through IEC 61850, Modbus, DNP3, MIRRORED BITS communications, or the front-panel LEDs.

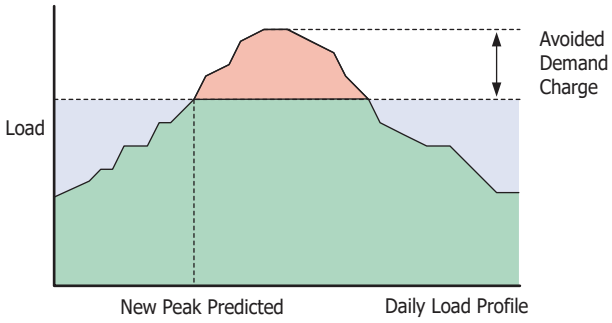


Figure 11 Reduce Peak Demand Charges With the Predictive Demand Alarm

Programmable Logic (SELOGIC Control Equations)

The meter provides user-programmable logic to combine meter calculations, contact inputs, remote command inputs, and timers to control internal logic and contact outputs. The logic allows the following operations:

- Logic (OR, AND, NOT)
- Math (+, –, x, /)
- Analog compare (>, <, <>, =, >=, <=)
- Triggers (RISING EDGE, FALLING EDGE)
- Sixteen latches
- Sixteen remote-control logic units
- Sixteen programmable logic variables with pickup and dropout timers
- Sixteen programmable analog variables

Time of Use

Record demand and energy consumption with a user-defined calendar, use time-of-use metering to bill consumption at different rates based on season, day type, and time of day. The program automatically self-reads and resets demand; there is no need to manually reset meters.

Software Features

Monitor the state of the power system by using no-cost ACSELERATOR QuickSet® SEL-5030 Software or view and analyze event records with SEL-5601-2 SYNCHROWAVE® Event Software. Add SEL-5705 Synchrowave Reports to manage and visualize your meter data from a central server.

Waveform Capture and Analysis

Quickly analyze event records, status bits, spectral analysis, and harmonic content by using the Meter QuickSet HMI. View and analyze captured event records with SYNCHROWAVE Event.

Figure 12 Event Report and Analysis

Trend Log Monitoring

Independent load profile recorders in the SEL-735 allow simultaneous meter and power quality logging of as many as 512 data channels. Trend averages, minimums, maximums, changes, and snapshots are recorded at a rate of once every 3 seconds. All possible configurations are shown in *Table 1*.

QuickSet offers a fast and simple method to retrieve, plot, and export load profile data to .hhf or .csv formats. Itron MV-90 meter reading software communicates to any SEL-735 communications port and automates meter reads for large-scale metering installations.

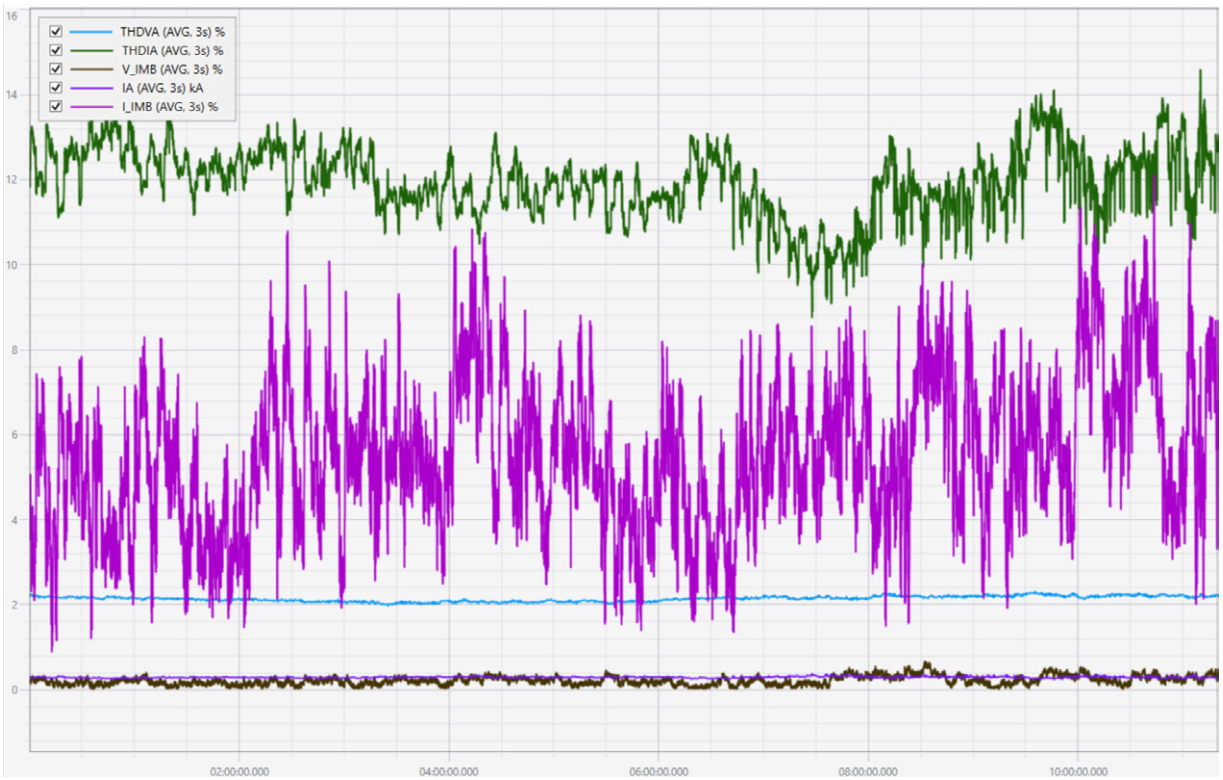


Figure 13 Trend Log in QuickSet HMI

VSSI Monitoring

Correlate system disturbances with the VSSI recorder. The SEL-735 stores and reports residual voltage, duration, affected phases, and time stamp of occurrence. View and generate VSSI CBEMA/ITIC curves in SEL-5705 Synchrowave Reports.

