G4600 Series

Power Quality & Grid Stability Analyzer

ELSPEC
When Power Meets Quality



www.elspec-ltd.com

G4600 Series

Power Quality & Grid Stability Analyzer

Capture & Record

The full electrical story, not only the events you predicted

Renewables, BESS, EV charging, UPS systems, data-center loads, drivers and fast power-electronic equipment have changed the character of power quality and stability problems. Many events are short, intermittent or oscillatory and may stay invisible to conventional averages or poorly configured triggers.

The G4600 records the electrical waveform continuously, no trigger depedency. The forensic record already exists when a question arises.

- Continuous waveform recording
- Advanced oscillation detection
- IEC 61000-4-30 Class A
- IEC 61850 / PMU / DNP3 / Modbus
- Cyber-ready architecture
- Synchronized monitoring

Built for utilities, data centres, critical loads, inverter-based generation and industrial power systems

Precision. Security. Reliability.

From Monitoring to Diagnosis

Modern Power Systems Need Continuous Evidence

The G4600 approach
Continuously measure and record the electrical waveform so the forensic record already exists when a question arises.

The result
Faster root-cause analysis, better compliance evidence, improved efficiency, and greater confidence in every operational decision.



1024 samples
Record voltage and current waveforms continuously at up to 1024 samples per cycle.

½ cycle resolution
Record precise frequency at ½ cycle resolution for fast frequency excursions, recovery behavior, generator starts, UPS transitions, BESS response and grid-stability review.

Synchronized measurement
Analyze RMS, harmonics, interharmonics, flicker, power, energy, phasors, sequence components, ½ cycle frequency, oscillation events and logic-based custom events from a synchronized measurement foundation.

Event detection
Use event detection for classification, alarming and reporting - not as the only mechanism for capturing data.

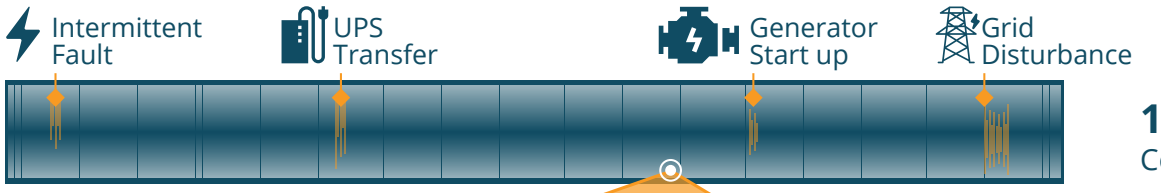
Up to 511th harmonic
Use 10/12-cycle spectral analysis with 5Hz bins across wide-band harmonic and interharmonic content, supporting resonance, inverter and equipment-compatibility investigations

SCADA integration
Integrate device data into SCADA, grid automation and PQSCADA Sapphire providing centralized visibility for monitoring and investigation.

PQZIP is the Differentiator

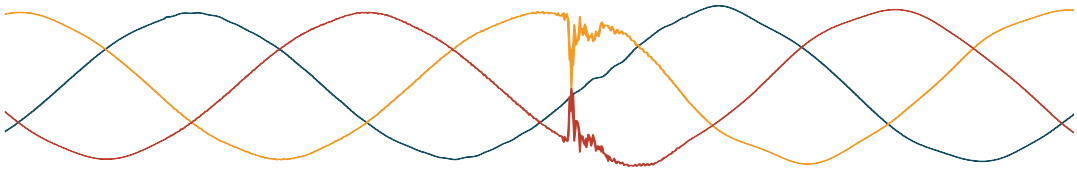
PQZIP Continuous Waveform Recording

Operational incidents leave electrical stamps. We capture them. Powered by Elspec PQZIP technology, the G4600 records high-resolution waveforms continuously and efficiently, eliminating dependence on predefined triggers. This unique approach delivers a complete view of electrical behavior before, during, and after disturbances, ensuring no critical evidence is missed. With continuous recording, intelligent analysis, local storage and instant access through the embedded web interface, the G4600 empowers teams to identify root causes faster, minimize downtime, and make operational decisions with greater confidence.



