neo MESSTECHNIK

Power Quality Class A+ | Digital Fault Recorder | Phasor Measurement Unit

POWER QUALITY ANALYZER

Power Quality Class A+

according to IEC61000-4-30 Ed. 4
Harmonics, Interharmonics, TDD, THD
up to 20.000 samples per cycle

Supraharmonics 500 kHz

2-9kHz (200Hz) according to IEC61000-4-7
8-150kHz / 500 kHz according to IEC61000-4-30

Grid Impedance 450 kHz

Resonance Detection up to 150 kHZ / 450 kHz
Harmonic emission limit allocation

Oscillation Detection

Half-period RMS stream, Phasor Measurement Unit
Oscillation detection (sub-synchronous)

Highest Precision

0.05% Accuracy | 500 kHz Bandwidth
TVE <0.01% (100 Times better than IEC/IEEE Std).

PQA8000H

PQA8000H-RM
fixed installation

PQA8000H
mobile

www.neo-messtechnik.com

POWER QUALITY ANALYZER

PQA 8000H

Accuracy	0.05%
Sampling Rate	up to 1 MS/s
Supraharmonics	500 kHz
Resolution	18 bit
Inputs	4x Voltage, 4x to 8x Current
Voltage Range	800 V / 1600 V
Safety Category	CAT III 1000V / CAT IV 600V
Isolation	6 kV (CH - GND & CH - CH)
Current Input	Rogowski, Clamp (AC/DC)
Dynamic	0.5 mA to 150 kA (15x Ranges)
Clamp Power Supply	+9 V / ± 15 V
Data Storage	up to 1 TB
IEC61000-4-30	Class A (Ed.3 and Ed.4)
Interfaces	Digital IO / CAN / RS485 / GPS LAN / WLAN / LTE / Bluetooth

HIGH **ACCURACY** — <0.05% for BOTH Voltage & Current | Class A++ TVE

ACCURATE **PMU** — <0.01% (100 Times better than IEC/IEEE Std.)

HIGH **SAMPLING RATE** — Up to 1MHz (20,000 samples/cycle)

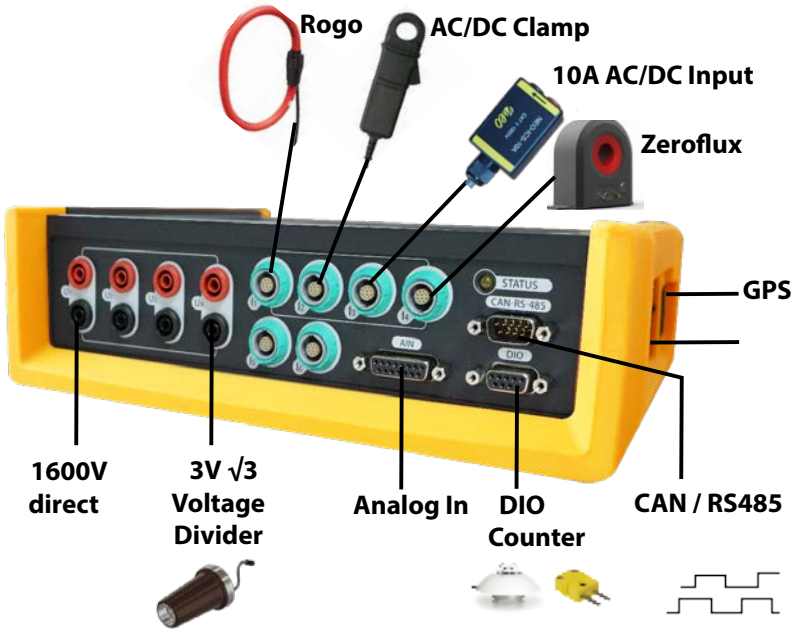
HIGH **RESOLUTION** — 18bit/24bit 0.5mA to 150kA with High Signal to Noise Ratio

HIGH **DYNAMIC RANGE** — CAT IV 600V, 6kVp Channel to Channel Isolation

HIGH **SAFETY CATEGORY**

FEATURES — up to 2TB SSD, Windows Industrial PC, 4 Hour Battery, 10.1 inch Multi-touch Display, Precise Time GPS Synchronization (100ns), DIO, CAN, RS485, DIN Rail Mount, Screw Mount, and Rack Mount Version, and more.

Connection of any sensor



HIGHLIGHTS

SMART TOUCH
The large 10.1 inch full-HD Smart Touch display responds immediately without any delay with intuitive operation like on a mobile phone.

MOBILE OPERATION
The integrated battery pack allows an operating time of up to 4 hours of operation. 5 LEDs indicate the remaining battery capacity. There is no need for an external power supply or special connectors... plug and play.

GPS
Integrated GPS enables high-precision time measurements & synchronization, which is ideal for PMU applications.

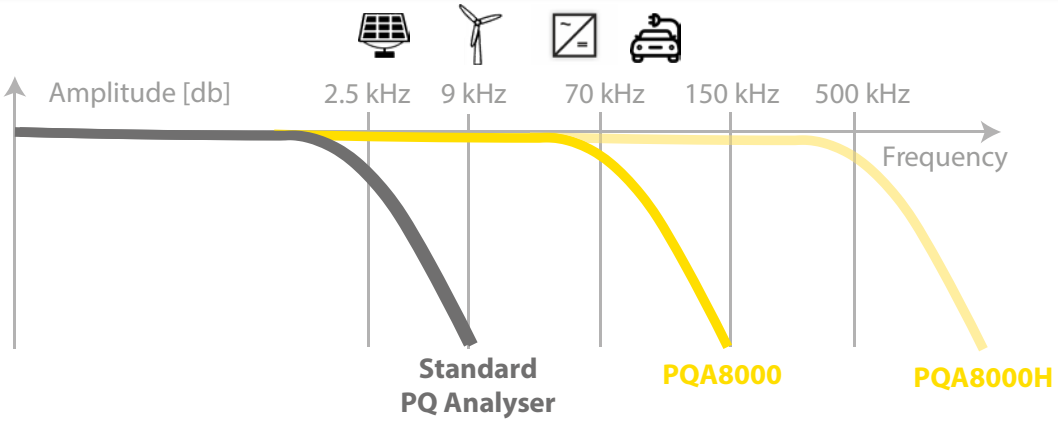
... measurement of over 5000 electrical parameters

LARGE SSD
The instrument is equipped with two SSD disks. One is dedicated for the OS and application software, and the other one is equipped for data storage (up to 1 TB).

INTERFACES
The instrument provides an easy integration with other analog and digital signals such as temperature. The interfaces include USB 3.0, TCP/IP, LAN, Wifi, Bluetooth, RS232, Modbus, 104, DIO, and CAN.

SENSOR SUPPLY
The instrument can provide excitation for your current sensors,
and there is no need for batteries or external power supplies.

SUPRAHARMONICS UP TO 500 kHZ FOR VOLTAGE AND CURRENT
Conventional PQ Analyzers, even if they are Class A certified, are not sufficient for modern measurement applications. We use the best available components to ensure the highest safety category and also the highest accuracy. NEO instruments offer high bandwidth (up to 1 MHz) and correct the frequency dependent behavior of current & voltage sensors as well as integrated electronics to achieve the best possible measurement results.
THE REFERENCE INSRUMENT



NEO SENSOR CALIBRATION

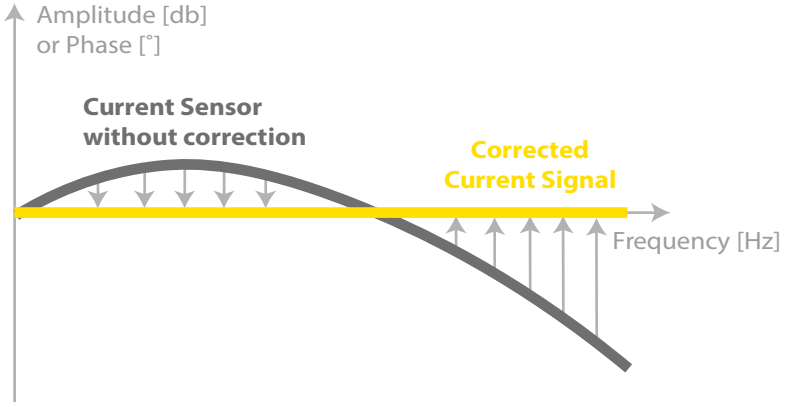
HIGHEST PRECISION

The NEO way of Sensor Integration

All current sensors offered by NEO Messtechnik are industry proven for different applications.
We use and improve on the best available sensors in the market.