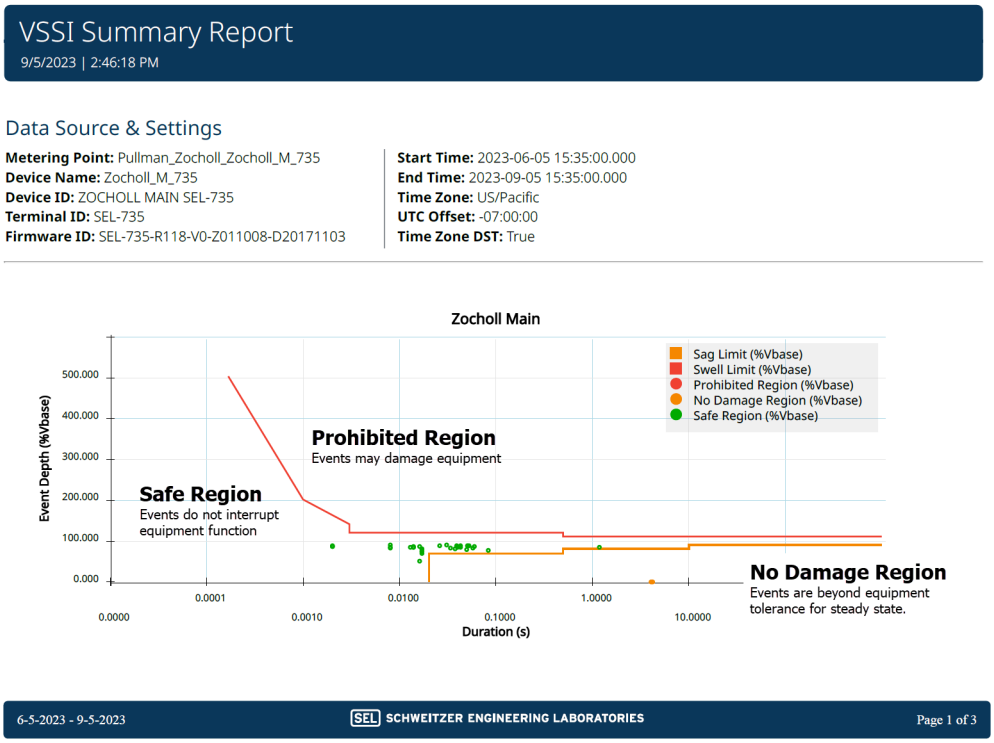


Figure 14 VSSI Summary in Synchrowave Reports

Flicker and Harmonics Monitoring

Monitor, record, and control using individual harmonic values, THD, and K-factor with resolution as high as the 63rd harmonic. Measure, record, and control using Group THD. Measure interharmonics from 1 Hz to 3800 Hz in 1 Hz sampling bins. Retrieve interharmonics with 1 Hz resolution through the Wave View application in QuickSet, which is available with the Advanced PQ ordering option.