1 Year
Continuous waveform

Seamless Data Expention:
High Resolution Raw Waveform Detail (Milliseconds)



1/2 cycle
Continuous waveform

Key Capabilities

Threshold-free setup

No need to predefine every possible disturbance condition just to preserve waveform evidence.

High-resolution waveform

G4610 / G4620 / G4630 configurations support 256 / 512 / 1024 samples per cycle.

Synchronized measurement engine

Simultaneous multi-channel sampling with voltage and current channels processed together.

Forensic replay

Review what happened before, during and after a disturbance, including events not known at the time of configuration.

Wide-band spectral visibility

10/12-cycle analysis with 5Hz bins supports harmonic and interharmonic investigation up to 25kHz / 30kHz on 50Hz / 60Hz networks.

From Measurement to Action

High-Resolution Measurements & Control-Grade Event Logic

Continuous recording is most valuable when it is paired with measurements that can be acted on. The G4600 combines high-resolution frequency recording, wide-band 5Hz spectral bins and a programmable event mechanism that turns complex electrical behavior into clear engineering evidence and actionable control signals.

Advanced Analysis Capabilities

Precise ½-cycle frequency recording

See fast frequency excursions and recovery behavior that conventional one-second trends can hide - valuable for generator starts, UPS transfers, islanding, BESS response, weak-grid operation and post-event stability review.

10/12-cycle spectrum with 5Hz bins

Analyze harmonics and interharmonics across the wide-band range, up to 25kHz (50Hz) and 30kHz (60Hz), to identify switching signatures, resonance, high-frequency distortion and equipment-compatibility risks.

Events beyond simple thresholds

Configure events on threshold exceedance, rate of change and comparison against a configurable T-time average - earlier visibility into developing conditions, not only after a classic sag, swell or interruption.

Logic-based event aggregation

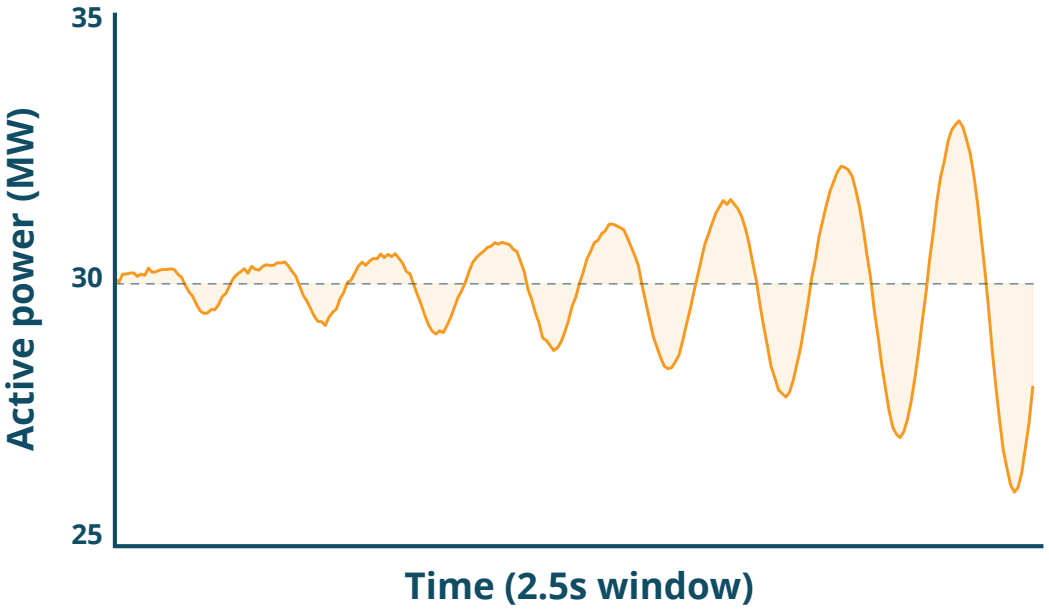
Combine conditions with AND, OR, XOR and NOT logic (e.g. Event 1 AND Event 2 AND NOT Event 3) to reduce nuisance alarms and create precise triggers for reporting, SCADA, digital and relay outputs and Sapphire workflows.