1) FREQUENCY DEPENDENT CALIBRATION

The NEO sensor integration calibrates each sensor over a wide frequency bandwidth and corrects frequency dependent phase shift and amplitude damping. This enables high precision from DC to high-frequency measurements.



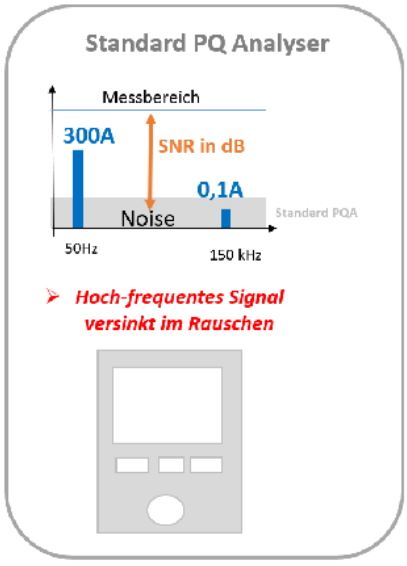
2) MEASUREMENT RANGE DEPENDENT CALIBRATION

In addition, the sensors will calibrated for each measurement range using multiple points.
The calibration will typically cover points from 1% to 100% of the nominal measurement range.
This will improve the accuracy and precision, especially at low current (e.g., 1% of nominal measurement range).

All sensors will be delivered with a standard calibration, which improves the accuracy compared to nominal specifications, whereas the NEO calibration will be performed on each individual sensor and needs to be ordered separately.

3) Signal-to-Noise Ratio (SNR)

NEO PQA8000H Series have a high signal-to-noise ratio (SNR) which means that even low currents (micro amperes) are measured accurately across the full range (DC to 500 kHz). In comparison, other analyzers on the market will measure noise, even at the fundamental frequency. NEO is state-of-the-art hardware.



INSTRUMENT OPTIONS

PQA8000

4x Voltage Input 1600V DC
4x Current Input (Rogowski, Clamp)
CAN / RS485

PQA8000-P

4x Voltage Input 1600V DC
6x Current Input (Rogowski, Clamp)
2x Analog Input (± 10V)
CAN / RS485 / DIO

PQA8000-M

4x Voltage Input 1600V DC
8x Current Input (Rogowski, Clamp)
CAN / RS485 / DIO

CUSTOMIZE DESIGN

Choose your colour

Connector Color

-select the color of the connectors to match cabling or standards

In addition, the transport bag of the PQA8000 device can be embroidered with company logos.

SPECIFICATIONS & ACCESSORIES

GENERAL SPECIFICATIONS

PC	Microsoft® Windows 11 IOT(64 bit) Intel® Quad Core Processor and 8GB RAM Locked OS for reliable operation Multilanguage Support
Storage	256GB SSD for OS and application software 256GB SSD dedicated for Data storage
Display	10.1 inch Capacitive Multi-Touch TFT LCD Sunlight Readable / 800cd
Battery	Li-Ion Battery 90Wh up to 4h operation
Power Supply	115V / 230V AC
Interfaces	3x USB, 1x Ethernet, WiFi, 1x HDMI
Dimensions	298 x 225 x 95 mm 11.8 x 8.8 x 3.7 inch
Weight	4kg / 8.8pound
Temperature Range	Operating: 0 to 60°C (32°F to 140°F) Storage: -20 to 80°C (-4°F to 176°F)
IP Class	IP2X
Accessories	Transport Bag and Keyboard included
Standards & Certification	IEC61010-1 (2011) / IEC61010-2-030 / IEC 61000-4-3 / IEC 61000-4-4 / LVD Directive 2014 / EMC Directive 2014/ Rohs Directive 2015/ EN 61000-3-2 / EN 61000-3-3 / EN 61326-1 / EN 55011 +A1, Class A

OPTIONS AND ACCESSORIES

SSD Upgrade	Upgrade to 512GB or 1TB data storage
GPS	Integrated GPS receiver and GPS mouse
GSM	Integrated Modem for telecommunication
DC Power	DC Power supply input +9V …. +36V DC
Dust Cover	Protect PQA8000 instrument in tough environments
Transport Case	Ruggedized Pelican-Case (IP67), with foamed insert adapted for the measurement instrument and pullout handle
color Code	Color code for all voltage and current inputs
Temperature Sensor	Thermocouple Type K temperature sensor on DSUB15 input
Radiation Sensor	Pyranometer Sensor on DSUB15 input
Current Sensor	See Chapter Accessories
Test Leads	See Chapter Accessories

SPECIFICATIONS

VOLTAGE INPUTS	
Inputs	4x
Range	Standard: 1600V/ 800V MV-Version: 600V / 20V
Accuracy	0.05% f.s.
Isolation	6kV isolation
Safety	CAT III 1000V CAT IV 600V
Impedance	10 MΩ

CURRENT INPUTS	
Inputs	PQA8000: 4x PQA8000-P: 6x PQA8000-M: 8x
Accuracy	0.05% f.s.
Type	Clamp or Rogowski IPCS (High-Precision 0.01% Current Sensor for Direct 1A & 5A Secondary CT) with
Instrument Ranges Clamp	2mV to 10V (15x Ranges)
Integrator Rogowski Range	1A to 300kA
Additional Analog Inputs (AIN)	1V, 2V, 5V, 10 V
Sensor Supply	±15V / 9V
TEDS	Automatic Sensor Detection*

ANALOG DIGITAL CONVERSION (A/D)	
Sampling Rate / Resolution	PQA8000: 124 kS/s / 24bit PQA8000H: 1 MS/s / 18bit
Filters	Analogue and Digital Automatic Anti-Aliasing Filter

DIGITAL I/O & INTERFACES	
Digital In/Out	Adjustable Trigger max. 350V
CAN, RS485	Selectable Termination

High precision Synchronisation

PQA8000H

PQA7000

- *Highest Precision SYNCHRONISATION*
- *Dataoverlay Functi*

PQA8000H-RM

FLEXIBILITY

Measurement at any voltage level (LV, MV, HV)

Low Voltage

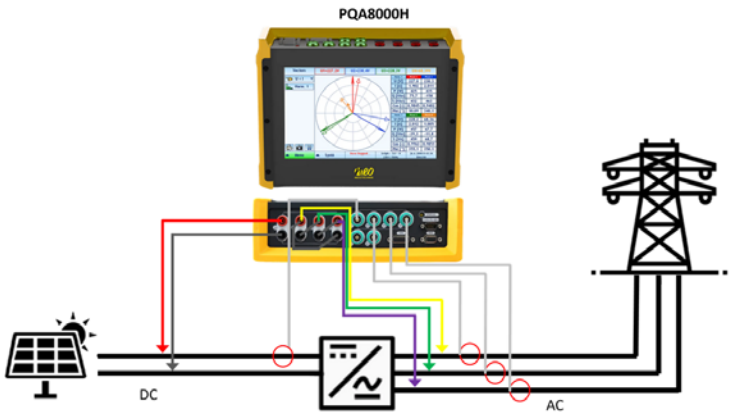
Medium Voltage

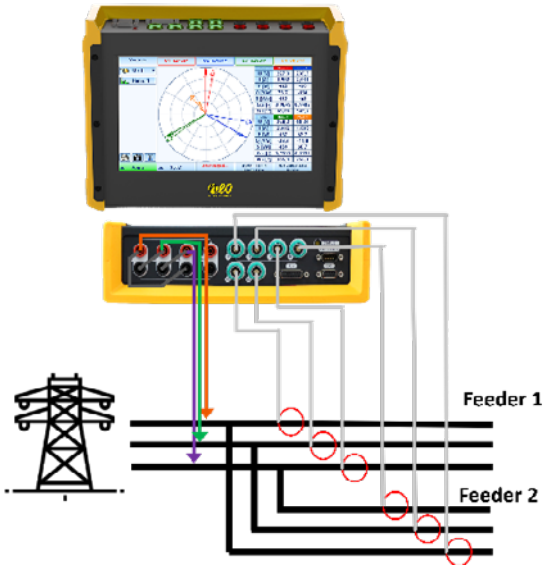
High Voltage

- Highest Precision in all voltage levels (0.05%)
- Full bandwidth of up to 150 kHz possible for LV, MV, and HV (see application notes)

Combined AC and DC measurement / Multifeeder

Fully isolated high voltage inputs (up to 1600V DC) allowing multiple AC and / or DC measurements.