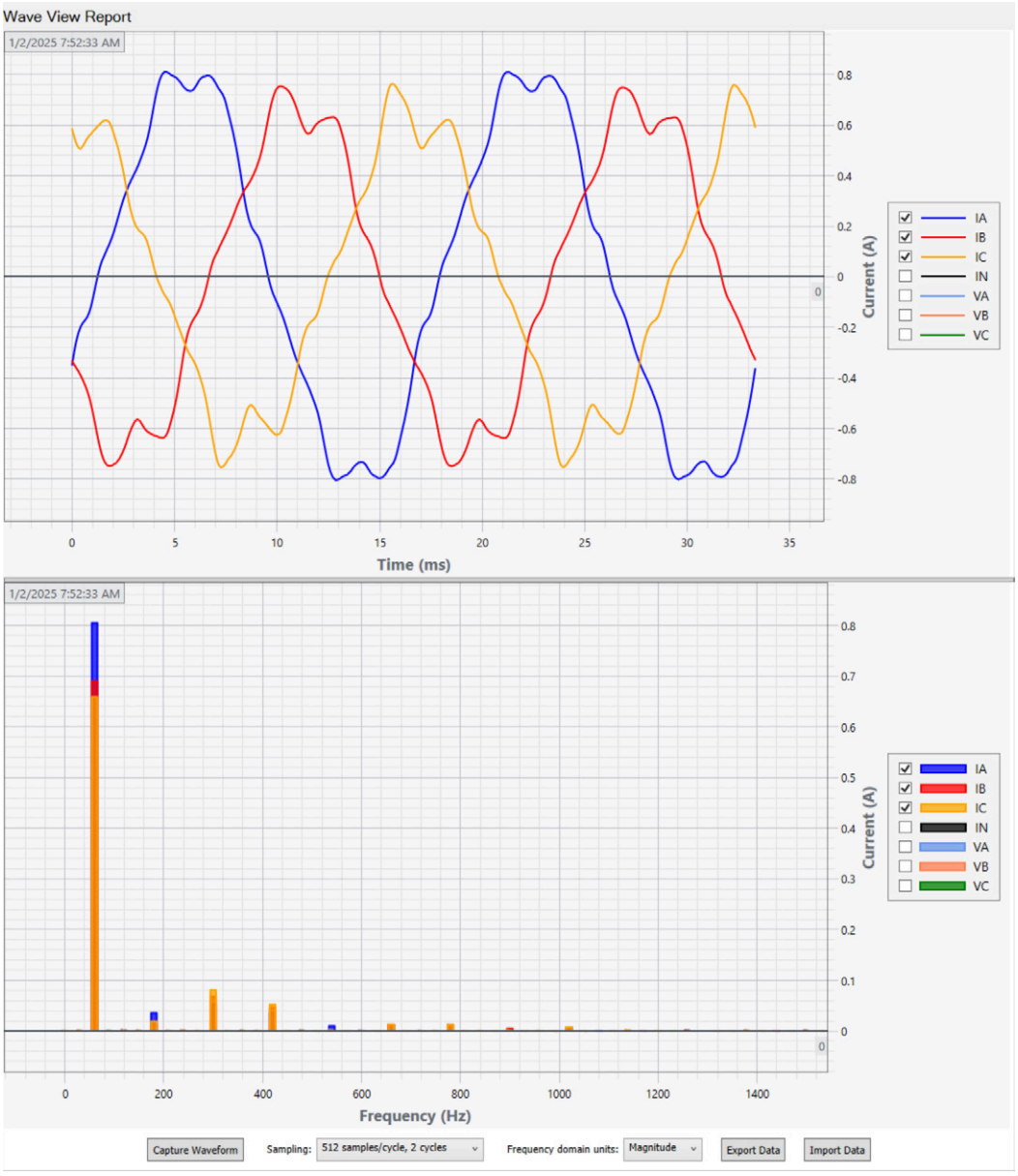


Figure 15 Harmonic Spectral Analysis

Continuous Waveform Recording

Never miss a disturbance again by recording the 3 kilosamples per second (ksps) continuous waveform stream with Synchrowave Platform software. Applications include archiving, virtual metering, subsynchronous oscillation analysis, and equipment failure analysis.

Figure 16 Continuous Waveform Streaming

Application Examples

The SEL-735 accurately reports bidirectional energy even in the presence of harmonics and distorted waveforms. When tested with peaked waveform distortion, the SEL-735 reports with a typical error of just 0.006 percent.

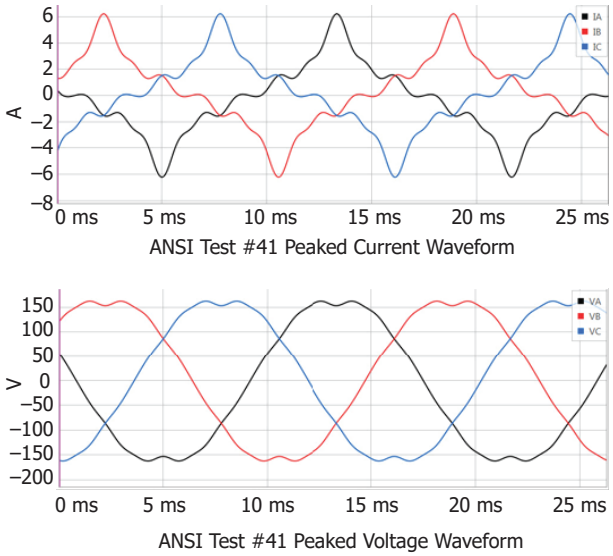


Figure 17 Current and Voltage Waveforms

Table 3 SEL-735 Performance With Peaked Waveform Distortion

Voltage Waveform	Current Waveform	0.1 Accuracy Class Reference Performance (%)	SEL-735 Measured Error (%)
Sinusoidal	Sinusoidal	±0.05	0.003
Sinusoidal	Peaked Current Waveform	±0.2	0.006
Peaked Voltage Waveform	Peaked Current Waveform	±0.3	0.006

Power Quality Monitoring and Troubleshooting

Use programmable triggers, such as voltage interruptions, to record as many as 10,000 oscillography events. The VSSI recorder time-stamps voltage excursions with as much as 4 ms resolution and records indefinitely by using an adaptive sampling rate. Settings include trigger thresholds and hysteresis as a percentage of the nominal value and an automatic recording duration dependent on the length of the voltage excursion. Configure continuous waveform streaming and Synchrowave software to capture all disturbances without needing to program pickup triggers.

Distributed Generation Control

Provide automatic start and remote control to distributed generation facilities. SELOGIC control equations support any logical or mathematical combination of measured quantities and set points to control a generator or load switch.

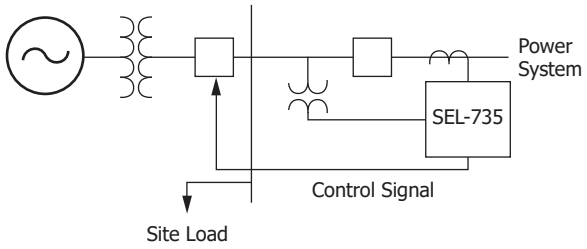


Figure 18 Distributed Generation Control

Optimize Energy and Resources

Use Synchrowave Reports to analyze data, identify system trends, and make planning decisions. Trend any signal received from the SEL-735, including measurements from pulse-type devices, to monitor consumption of resources such as water, air, gas, and steam (WAGES). The SEL-735 includes as many as six pulse inputs. Load profile recorders provide as much as 20 years of storage with 512 channels to assist with tracking efficiency measures, unused resources, and performance efficiency such as kWh per cubic meter of water pumped.