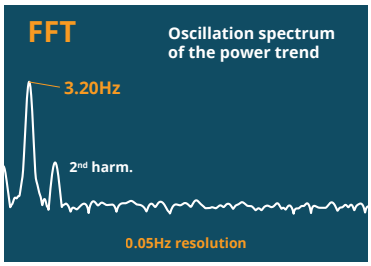
Continuous Waveform Recording

Detect the Oscillation. Quantify the Severity. Preserve the Evidence.

Oscillation Detection for IBR-Dominant Systems

As renewable generation, BESS, UPS systems, power-electronic loads, FACTS/HVDC assets and weak-grid conditions increase, engineers need more than sag/swell logs. They need to detect oscillatory behavior, quantify it and connect it to the underlying waveform evidence.





Measured Parameters

Frequency	50.02Hz
Active power (avg)	30.0MW
RMS V (Ph-N)	19.1kV
Osc. frequency	3.20Hz
Osc. amplitude	4.5MW (15%)
Damping ratio	-0.050 (growing)

Detection range

0.05-55Hz oscillation detection for low-frequency and subsynchronous phenomena.

Selectable parameters

Operates on half-cycle or one-cycle parameters such as frequency, RMS voltage/current, sequence components and power.

Severity states

Real-time Event / Alarm / Trip classification with a clear severity hierarchy.

Calculated metrics

Oscillation frequency, damping ratio, phase, maximum amplitude and average amplitude.

System integration

Oscillation state and metrics available through supported protocols and PQZ data workflows.

Operational response

Use oscillation state to support alarms, digital outputs, relay outputs and Sapphire investigation.

Why it matters

Oscillations may stay within normal voltage or current limits while still indicating control-loop interaction, resonance, insufficient damping or developing instability.

Continuous waveform recording gives engineers the evidence to validate models, replay behavior and perform deeper EMT or power-system studies after the event.

Oscillation logs with state transitions help distinguish a short benign fluctuation from an escalating instability trend.



Integration-Ready for Modern Automation Networks

The G4600 is designed as a measurement node inside the digital electrical infrastructure, not only as a standalone analyzer. It supports standard industrial and utility communication paths for SCADA, protection, automation and enterprise power quality systems. Efficient low-bandwidth communication enables reliable transfer of critical data from remote locations. Integration-ready by design, the G4600 simplifies deployment within modern automation networks while ensuring reliable, secure, and time-synchronized data exchange.

Substation & utility protocols
IEC 61850 MMS / GOOSE / Sampled Values, DNP3, PMU IEEE C37.118, Modbus TCP/RTU.

Time synchronization
GPS, IRIG-B, IEEE 1588 PTP, NTP/SNTP and internal clock sources for synchronized timestamping and sampling.

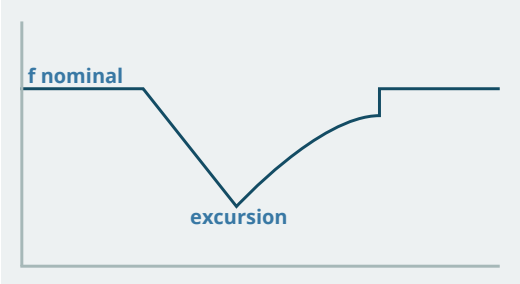
High-performance data access
Fast Modbus mapping, dynamic mapping files, SFTP, real-time web visualization and protocol access to event states and calculated values.

Cyber-ready operation
HTTPS, SSH/SFTP, certificate management, user permissions, protocol enable/disable controls and system logging.