Example 1: AC and DC measurment (see picture)
Example 2: Measurement after variable frequency drive (VFD)
Example 3: Measurement of 2x 3-phase systems AC
Example 4: Measurement of 8x 1-phase systems AC or DC

DC Grid Power Quality

- Voltage Events
- Voltage unbalance in case of bipolar DC grids
- RVC
- DC Ripple for Voltage and Current
- Voltage RMS (200ms + 10min aggregation)
- Voltage RMS 10ms + Raw Data record in full sampling rate in case of disturbances)
- Supraharmonics up to 500 kHz
- THD
- Grid Impedance / Resonances
- State of Grid (very important

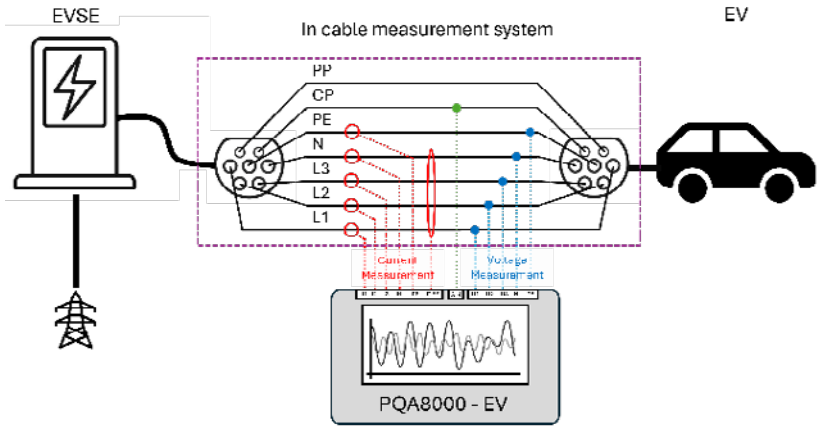
CUSTOMIZATION

PQA8000H - EVSE

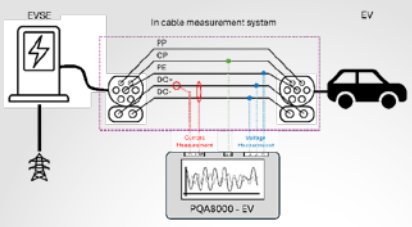
Example with Type 2 connector

PQA8000H upgrade to Pelicase for **Plug&Play** operation with the following optional integrations:

- Current sensors like rogowski or zeroflux transducers inside the Pelicase
- Power Supply CATIV 230V/400V to supply directly
- Residiual current monitor for Leakage current measurement
- CP Measurement
- Auxiliary sensors and interfaces (CAN etc.)
- 12V vehicle board system power supply with polarity protection and fuse
- Grid Impedance Analyser
- PLC (Power Line Communication Sniffer)
- Virtual vehicle switch for EV Charging station tests
- Connection cable Type 2 or any other connector possible (SAE, GB)



Also as DC version available with CCS



19-inch Rack Mount Premium PMU

PQA-8000H-RM Rack Mount Version

19-inch 2U Rackmount with 310mm Depth

POWERHOUSE: Industrial Intel i3 and 32 GB RAM

Connections & Terminations customizable

Integrated High Precision Current Sensors optional

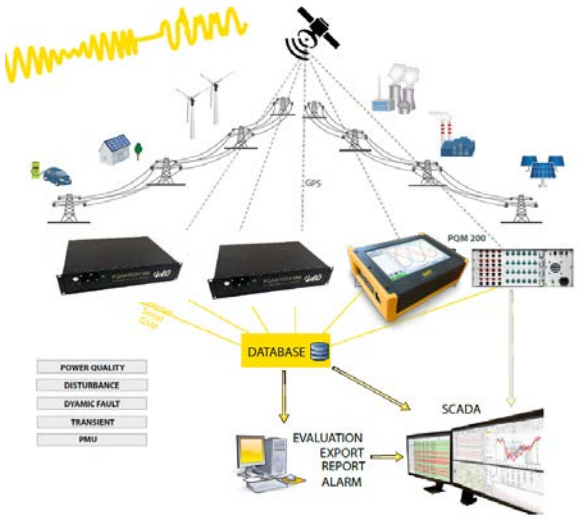
Over 100 parameters at 10ms or 20ms (cycle-by-cycle)

Data Driven Solutions
Power Quality, Synchrophasor (PMU), BESS, FCAS, Fault Location (within metres), Protection, Control, Asset Health, Bushfire Prevention, Oscillations, Supraharmonics, Grid Impedance, Islanding, and more.

Analytics
Real-time Visualisation & Insights (400x SCADA), Historical Analytics, Modeling, Compliance Reporting. Any Device. Any Sensor. Any System.

Digital Twin & Context
Understand Data in Context with Digital Twin, Asset Metadata, Geospatial (GIS), Big Data. TSO, DSO, Private Grids, and Individual Facilities.

Artificial Intelligence & Custom Apps
Modular, Scalable, Custom Apps. Artificial Intelligence for Anomaly Detection, Prediction, Analysis, Classification, and more. API available.



Real-time synchronized grid monitoring, power quality analysis, asset management, fault analysis, oscillation detection, model validation, artificial intelligence, and wide-area monitoring — unified in one powerful platform.

Synchrophasor

Real-time phasor measurement data via IEEE 60255-118-1 / C37.118 up to 100/200 frames per second that is **x400 times faster than SCADA Systems**

Power Quality

Comprehensive PQ analysis tools, compliance standards (EN50160 and IEEE-519, custom compliance), report, **export to industry standard formats.**

WAMS

Multi-Sensor **synchronized investigations on the same timescale** for stability analysis, event propagation, oscillation detection, and more.

Oscillation Detection & Stability Monitoring

Continuous sub-synchronous monitoring of oscillatory behaviour with state-of-the-art methods and visualization.

Artificial Intelligence & ML

With SmartGRID EDGE X1 Hardware (powered by NVIDIA), experience world-class classification models for power quality, anomaly detection, more

Built-in Jupyter Notebooks, Grafana, APIs

Use SmartGRID's built-in analysis dashboards or conduct your own analysis with built-in Jupyter Notebooks & Grafana.

Interfaces:
- Modbus TCP
- DNP3
-C37.118
- PQDif
- Comtrade
- CSV / Excel
- API

Retrospective PMU Data Recall (RPDR) – Most PMUs can only stream data to a data concentrator, which means during communication failures PMU data is often lost. With SmartGRID's RPDR feature, PMU data is never lost, and data is filled back in retrospectively when using SmartGRID EDGE X1 Hardware (powered by NVIDIA) connected locally to the PMU sensor, or natively supported by the PMU (such as NEO PQA-8000H Series).