Figure 19 Signals Report

Identify Subcycle Transients

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

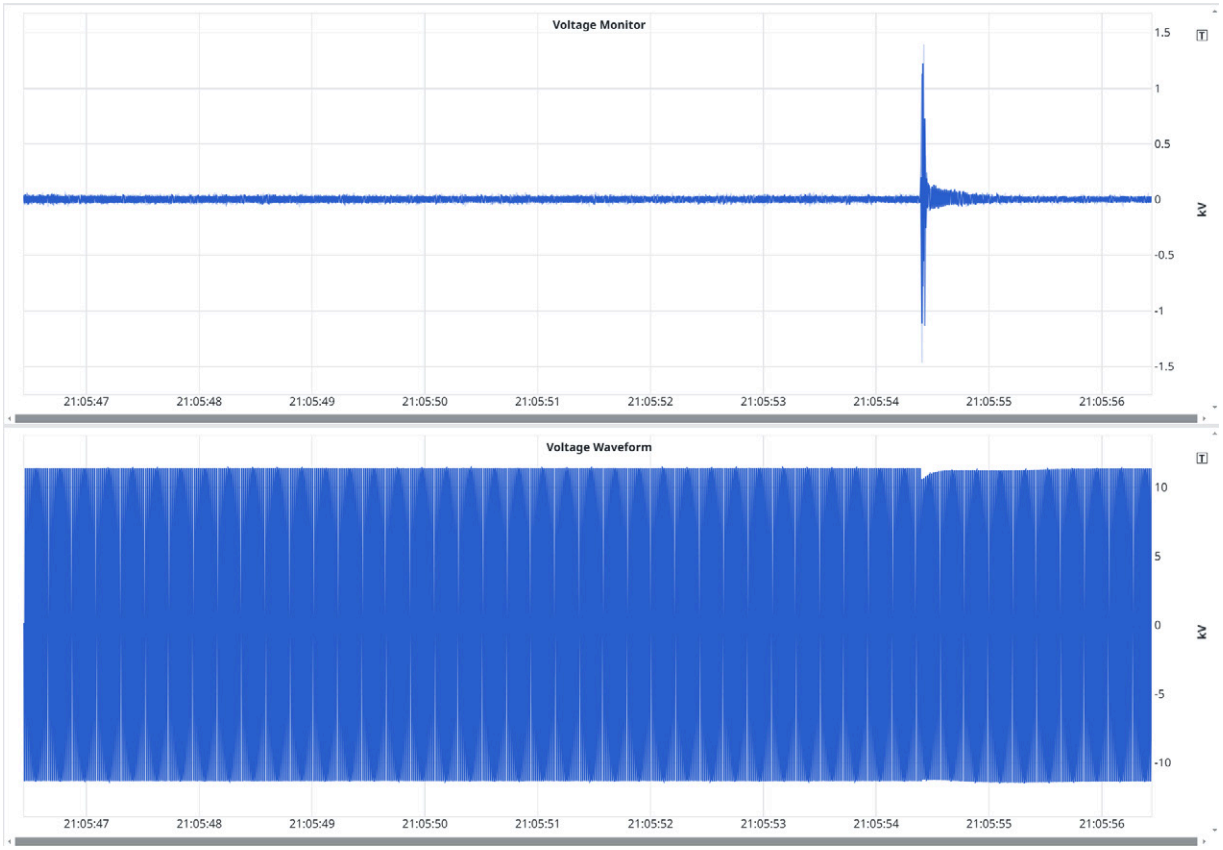


Figure 20 Waveform Disturbance Detection

Retrofit Applications

Outdoor Enclosure

- Replace socket meters with a low-cost enclosure and prewired FT-1 test switch.
- Quickly install the meter with the support of thoughtful design details, such as DIN rails for accessories; a lockable, stainless steel latching system; wall-mount brackets; prewiring from the meter to the test switch; and wire clamps. The fully sealed enclosure complies with NEMA 4X, IEC 529, and IP66 protection requirements.

Figure 21 Outdoor Enclosure Mounting

Easily Extractable Meter (EXM)

- Extractable in less than one minute.
- Safer than draw-out and socket meters.
- Self-shorting CT connector.
- Clearly marked wires.
- Easier to install and half the cost of a draw-out meter.
- Simplified field testing with integrated connectors.
- Simple retrofit brackets replace draw-out meters.

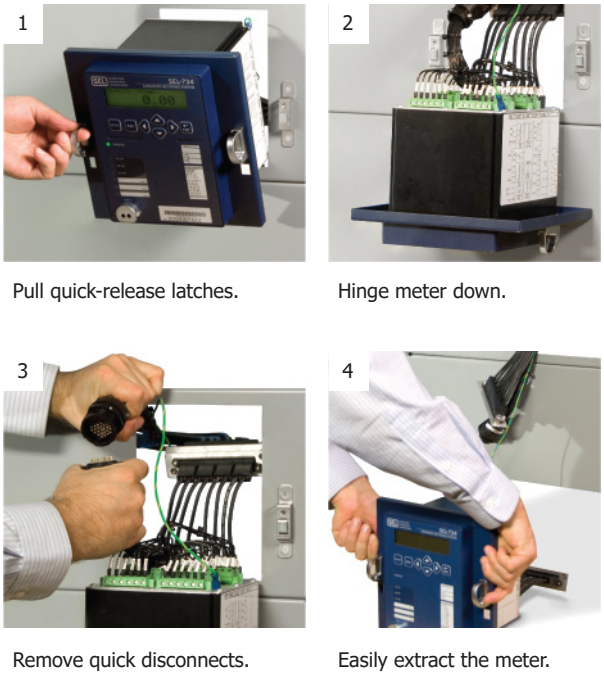


Figure 22 EXM Option Instructions

Mounting Options and Accessories

Refer to the Metering Accessory Catalog, available at selinc.com/products/73x/meter-options/, for more information on brackets, retrofit bezels, cover plates, and other accessories.

Figure 23 Mounting Options and Other Accessories

Portable Power Quality Meter

Monitor power quality anywhere with the rugged SEL-735 Portable Power Quality Meter. You can pinpoint power quality problems and energy consumption on subcircuits with clamp-on CTs and clip-on voltage leads. In addition, the portable meter lets you log years' worth of data with 1 GB of onboard memory.