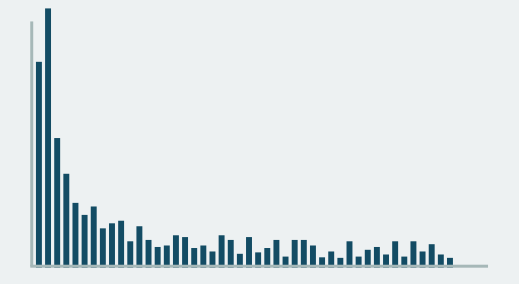
For SCADA teams
Standard protocols, configurable mapping and real-time data exchange simplify integration into existing automation systems.

For IT & cybersecurity teams
Secure access methods, certificate support and role-based configuration reduce exposure while preserving operational flexibility.

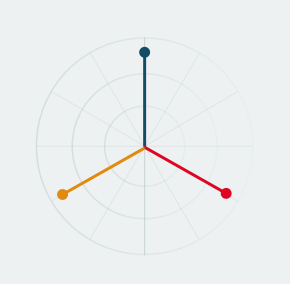
Measurement engine at a glance



½-cycle frequency excursion & recovery



Wide-band harmonics, 5 Hz bins



Continuous phasor logging

Extend Your Meter. Replace Your RTU.

Multi I/O Modules

The G4600 series goes beyond metering with an optional Multi-I/O module designed to cover virtually any application. Seamlessly integrating with external sensors, SCADA/BMS systems, and control equipment through digital I/O, analog signals, and relay channels, it eliminates the need for separate RTUs, PLCs, and multiple standalone devices, reducing installation costs and complexity. Process variables are directly correlated with power quality events on a single unified timestamp, giving you the complete operational picture from one intelligent device. The G4600 series supports up to three I/O modules using internal power, delivering:

Up to **24** Fast Digital Inputs

Up to **12** Fast Digital Outputs

Up to **12** Analog 4-20mA Inputs

Up to **12** Analog 4-20mA Outputs

Up to **9** Relay Outputs



Commission locally. Investigate centrally. Report professionally.

Local Web Interface & PQSCADA Sapphire

The G4600 web interface provides fast access to configuration, live values, waveform visualization, events, energy, harmonics, phasors and Multi I/O status. PQSCADA Sapphire extends this into fleet-level storage, advanced engineering analysis, automated reporting and multi-site investigation.

Real-time
Live visibility
RMS, power, harmonics, unbalance, flicker, phasors, waveform, energy and I/O views.

Events
Investigation
PQ, system, custom, aggregated and I/O events with threshold, rate-of-change and T-time average comparison, logic aggregation, start/end time, duration, phase, severity and value.

Reports
Export anywhere
EN50160, IEEE1159, grid-line-code reports, COMTRADE, PQDIF, PQZIP, Excel, CSV, PDF and image exports.

Charts
Advanced visualization
Trend, grid, spectrum, event, statistics, scatter, phasor and cyclic histogram charts.

Config
Management
Device settings, users, protocols, network, time sync, firmware, licenses, certificates and configuration files.

Fleet
Multi-site analysis
Centralized engineering software across many meters, sites and applications.



Six Instruments Consolidated Into One Device

One Platform. Multiple Power-System Roles.

PQM
Power Quality Monitoring

DFR
Digital Fault Recording

SER
Sequence-of-Events Recording

DSM
Dynamic System Monitoring

PMU
Synchrophasor / PMU

EBM
Energy & Billing Measurement

Built for Demanding Applications

Where the G4600 Delivers



Data Centers & Critical Loads

Protect uptime by capturing UPS transfers, generator starts, switching events and unexplained disturbances, with the full waveform context around each one.



Inverter-Based Generation & BESS

Capture inverter switching behavior, control-loop interactions and weak-grid dynamics. Grid-code compliance evidence is recorded automatically, without pre-configuration.



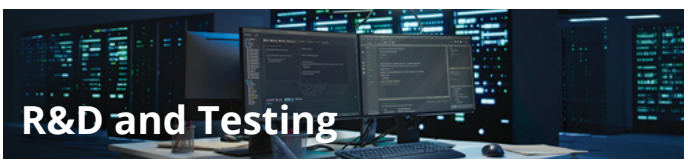
Utilities & Substations

IEC 61850 integration, PMU streaming and disturbance investigation from a single device. Oscillation events are classified and timestamped with GPS / PTP accuracy.