Dynamic Measurement International Grid Codes

Voltage & Current Sampling Rate (Not Stated, 1024 samples/cycle Recommended)	Up to 20,000 samples/cycle (1MHz) for both voltage and current. User selectable.
Voltage & Current Accuracy (Not Stated, 0.1% Recommended)	<0.05% for BOTH voltage and current for full range. <0.02% (Typical)
Sampling Rate of Local Frequency Measurements (≤50 ms)	10ms (ie. half-period/half-cycle values)
Sampling Rate of Generation Amount & Load Amount Measurements (≤50 ms)	10ms (ie. half-period/half-cycle values)
Measurement Range of Power Flow Measurements (Intrinsic Uncertainty of ≤2%, and Resolution of ≤0.2%)	Yes, guaranteed Intrinsic Uncertainty of ≤2%, and Resolution of ≤0.2% across FULL range.
Local Frequency Measurement Range (Intrinsic Uncertainty ≤0.01 Hz (10mHz) and Resolution of ≤0.0025 Hz (2.5mHz))	Yes, Absolute Frequency Accuracy of ± 0.000550 Hz (± 550 µHz) with Frequency Uncertainty ± 0.000027 Hz (± 27 µHz, k=2, 95% confidence) for ALL Frequencies with Frequency Resolution of 0.000003 Hz (3 µHz).
Recording Period for Power & System Frequency Measurements (≥5 s before FDT and ≥60 s after it)	Yes. 60s before FDT and ≥7200 s after it. User Selectable. Continuous Half-Period (10ms) or Cycle (20ms) Recording Possible.
Trigger for Recording Measurements (At least whenever Local Frequency changes ≥ Trigger Range)	Yes. Trigger on any parameter. User Selectable. Continuous Half-Period (10ms) or Cycle (20ms) Recording Possible.
Cycle-by-Cycle (CBC) Frequency (Not stated, Required)	Yes. High Precision CBC Frequency (20ms values), and Half-Period Values (10ms) also available. User Selectable.
Rate-of-Change-of-Frequency (ROCOF, df/dt) (Recommended)	Yes. High Precision ROCOF
Other Requirements including Reporting	Yes.
IEC/IEEE 60255-118-2018 Synchrophasor Standards for Phasor Measurement Unit (PMU)	
Total Vector Error (TVE) < 1% (considers magnitude, angle, time synchronization errors)	<0.01% (100 Times Better than IEC/IEEE Standards)
Angle Error (<0.573 degrees for TVE <1%)	0.003 degrees
Time Synchronization Accuracy (<1000ns or 1 micro-second)	100ns (typical) through GPS

EXAMPLE AUSTRALIA: EXCEEDS AEMO VERY FAST FCAS REQUIREMENTS

As per AEMO Market Ancillary Services Specification v8.2 document, the NEO PQA8000H Series:

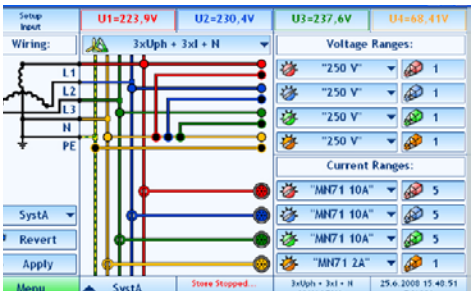
- Meet and Exceed the MASS/FCAS Specifications for ALL AEMO Very Fast, Fast, Slow, Delayed, Regulation FCAS categories.
- Meets and Exceeds Section 5.3.2 and Table 5 – Measurement Requirements for FCAS (see below)
- Meets Section 5.4 Data Retention (12 months minimum). All FDT Data is stored on the NEO PQA8000H Meter indefinitely, can be exported, and backed up.
- Meets Section 5.5 Reporting Requirements. NEO PQA8000H Meter includes advanced NEO Report and Analysis software to easily export required data as requested by AEMO.
- This datasheet satisfies Section 6.5 and 6.5.1 Traceability of Contingency FCAS metering equipment, where the manufacturer, NEO Messtechnik have internally verified Very Fast FCAS Metering Requirements as per Table 5.

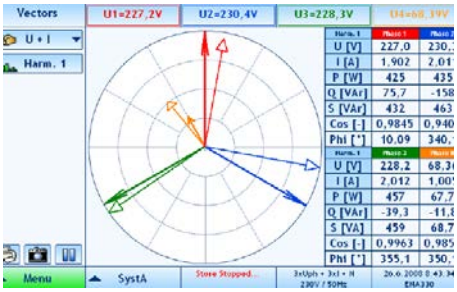
AEMO Very Fast FCAS Requirements per Market Ancillary Services Specification (MASS) v8.2 & Recommendations

SOFTWARE

1 SETUP

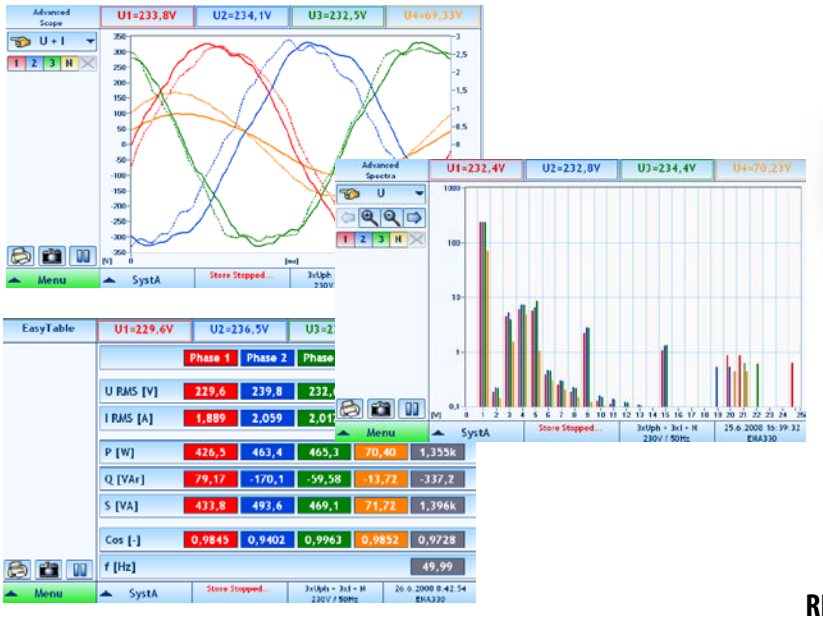
The instrument has a clear structure that shows schematics with explanations.





2 MEASURE

During measurements the user can define widgets such as Scopes, Vector Scopes, Harmonic FFTs, Tables, and Recorders.



REMOTE CONNECTION

via AnyDesk©, Teamviewer©, or any other software

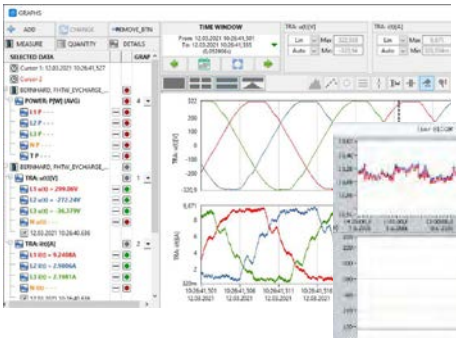
TRULY INTUITIVE

Intuitive Measurement menus: Cleary structured and explicit menus

HIGHLIGHTS

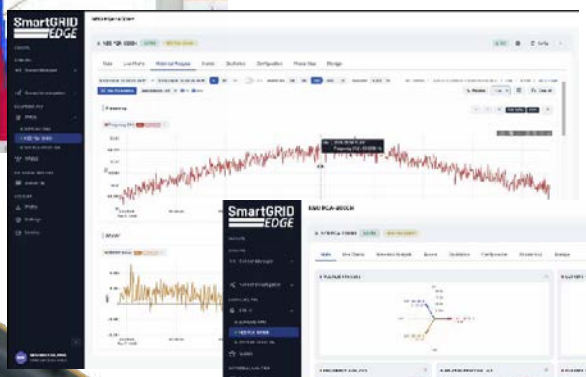
3 ANALYZE using NEO Report Software or third-party software

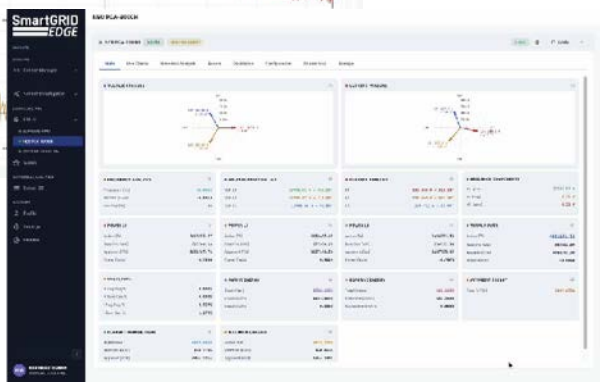
Sophisticated functions include PQ Data, Transients, Disturbances, Spectrum, Alarms, and more.