Figure 24 Portable Power Quality Meter

Diagrams and Dimensions

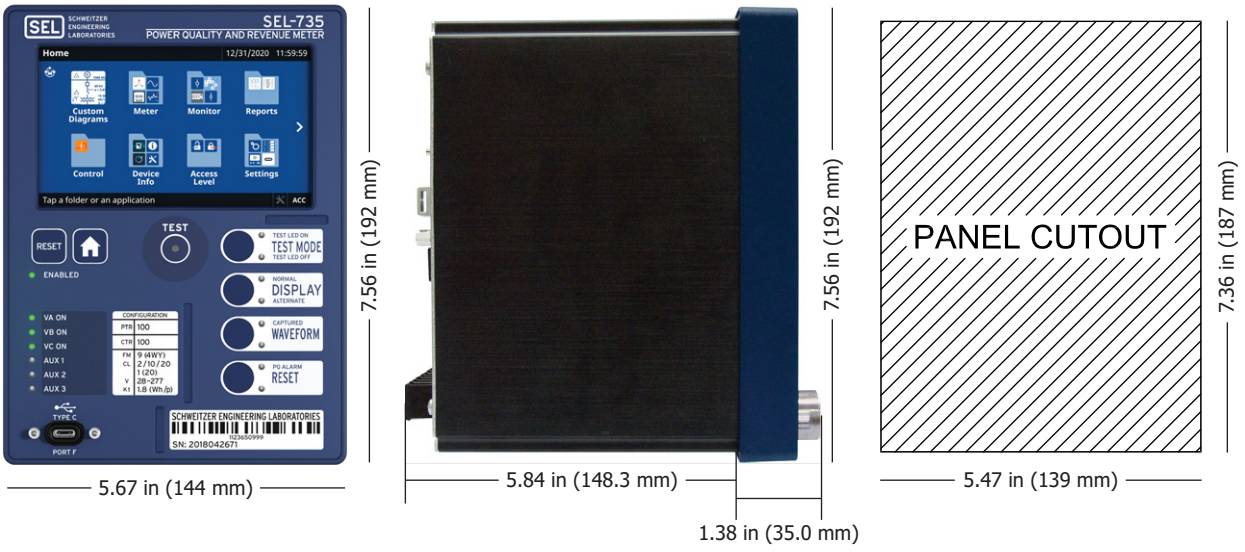


Figure 25 SEL-735 Vertical Dimensions

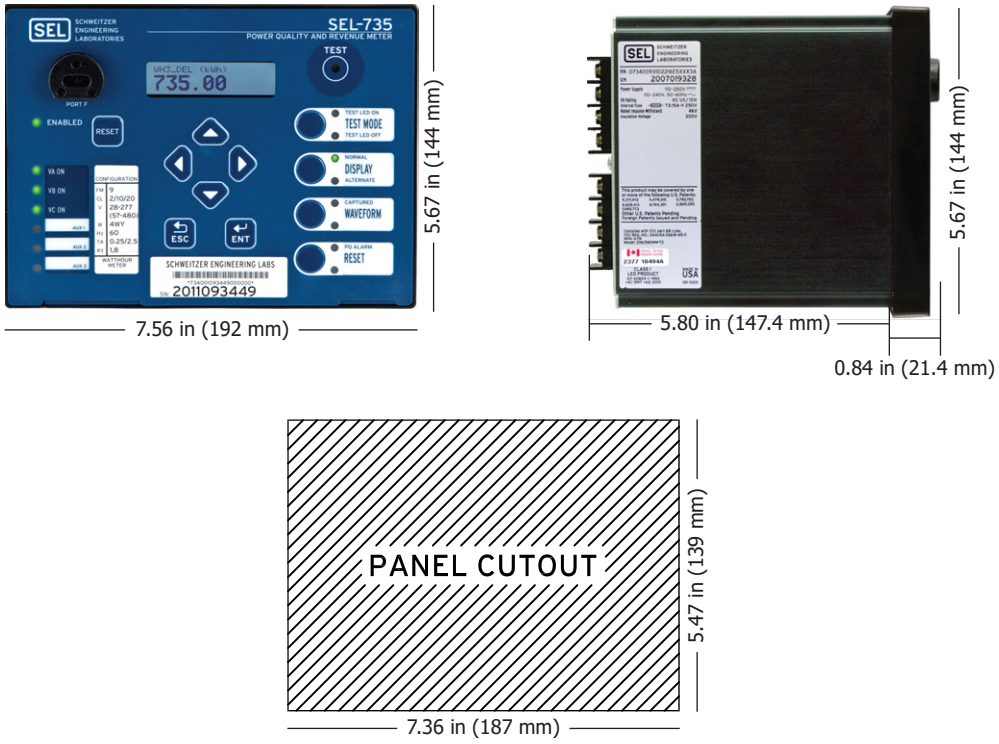


Figure 26 SEL-735 Horizontal Dimensions

Specifications

⚠ CAUTION
Observe ratings prior to commissioning.

Compliance

American National Standards Institute (ANSI)	ANSI C12.1-2014 for Electric Meters, Code for Electricity Metering and ANSI C12.20-2015 for Electricity Meters—0.1, 0.2, and 0.5 Accuracy Classes verified compliant by an accredited third-party test laboratory
Australian National Measurement Institute	NMI M6-1 Electricity Meters: Part 1: Metrological and Technical Requirements verified by an accredited third-party test laboratory
Australia and New Zealand	RCM Mark
California ISO (CAISO)	CAISO Compliant (applies to Blondel-compliant Form 5 and Form 9 only)
Canada	ICES-001(A) / NMB-001(A)
Comisión Federal de Electricidad (CFE)	G0000-48-2010 verified compliant by Laboratorio de Pruebas de Equipos y Materiales (LAPEM)
Electric Reliability Council of Texas (ERCOT)	ERCOT Compliant (applies to Blondel-compliant Form 5 and Form 9 only)
European Union (EU)	CE: Mark—EMC Directive (2014/30/EU), Low Voltage Directive (2014/35/EU)
Federal Institute of Metrology (METAS)	Certified to IEC 61000-4-30 Ed. 3.0 (2015) Class A, Testing according to IEC 62586-1 Ed. 2.0 (2017) and IEC 62586-2 Ed. 2.0 (2017) Certified to IEC 62052-11:2020, IEC 62053-22:2020, IEC 62053-24:2020, AS 62052.11:2018, AS 62053.22:2018, and AS 62052.31:2017

International Electrotechnical Commission	IEC 62052-11:2020, Electricity metering equipment (AC) - General requirements, tests and test conditions
ISO 9001	Designed and manufactured under an ISO 9001 certified quality management system
New York	New York State Department of Public Service Commission (applies to Blondel-compliant Form 5 and Form 9 only)
Underwriter's Laboratories, Inc. (Normal Locations)	UL Listed to U.S. and Canadian safety standards (File E220228, FTRZ, FTRZ7, NRAQ, NRAQ7, PICQ, PICQ7)
Underwriter's Laboratories, Inc. (Hazardous Locations)	ANSI/ISA 12.12.01-2015 and CSA C22.2 No. 213-15 Class I Division 2 Hazardous Locations (File E475839, NRAG, NRAG7).
United Kingdom	UKCA Mark

General

AC Voltage Inputs

Measurement Category:	III
Maximum Rating:	300 $V_{L–N}$, 520 $V_{L–L}$ continuous 600 $V_{L–N}$, 1039 $V_{L–L}$ for 10 seconds

PT input has only been evaluated for a maximum of 300 L-N Vac input rating by UL.