Industrial Plants

Investigate production disruptions after the fact - no trigger threshold needed. Motor-drive harmonics, resonance and intermittent faults all preserved in the continuous record.



R&D and Testing

Continuously capture high-resolution electrical behavior for validation, model comparison and advanced analysis.

Rugged measurement. Flexible expension. Digital integration.

Designed for Field Installation

Voltage inputs
4 physical channels, 1,000 VAC/VDC direct measurement, >10 MΩ input impedance, CAT IV / CAT III ratings.

Current inputs
4 physical current channels, 0.01-79A measurement range, low-burden current measurement.

Power supply
85-264 VAC, 47-63 Hz; 80-300 VDC; auxiliary low-voltage input; low-voltage ride-through up to 30 seconds.

Mechanical
174.6×231.7×183.2mm (6.87"×9.12"×7.21");
approx. 1.66kg base (3.66lb);
DIN rail, enclosure or flat-surface mounting.

Environment
-20 to +70 °C operation; -40 to +85 °C storage; 85% humidity; up to 2,000 m altitude.

Multi-I/O expension
Modular I/O support for complex installations
Up to 3 multi I/O modules with multiple Digital, Analog and Relay channels.

Smart Display

The G4600 Smart Display provides a local HMI through a rugged 7-inch IPS touchscreen. Available as an optional accessory, it automatically discovers and connects to one or more G4600 devices, giving access to real-time measurements, waveforms, events, diagnostics, and I/O status. Power and communications are delivered through a single PoE connection for simple installation. Designed for indoor and outdoor use, the multitouch display supports operation with work gloves and enables meter configuration and firmware updates without the need for a service laptop.



Specifications

Measurement Ranges, Resolution & Accuracy

Voltage, current & frequency

Parameter	Measurement range	Resolution	Accuracy
VRMS (AC/DC)	0–1,000V[1]	10mV	±0.1% of nominal voltage[2]
ARMS	0.01-79A	10mA	±0.1% of nominal current
Voltage peak	up to 8kV	10mV	±0.1% of reading
Frequency (50Hz nom.)	40-70Hz	1mHz	±1mHz
Frequency (60Hz nom.)	40-70Hz	1mHz	±1mHz

[1] Accuracy applies from 5V
[2] For nominal voltage 110 to 690V

Harmonics, flicker & unbalance

Parameter	Measurement range	Resolution	Accuracy
Harmonic order	1 to 511 (subgroups per IEC 61000-4-7)	0.01V	IEC 61000-4-7
Inter-harmonic order	1 to 511 (subgroups per IEC 61000-4-7)	0.01V	IEC 61000-4-7
THD (n = 50)	0-1000%	0.01%	±0.25%
Phase angle	-180° to +180°	0.01°	±0.01°
Flicker (Pst, Plt)	0-20	0.01	±5%
Flicker (Pst inst.)	0-20	0.01	±8%
Voltage unbalance (neg./zero seq.)	0-100%	0.1%	0.15%
Current unbalance (neg./zero seq.)	0-100%	0.1%	0.5%

Power & energy

Parameter	Measurement range	Resolution	Accuracy
Active power	±5kW × CT × PT ratio	10mW	±0.2%
Reactive power	±5kVAr × CT × PT ratio	10mVAr	±0.5%
Apparent power	±5kVA × CT × PT ratio	10mVA	±0.2%
Active energy	±5kWh × CT × PT ratio	10mWh	±0.1%
Reactive energy	±5kVArh × CT × PT ratio	10 mVArh	±0.5%
Apparent energy	±5kVAh × CT × PT ratio	10 mVAh	±0.2%