NEO Report (included) & NEO Soft (Advanced Software Option)

SmartGRID EDGE x NEO (Fully Integrated). Visit smartgridedge.com





4 REPORT

The instrument can automatically generate reports and professional documentation. The user can create reports that include all relevant information (location, comments, company logo, etc) directly on-site or during post processing. PDF reports that are saved on the instrument are always available and can be shared directly via email.

Report EN50160

Database SCADA

Remote Connection

5 EXPORT

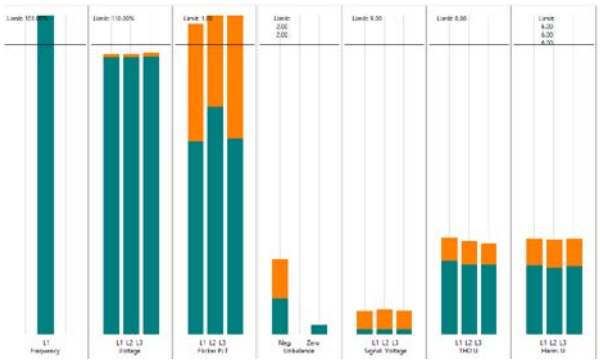
Data can be exported into CSV, XLS, PDF, Comtrade, and PQDiff.

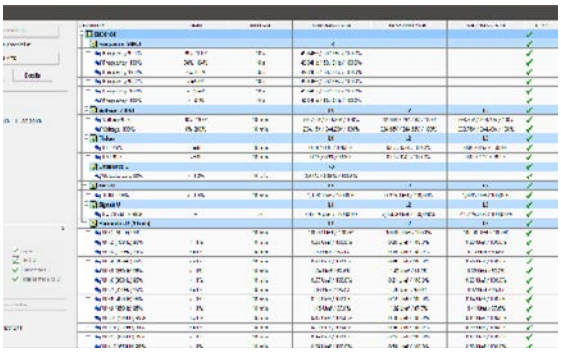
6 OTHER PROGRAMS

The instrument uses Microsoft Windows© as the operating system. Programs such as Microsoft Excel, Word or Matlab can be added as well as Email messaging services.

SOFTWARE ENA
Electrical Network Analyser

Perfect for power quality assesments and analysis according to international standards



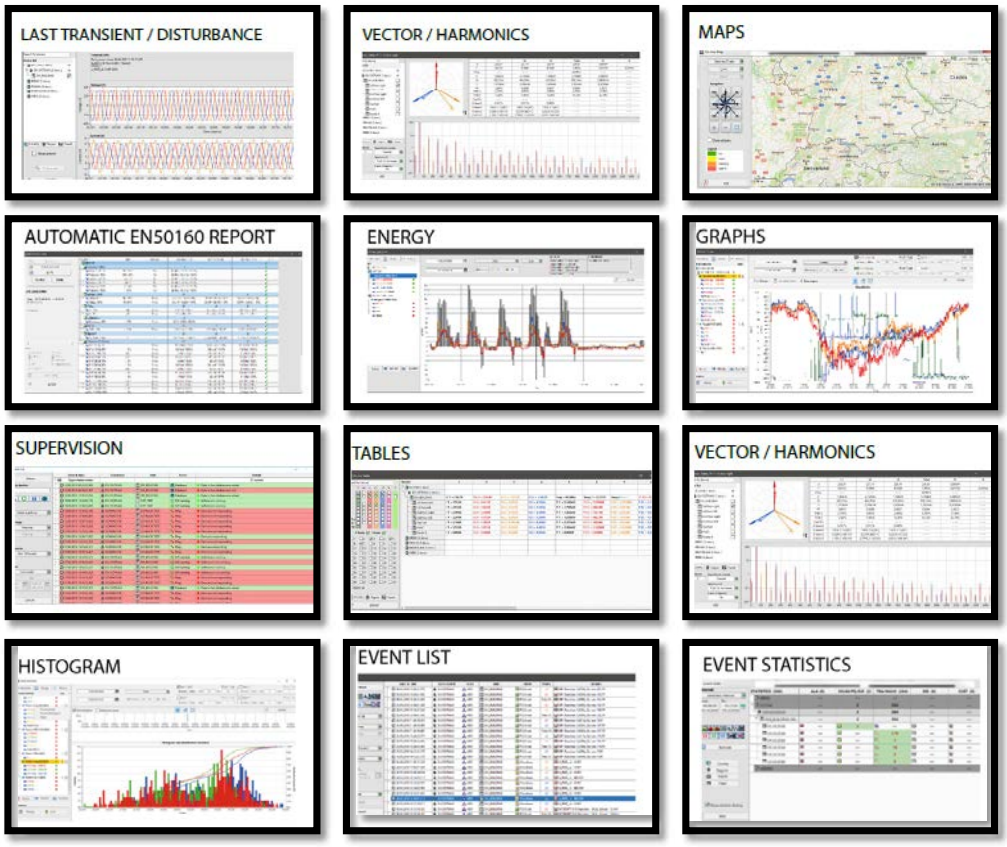


Automatic Reporting

PDF Report generator

Create your own report templates and save a lot of time for data analysis and reporting.
Options for Automatic Report:

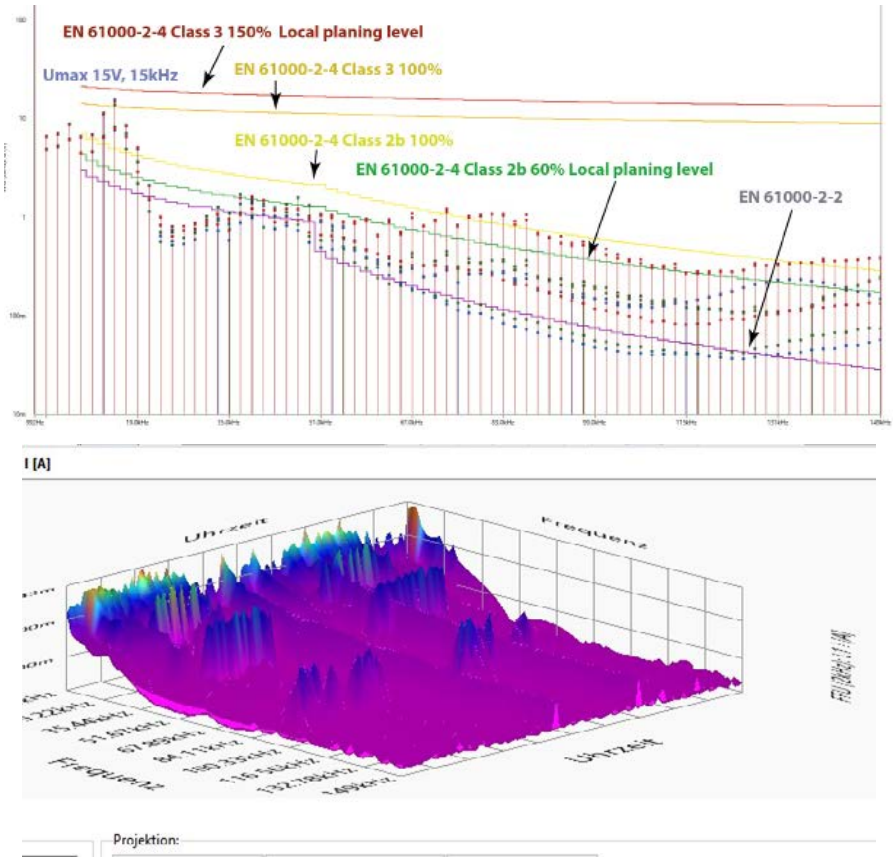
- Power Quality Report for IEC and IEEE Standards
- Harmonics, Interharmonics, Subharmonic, Supraharmonics
- Transient auto export
- 1/2 Period RMS Values , Vector diagram
- 2D chart, 3D Chart, table, ITIC, RVC, etc.
- Pictures, text, logo etc.