Range

Revenue:	28–300 $V_{L–N}$, 48–520 $V_{L–L}$
Measurement:	11–300 $V_{L–N}$, 19–520 $V_{L–L}$

Burden: 10 MΩ

AC Current Inputs

Measurement Category:	III
Maximum Rating:	20 A continuous, per UL 61010 500 A for 1 second (thermal) 100 A for 25 seconds (thermal)

Range

Current Class CL2/CL10/CL20, optimized for low-end accuracy

Revenue:	0.010–22 A
Measurement:	0.001–22 A continuous

Current Class CL10/CL20, optimized for 100 A fault recording

Revenue:	0.050–22 A
Measurement:	0.005–22 A continuous 22–100 A symmetrical (with saturation)

Burden: ≤0.5 VA

Frequency and Rotation

60 or 50 Hz system frequency specified at time of order. User-selectable ABC/ACB phase rotation. Frequency tracking range: 40 to 70 Hz based on V_A or V_C.

Power Supply

UL Ratings

120/240 Vac:	50/60 Hz, 60 VA
125/250 Vdc:	25 W
24/48 Vdc:	22 W
12/24 Vdc:	22 W

Typical Power Consumption:

<20 VA/7 W typical
<30 VA/9 W typical (color touchscreen model)

Startup Time to Begin Energy Metering:	<5 seconds

Continuous Operating Limits

110–240 Vac/Vdc:	85–264 Vac (50/60 Hz) 85–275 Vdc
24/48 Vdc:	19–58 Vdc
12/24 Vdc:	9.6–30 Vdc
Interruption: (IEC 60255-11:1979)	50 ms at 125 Vac/Vdc 50 ms at 48 Vdc 10 ms at 24 Vdc 2 ms at 12 Vdc
Ripple: (IEC 60255-11:1979)	12% for dc inputs
Terminal Voltage Dropout:	<40 V within 1 minute of power removal
Rated Insulation Voltage (IEC 60664-1:2020):	300 Vac

100BASE-FX Fast Ethernet Fiber-Optic Port

Fiber Type:	Multimode
Data Rate:	100 Mbps
Wavelength:	1300 nm
Optical Connector Type:	LC
Link Budget:	11.8 dB
Fiber Size:	62.5/125 µm or 50/125 µm
Approximate Range:	2 km
TX Power (Max):	–14 dBm average
TX Power (Min):	–20 dBm average (62/125)
TX Power (Min):	–23.5 dBm average (50/125)
RX Sensitivity:	–31 dBm average
RX Power Input (Max):	–14 dBm average

Communications Protocols

SEL ASCII/Compressed ASCII, SEL Fast Operate/Fast Meter, MIRRORED BITS, SEL Distributed Port Switch (LMD), Modbus RTU/TCP, DNP3 serial and LAN/WAN, FTP, TCP/IP, Y-Modem, SNTP, IEC 61850, Telnet, MV-90, IEEE C37.118-2014 (Synchrophasor measurements), and Continuous Waveform Streaming (CWS)

Output Contacts

Ratings determined by IEC 60255-23:1994

Standard (Electromechanical)
250 Vac, 30 Vdc, 3 A resistive

Make:	30 A per IEEE C37.90-1989 3.6 kVA, Cos Φ = 0.3
Break Rating:	360 VA, Cos Φ = 0.3

Breaking Capacity (10000 Operations):

12/24 Vdc	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 Vdc	0.20 A	L/R = 40 ms

Carry:	3 A at 120 Vac, 50/60 Hz 1.5 A at 240 Vac, 50/60 Hz 50 A for 1 second
Durability:	>10,000 cycles at rated conditions
Pickup/Dropout Time:	<16 ms
Maximum Operating Voltage (Ue):	250 V
Current (Ie):	3 A
Rated Insulation Voltage (Ui) (Excluding EN 61010):	300 V

Optional (Solid State)

Voltage:	250 Vdc/Vac
Current:	100 mA maximum
Capacity:	0.6 VA at 25°C, 0.2 VA at 85°C
Pulse Rate:	20 pulses per second
Maximum On Resistance:	Typical: 50 Ω Guaranteed: <100 Ω
Minimum Off Resistance:	10 MΩ
Pickup/Dropout Time:	<25 ms

Analog Outputs

Maximum Firmware Update Rate:	100 ms
Maximum Settling Time for Full Range Change to 0.1% Full Scale:	500 ms
Bandwidth:	0 to 4 Hz

±1 mA Output

Range:	±1.2 mA
Minimum Output Impedance:	100 MΩ
Maximum Load:	10 kΩ, 100 µH
Accuracy:	±0.15% ± 2.0 µA at 25°C

4–20 mA Output

Range:	±24 mA
Minimum Output Impedance:	100 MΩ
Maximum Load:	500 Ω, 100 µH
Accuracy:	±0.20% ± 10 µA at 25°C

Optoisolated Input Ratings (Digital Input Ratings)

DC Control Signal 250 Vac/Vdc (Signal Level)

250 Vdc:	Pickup 200–275 Vdc Dropout 150 Vdc
220 Vdc:	Pickup 176–242 Vdc Dropout 132 Vdc

125 Vdc:	Pickup 100–137.5 Vdc Dropout 75 Vdc
110 Vdc:	Pickup 88–121 Vdc Dropout 66 Vdc
48 Vdc:	Pickup 38.4–52.8 Vdc Dropout 28.8 Vdc
24 Vdc:	Pickup 15–30 Vdc Dropout <5 Vdc
12 Vdc:	Pickup 9.6–16.7 Vdc Dropout <6 Vdc