Inputs, Sampling & Recording

Inputs & sampling			
Parameter	**G4610**	**G4620**	**G4630**
Voltage channels	AC/DC: 4 (3 phase + neutral)	AC/DC: 4 (3 phase + neutral)	AC/DC: 4 (3 phase + neutral)
Voltage range (direct)	1,000 VAC/VDC	1,000 VAC/VDC	1,000 VAC/VDC
Input impedance / capacitance	>10MΩ / 320pF	>10MΩ / 320pF	>10MΩ / 320pF
Overvoltage category	600V CAT IV / 1000V CAT III	600V CAT IV / 1000V CAT III	600V CAT IV / 1000V CAT III
Current channels	4	4	4
Current range	0.01-79A	0.01-79A	0.01-79A
Current burden	0.0008VA @5A	0.0008VA @5A	0.0008VA @5A
Bandwidth	6.25kHz	12.5kHz	25kHz
Sampling rate	256 samples/cycle	512 samples/cycle	1024 samples/cycle
A/D converter	24-bit	24-bit	24-bit
Harmonics reach (50Hz)	up to H128	up to H256	up to H511

PQZIP recording			
Parameter	**G4610**	**G4620**	**G4630**
Continuous waveform	~1 week	~1 month	~1 year
Method	Gap-less continuous recording of all electrical parameters - no event thresholds required	Gap-less continuous recording of all electrical parameters - no event thresholds required	Gap-less continuous recording of all electrical parameters - no event thresholds required
Event log memory	up to 100000 event logs	up to 100000 event logs	up to 100000 event logs
Internal memory	64GB	64GB	64GB

Communication, Time Sync, Power & Physical

Communication, time sync & power	
Parameter	
Ethernet	2 × RJ45, 10/100/1000Mbit
LAN protocols	Modbus TCP, DNP3, SSH, FTP, SFTP, PMU (IEEE C37.118), IEC 61850 (MMS/GOOSE/SV), PTP
Serial	RS-485 / 422, Modbus RTU, up to 115,200 baud, full duplex
Power over Ethernet	PoE-PSE output - 13W, 48VDC
Time synchronization	GPS / NTP / IRIG-B / PTP / PPS / Self
Sync accuracy	0.5µs GPS & IRIG-B · 1µs PTP (Layer 2) · 100µs SNTP
Real-time clock	±5ppm
Power supply	85-264VAC, 47-63Hz · 120–370VDC · aux. 24VDC ±20%
Low-voltage ride-through	up to 30 seconds

Physical & environmental	
Parameter	
Dimensions	174.6×231.7×183.2mm (6.87"×9.12"×7.21")
Weight	1.66kg base (3.66lb)/ 2.03kg (1MIO) (4.48lb) / 2.38kg (2MIO) (5.25lb)
Mounting	DIN rail, enclosure or flat-surface
Ingress protection	IP 20 per IEC 60529
Operating / storage temp.	-20 to +70°C / -40 to +85°C
Humidity / altitude	85% / up to 2,000m
Multi-I/O expension	up to 3 modules: 24 DI, 12 DO, 12 AI, 12 AO, 9 relays

Standard compliance	
Standards	IEC 61000-4-30 Class A, IEC 61000-4-7, IEC 61000-4-15, IEC 61000-4-19, IEEE 519, IEEE 1159, IEEE C37.118, IEC 62053-22/23/24, IEC 61850, EN 50160, IEC 62052-11/31, IEC 60068-2-1/2/6/14/27/57/78, IEC 60255-21-1/2/3, IEC 62262, IEC 60068-2-31, IEC 61010-1 safety, CISPR 32/FCC/ICES EMC, IEC 62586-1/2

Worldwide Innovator in Power Quality

Since 1988 Elspec has developed, manufactured and marketed proven power quality solutions far exceeding our clients' needs and expectations. Our innovations not only simplify the understanding of the quality of power itself, but are also highly compatible, making it suitable for any business and/or application. Elspec's international team of professionals with extensive experience in electrical engineering, are ready to provide a tailor-made strategy that will enable a sustainable and efficient use of your electrical energy.

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September 2026