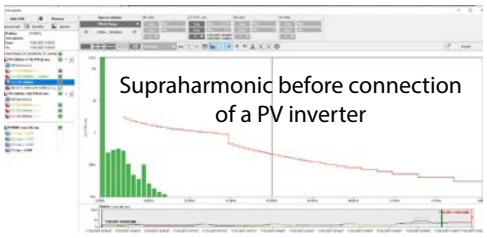


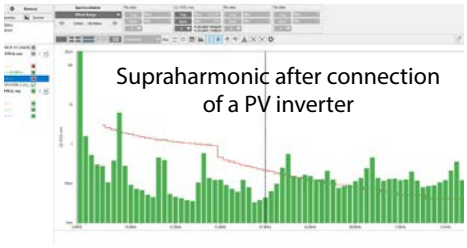
SOFTWARE ENA
Electrical Network Analyser

MESSTECHNIK

Example: Harmonic analysis with Immunity, Compatiblity and Emission reference standards



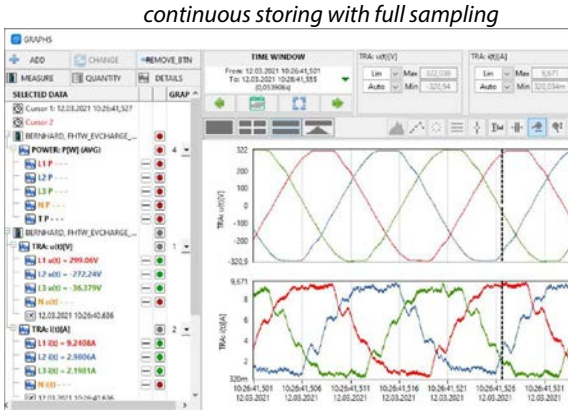


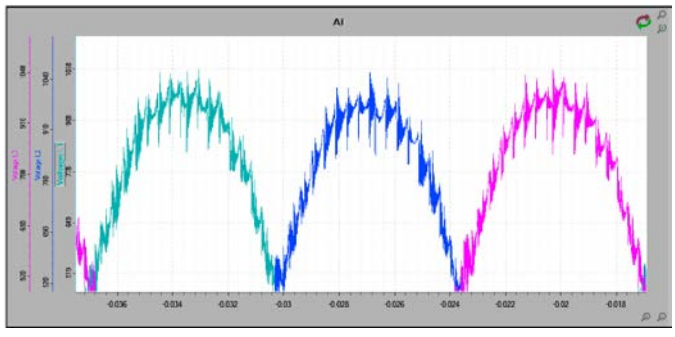


3D Supraharmonic FFT
(Time, Frequency, Amplitude) of a PV inverter over 2 days. The operation of the PV inverter during day time nicely can be seen

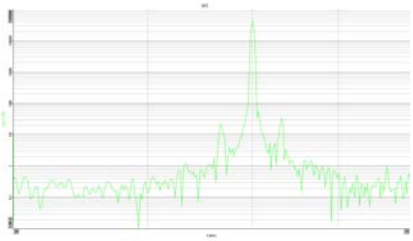
Continous Data storing: Raw data, 1/2 Period, 3s, 1min, 10min

continuous storing with full sampling





Oscillation detection

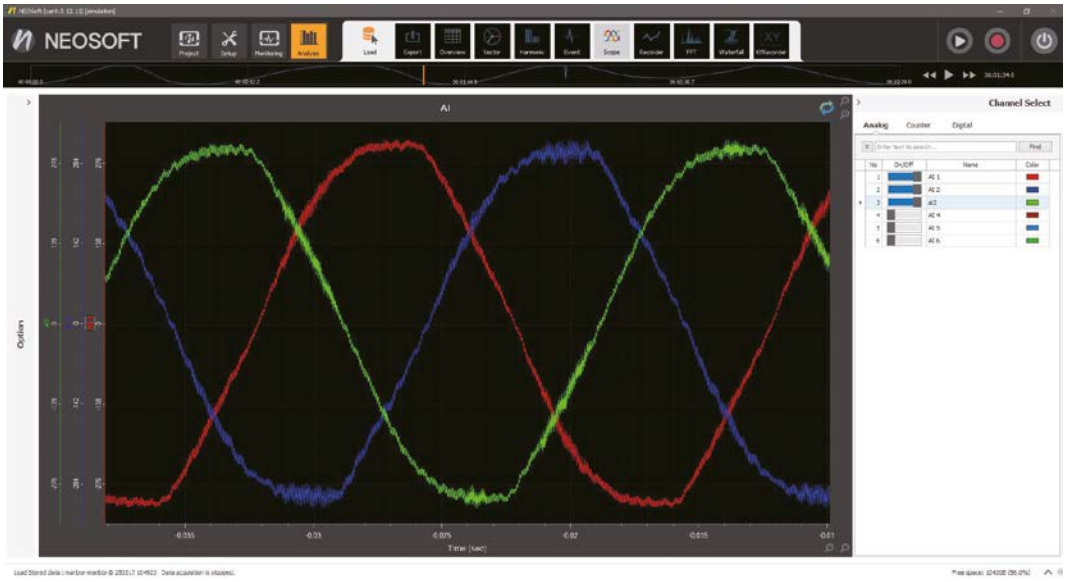


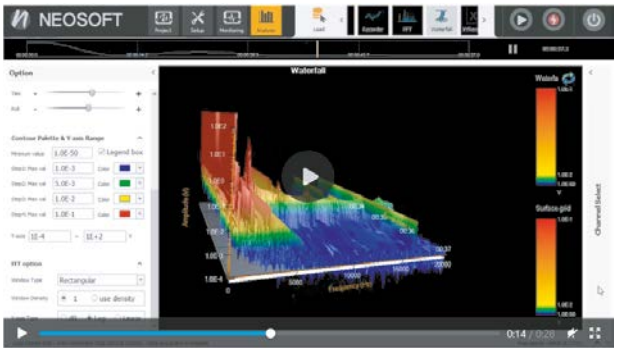
based on:
- FFT
- Interharmonics
- PMU

Common Mode and EMC

- Common Mode Voltage
- Common Mode Current
- Leakage Current
- Differential Mode EMC

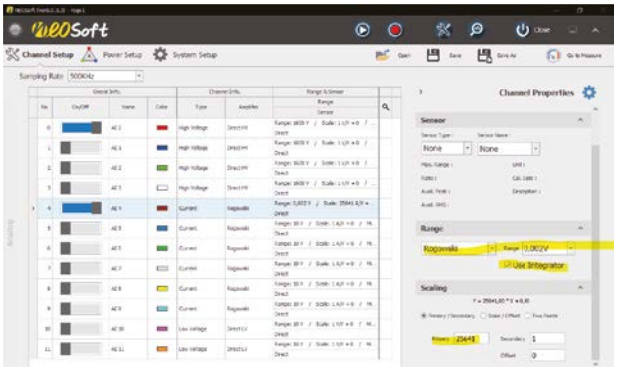
NEOSoft





World's most powerful
Data Acquisition Software

On the fly data analysis during active measurement

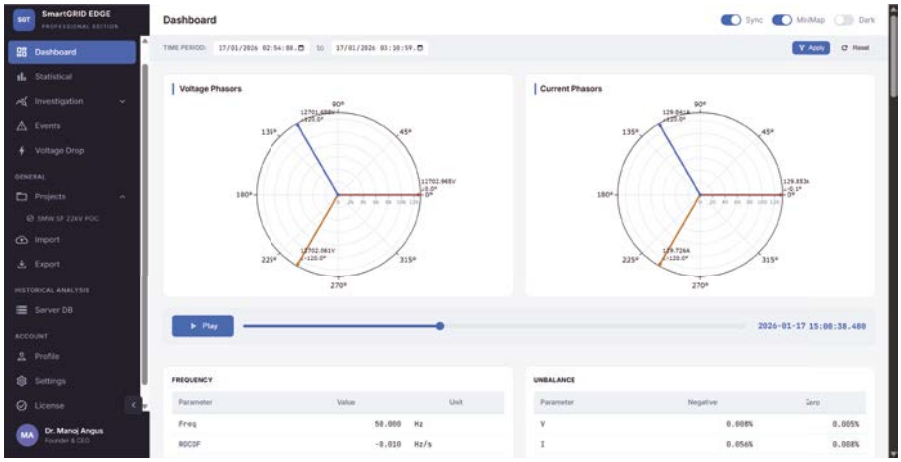


- Continous Raw Data Record
- Power Analyser
- Power Quality Analyser
- FFT Analyser
- Data Logger / Recorder
- Scope Corder