AC Control Signal

250 Vac:	Pickup 170.6–300 Vac Dropout 106 Vac
220 Vac:	Pickup 150.3–264 Vac Dropout 93.2 Vac
125 Vac:	Pickup 85–150 Vac Dropout 53 Vac
110 Vac:	Pickup 75.1–132 Vac Dropout 46.6 Vac
48 Vac:	Pickup 32.8–57.6 Vac Dropout 20.3 Vac
24 Vac:	Pickup 14–27 Vac Dropout <5 Vac

Current Draw at Nominal DC Voltage: 2–6 mA

Time-Code Input

Meter accepts demodulated IRIG-B time-code input at EIA-232 Port 3, Port 2, or dedicated IRIG-B port (2-pin Phoenix connector).

IRIG Port Electrical Characteristics

Nominal Voltage:	5 Vdc
Maximum Voltage:	8 Vdc
Input Resistance:	>2 kΩ

Dedicated IRIG Port

On (1) State:	Vih ≥ 3.5 V
Off (0) State:	Vil ≤ 1.5 V

IRIG Pins on Port 2 and Port 3

On (1) State:	Vih ≥ 2.0 V
Off (0) State:	Vil ≤ 0.8 V

Time Accuracy

Clock Drift With No Time Input:	4 minutes per year, typical
IRIG Accuracy:	±2 µs

Simple Network Time Protocol (SNTP) Accuracy

Manycast or Unicast:	±5 ms (when directly connected to SNTP server)
Broadcast:	No specified accuracy

Operating Temperature

IEC 60068-2-1&2:1993: –40° to +85°C (–40° to +185°F)

Note: Not applicable to UL applications.

LCD/Color Touchscreen

Operating Temperature: –20° to +70°C (–4° to +158°F)

Dimensions: 3.86" x 0.902"

Operating Environment

Insulation/ Protective Class: 1

Pollution Degree: 2

Overvoltage Category: CAT III: Color touchscreen model
Power supply input, output contact, and digital input voltages must all be HLV or must all be SELV (no mixing of HLV and SELV).
No option cards installed.
CAT II: All other vertical and horizontal configurations.
SELV = non-hazardous low voltage.
HLV = hazardous voltage, >60 Vdc, >30 Vac (specified for dry environments)

Indoor Use (Atmospheric Pressure: 80–110 kPa)

Maximum Humidity: 95% RH non-condensing

Maximum Altitude:

Altitude	Working Voltage
0–2000 M	300 Vac
2000–4000 M	150 Vac

Weight

2.3 kg (5.0 lb)

Dimensions

Refer to *Diagrams and Dimensions on page 21*.

Terminal Connections

Rear Screw-Terminal Tightening Torque

Current Input Terminal Block (Ring Terminals Are Recommended)

Minimum: 0.9 Nm (8 in-lb)
Maximum: 1.4 Nm (12 in-lb)

Connectorized®

Minimum: 0.5 Nm (4.4 in-lb)
Maximum: 1.0 Nm (8.8 in-lb)

Compression Plug Mounting Ear

Minimum: 0.18 Nm (1.6 in-lb)
Maximum: 0.25 Nm (2.2 in-lb)

Connectorized terminals accept wire size 12–24 AWG.

User terminals or stranded copper wire should be at a minimum temperature rating of 105°C (221°F).

Synchrophasor Measurements

Compliance: P Class Synchrophasor data compliant with IEEE C37.118.1-2011 as amended by IEEE C37.118.1a-2014.

Data Transfer: IEEE C37.118.2-2011 (Backward compatible with IEEE C37.118-2005)

Message Rates: 60 Hz: 1, 2, 4, 5, 10, 12, 15, 20, 30, 60 messages per second
50 Hz: 1, 2, 5, 10, 25, 50 messages per second

Measurement Category

Nominal Voltage:

120 V when VBASE < 180

240 V when 180 < VBASE < 250

250 V when VBASE ≥ 250

Voltage Range:

80%–120% of Nominal Voltage

Nominal Current:

ANSI CL2/20 and IEC 1 A/2 A/5 A nominal configurations. (1 A, 2 A, and 5 A are the preferred nominal current ratings for transformer-connected IEC meters in IEC 62052-11.)

Processing Specifications

AC Voltage and Current Inputs

512 samples per power system cycle.

Control Processing

1/2-cycle processing interval

SELOGIC Pickup and Accuracies

SELOGIC Timers:	±1/2 cycle
Analog Values:	±3%

Metering/Monitoring

Voltage, Current, and Power Accuracy

Unity Power Factor:	±0.06%
0.5 Power Factor:	±0.16%

Energy Accuracy (Form 5 and Form 9 Only)

Unity Power Factor:	±0.06% guaranteed ±0.02% typical
0.5 Power Factor:	±0.16% guaranteed ±0.06% typical

ANSI C12.20-2015 Accuracy Class 0.1

IEC 62053-22 Accuracy Class 0.1 S

IEC 62053-24 Accuracy Class 0.5 S

IEEE 519 PQ Compliance with pre-programmed settings

Frequency Accuracy

FREQ_PQ:	±0.001 Hz
FREQ:	±0.01 Hz
FREQ_PMU:	±0.005 Hz at stable frequency ±0.001 Hz at stable frequency between 59–61 Hz or 49–51 Hz

Power Quality

IEC 61000-4-30:2015 Class A

Flicker

PST:	±5% over the range 0.5–25 P_{ST} (10-min interval)
PLT:	±5% over the range 0.5–25 P_{LT} (2-hour interval)