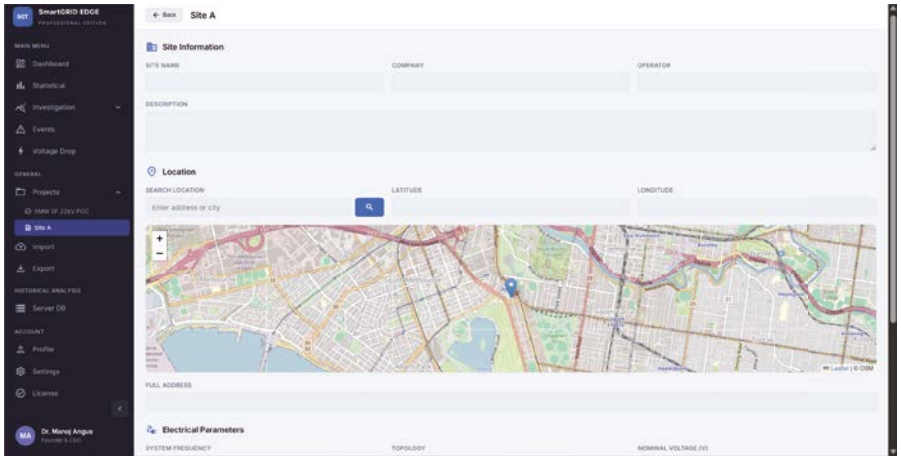
Smart Grid Edge
Wide Area Monitoring System

MESSTECHNIK

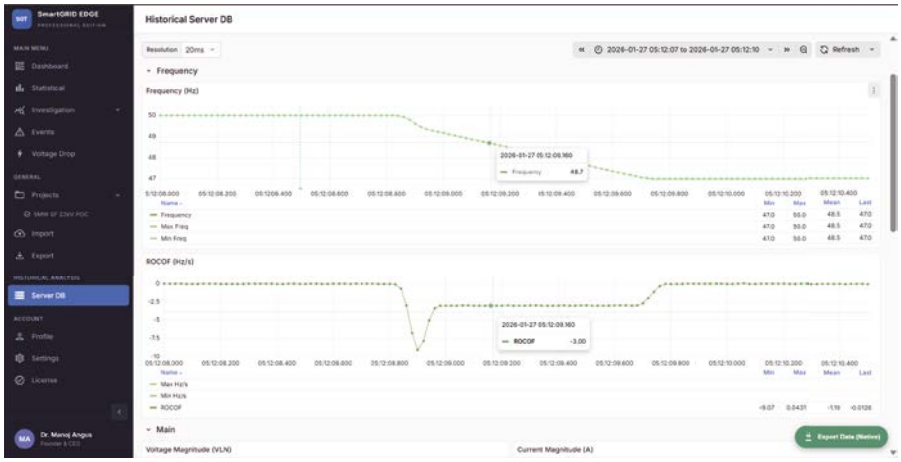
Losless Compression Up to 90% and 100x faster than traditional SQL databases



- Power Quality: Class A
- Subharmonics
- Harmonics
- Interharmonics
- Supraharmonics 500 kHz
- Grid Impedance

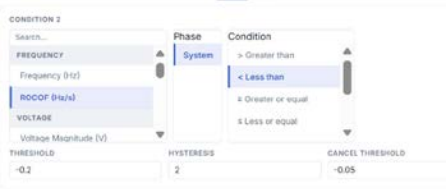


- IEC Reporting (IEC61000-2-2 etc.)
- IEEE Reporting (IEEE519 etc.)
- Grid Codes (AEMO, EN50160 etc.)
- Fault Recording
- Fault Detection



- Phasor Measure Unit
- Osillation Detection
- 10 ms Disturbance Data
- Raw Data

Customizable Events



Typical SQL databases were NOT designed to handle high-resolution and high-speed data from sensors, creating bottlenecks and longer wait times for querying data during analysis. SmartGRID Time-Series Database (also known as SGTSdB) is built for speed and fine-tuned for high-resolution time-series data. SGTSdB has lossless compression which means you retain RAW data resolution with lower storage space and lower environmental impact – there are no drawbacks. Based on internal tests, SGTSdB can be up hundreds of times faster than traditional SQL systems.

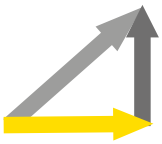
POWER QUALITY

... over 5000+ electrical parameters

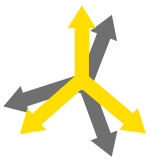
POWER

Voltage
Current

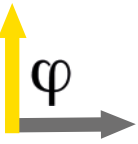
Power



Vector



Reactive
Power



Energy

Digital
Signalling

Power Calculation	P, Q, S, PF, cos phi, D, DH, QH
Frequency	10 sec, AVE, MIN, MAX
Voltage, Current	RMS, AVE, MIN, MAX, ½ Period-values, 200ms, 10s, 10min
Energy	Total, positive, negative (P, Q, P+, P-, Q+, Q-)
Efficiency	DC / AC, U-I Curve for PV
Wiring	DC, 1-Phase, 2-Phase, 3-Phase Star and Delta

WAVEFORM & TRANSIENTS

Transients

Resonances
Oscillations

Switching

DC Offset

Overvoltage

Undervoltage

... over

MIN, MAX, RMS, AVE	U, I, P, Q, S, f, PF, phi, THD, Harmonics, Interharm., Unbalance, etc.
ENVELOPE / WINDOW	U, I
DELTA	dU, dI, df, dP, etc.
DERIVATE (RATE OF CHANGE)	dU/dt, df/dt etc. … per ms, number of periods or half-period
COMBI-TRIGGER	Combination of triggering including mulitple conditions
VOLTAGE SIGNALLING	Threshold
RAPID VOLTAGE CHANGES (RVC's)	dU, dc, dt
EN50160	Trigger on any EN50160 parameter (Max, Quantil)

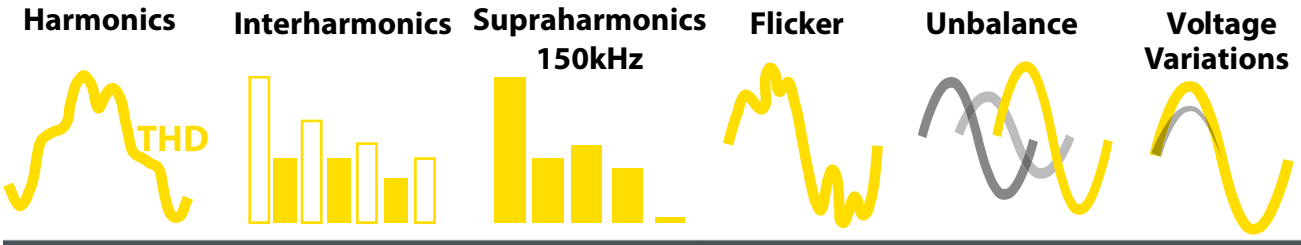
COMPLYING STANDARDS

POWER QUALITY, HARMONICS, FLICKER:
IEC61000-4-30 Ed. 3 Class A / IEC61000-4-7 / IEC61000-4-15 /
IEC62586-2 Ed. 2 / IEC62586-1
PUBLIC GRID, RAILWAY AND INDUSTRY
EN50160 / EN50163 / IEC61000-2-2 / IEC61000-2-4 (Class 1; 2; 3) /
IEEE519 / IEEE 1159 / IEC61000-2-12 / NRS048
WIND POWER, RENEWABLES AND GRID CODES
IEC61400-21 / IEC61400-12 / FGW-TR3 / VDE N-4105 / VDE N-4100 /
VDE N-4110 / D-A-CH-CZ / BDEW / ROCOF / IEEE C37.118-2005 (PMU)
MOTORS, TRANSFORMERS AND ELECTRICAL EQUIPMENT
IEC60034 / IEC 60076-1 / IEC61000-3-2 / IEC61000-3-3 / IEC61000-3-11 / IEC61000-3-12