Type Tests

Electromagnetic Compatibility Immunity

Product Standards:	ANSI C12.20-2015 IEC 62052-11:2020 IEC 61000-6-2:2005 + AC:2005 IEC 61000-6-4:2006 + A1:2010 IEEE C37.90-2005
Conducted Radio Frequency Immunity:	IEC 61000-4-6, 150 kHz to 80 MHz, 1 kHz 80% AM 10 Vrms Spot Frequencies: 27 MHz and 68 MHz
Damped Oscillatory Wave Immunity:	ANSI C12.1 IEC 61000-4-18 IEEE C37.90.1
Current:	±2.5 kV common
Voltage:	±2.5 kV common, ±2.5 kV differential
Power:	±2.5 kV common, ±2.5 kV differential
Input:	±2.5 kV common, ±2.5 kV differential
Output:	±2.5 kV common, ±2.5 kV differential
Communication:	±2.5 kV common
Signal:	±2.5 kV common
Electrical Fast Transient Burst:	ANSI C12.1 IEC 61000-4-4 IEEE C37.90.1
Power, Input/Output, Voltage/Current Circuits:	±4 kV @ 5 kHz
Communication:	±2 kV @ 5 kHz
Electrostatic Discharge:	ANSI C12.1 IEC 61000-4-2 IEEE C37.90.3 Contact Discharge: ±8 kV Air Discharge: ±15 kV
Emissions:	ANSI C63.4 CISPR 11/22/32 EN 55011/22/32 Class A or B (configuration-dependent) Canada ICES-001(A) / NMB-001(A)
Power Frequency Magnetic Field Immunity:	ANSI C12.1 ANSI C12.20 IEC 61000-4-8 100 A/m for 60 seconds 1000 A/m for 3 seconds Maximum deviation as specified in ANSI C12.20

Radiated RF Immunity:

ANSI C12.1
IEC 61000-4-3
IEEE C37.90.2

Frequency (MHz)	Field Strength	Modulation
0.2–80	15 V/m	AM 90% 1 kHz sine
80–2000	20 V/m	AM 80% 1 kHz sine AM 90% 1 kHz sine
80–2000	30 V/m	Continuous wave
2000–10000	15 V/m	Continuous wave
80–2000	20 V/m	Keyed 0.5 s on 0.5 s off
80/160/380/450/900/1850/1890/ 2150/2600/3500/3800/5000	20 V/m	AM 80% 1 kHz sine
900/1732/1800/1890/2310/ 2450/5800	20 V/m	Pulse Mod. 50%

Ring Wave (100 kHz):

ANSI C12.1
IEC 61000-4-12
IEEE C62.41.2
(Location Category B, Table 2)
Power, Voltage/Current Circuits:
±6 kV (12 Ω) LL
±6 kV (12 Ω) LE
±4 kV with barrier-style Euro plugs installed

Startup and Shutdown:

IEC 60255-26
60 s ramp/5 min power off

Surge Immunity:

ANSI C12.1
IEC 61000-4-5
IEEE C62.41.2
(Location Category B, Table 3)

Power, Voltage/Current Circuits:

±6 kV (2 Ω) LL
±6 kV (2 Ω) LE
±4 kV with barrier-style Euro plugs installed

Ethernet:

±6 kV

EIA-232, EIA-485, IRIG-B:

±2 kV

Input/Output:

±2 kV LL
±4 kV LE

Environmental

Product Standards:

ANSI C12.20-2015
IEC 62052-11:2020
IEC 60255-27:2014

Environmental:

ANSI C12.1
IEC 60068-2-1
IEC 60068-2-2
IEC 60068-2-30
–40° to +85°C
5% to 95% relative humidity (37°C dew point)

Object Penetration:

IEC 60529

Enclosed in Panel With Available Gasket (P/N: 915900097) (Monochrome Model):

IP65

Enclosed in Panel With Available Gasket (P/N 915900097) and Cover for Front USB-C Port (Touchscreen Models):

IP54

Without Gasket:

IP41

Back (Terminals):

IP20

Portable Power Quality Enclosure (When Door Closed):	IP67
NEMA Enclosure:	4X
Seismic:	IEC 60255-21-3 Class 2 Quake Response
Shock/Bump:	ANSI C12.1 IEC 60068-2-27 IEC 60255-21-2 Class 1 Shock Withstand Class 2 Shock Response Class 1 Bump
Vibration:	ANSI C12.1 IEC 60068-2-6 IEC 60255-21-1 Class 2 Endurance Class 2 Response

Accuracy

ANSI C12.20-2015	Accuracy Class 0.1; CL2/10/20, and CL10/20 (applies to Blondel-compliant Form 5 and Form 9 only)
IEC 62053-22:2020	Class 0.1 S
IEC 62053-24:2020	Class 0.5 S
IEC 61000-4-30:2015 IEC 62586-2:2017	Class A

Safety

Product Standards:	ANSI/ISA 12.12.01-2015 and CSA C22.2 No. 213-15 Class I Division 2 Hazardous Locations CAN/CSA-C22.2 No. 61010-1-12:2018 IEC/UL 61010-1:2010 IEC/UL 61010-2-030:2010 (300 V, Measurement Category III) IEC/UL 61010-2-201:2013 IEC 62052-11:2020 IEEE C37.90-2005
Dielectric Strength/Impulse:	IEC 61010-1 IEC 62052-11 IEC 60255-27 IEC 60664-1 IEEE C37.90

Routine Dielectric Test Levels

Current Inputs:	2.2 kVdc
Voltage Inputs:	2.2 kVac
Inputs and Outputs:	2.2 kVac
Analog Outputs:	3.11 kVdc
Power Supply:	3.11 kVdc
EIA-485 Port:	1.50 kVdc
Insulation Resistance:	IEC 61010-1 IEC 60255-27 Meets applicable levels
Flammability of Insulating Materials:	IEC 61010-1 IEC 62052-11 IEC 60255-27 Meets applicable levels

Max Temperature of Parts and Materials:	IEC 61010-1 IEC 62052-11 IEC 60255-27 Meets applicable levels, normal use
Protective Bonding/Continuity:	IEC 61010-1 IEC 60255-27 Meets applicable levels

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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