CLASS A++

neo MESSTECHNIK

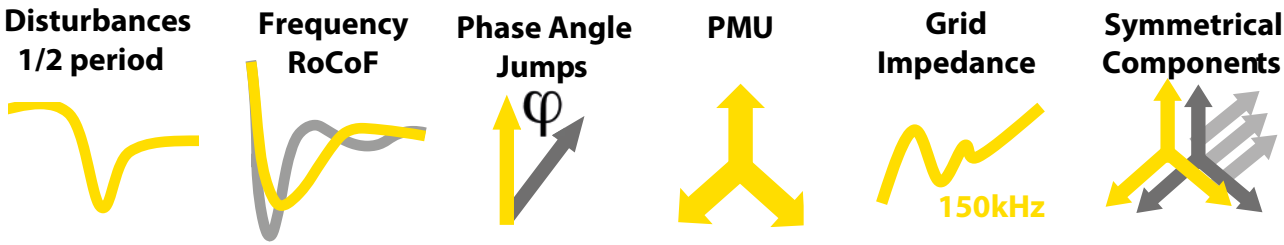
POWER QUALITY



according to IEC 61000-4-30 Ed.3 and IEC 62586	
Harmonics (Voltage, Current, Phi, Power)	Class A
Interharmonics	Class A
THD U, THD I	Class A
Higher Frequencies (200Hz band)	2 - 9 kHz (can be calculated from 0 to definable upper limit)
Higher Frequencies (2000Hz band)	8 - 150 kHz / 500 kHz for voltage and current (PQA 8000H)
Symmetrical Components & Unbalance (Pos-, Neg- and Zero Sequence)	Class A
Rapid Voltage Changes	Class A
Flicker (PST, PLT, Pinst)	Class A
Voltage Events (dip, swell, interruption – time, extrema, length)	Class A
Frequency	10 sec, AVE, MIN, MAX
Voltage, Current	RMS, AVE, MIN, MAX, ½ Period-values, 200ms, 10s, 10min
Time Synchronisation	Class A

5000+

DISTURBANCES AND SYSTEM DYNAMICS



1/2 PERIOD TRIGGER	U, I, P, Q, S, f, PF, phi, THD, Harmonics, Interharm., Unbalance, etc.
PHASE ANGLE TRIGGER	phi
SYMMETRICAL COMPONENTS	Pos., Neg., Zerosequence
RATE OF CHANGE FREQUENCY (ROCOF)	df/dt
Phasor Measure Unit (PMU) according to IEEE C37.118	Total Vector Error 0.01% (typ.) Angle Error 0.003°(typ) Timestamp Accuracy 0.1 µs up to 50 fps / via TCP / open PDC format / Offline storage possible

ADDITIONAL FEATURES INCLUDE

- ☑ **compounded trigger settings**
- ☑ **definable pre-triggers and post-time extensions**

World's best

Grid Impedance Analyser

Specifications	
Measurement Range	230 V / 400 V / (Option 690 V)
Safety Category	CAT IV 300V (Option 600V)
Frequency Range	up to 150 kHz (Option 450 kHz)
Frequency Nominal	50 Hz / 60 Hz / 16.7 Hz / DC
Resolution	18 bit
Signal-to-Noise Ratio (SNR)	>100 dB
Exciation time	400ms
Max. Current	5A rms
Wiring	L-N / L-L (Option: 3-Phase)
Battery	4 hours (powered by PQA8000H)
Export	CSV, RAW, JPG
Weight	2 kg
Dimensions (LxBxH)	GIA1 272x248x130mm GIA3 272x248x182mm

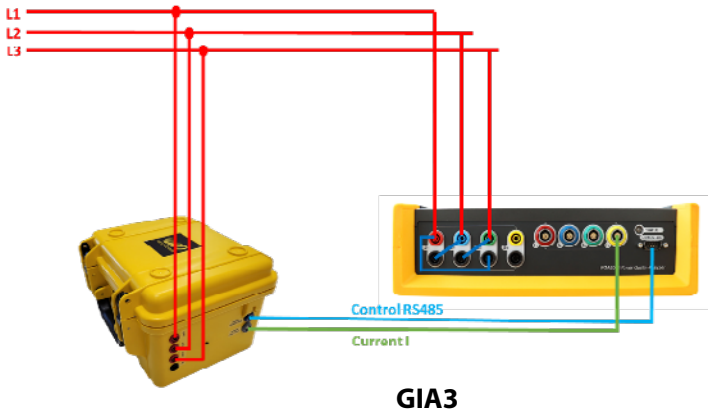
- **COMPACT DESIGN**
- **MOBILE OPERATION**
- **HIGH ACCURACY**
- **FAST MEASUREMENT**

Grid Impedance

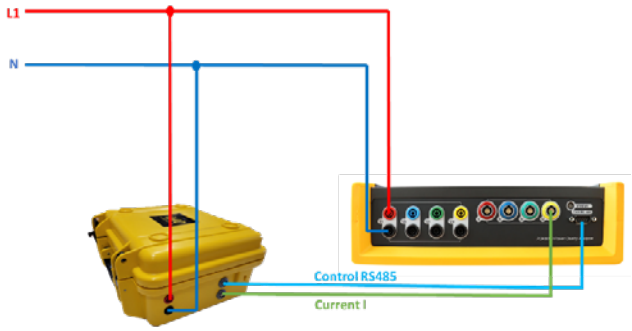
Power Quality

Grid Impedance Analyser
GIA1 and GIA3

PERFECT EXTENSION FOR PQA8000H



GIA3
for 3-phase application
(star or delta)

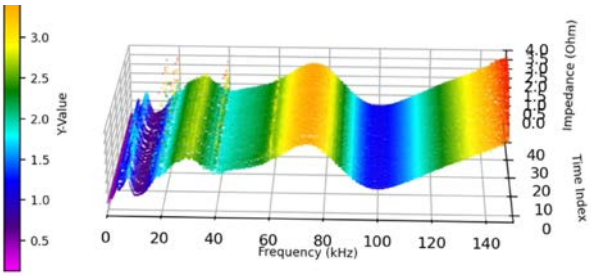


GIA3
for single phase application
(line-to-line measurement possible)

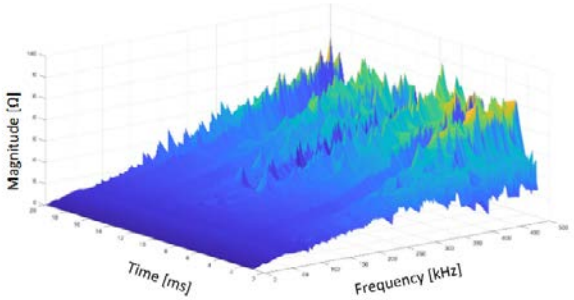
- **50/60 Hz Impedance**
- **Harmonic Impedance to 2 kHz**
- **Supraharmonic Impedance to 150 kHz**
- **PLC Impedance to 450 kHz**
- **DC Grid Impedance & Stability**

2D Chart & Plotter
Comparison of different measurements
/ Damping Analysis for 2 measurement points

Table View



3D Chart for long-term measurement



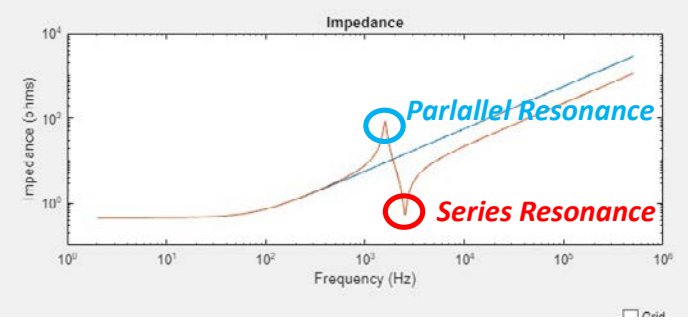
Subcycle Impedance

USE CASE - Resonance Detection
and Harmonic Limit allocation

The high penetration of distributed generation and modern electrical devices based on active power electronics are causing significant changes in the higher frequency grid impedance.
The additional inductances and capacitances (LCL filter, DC link etc.) causes multiple parallel and series resonances. Effects are high harmonic currents, high harmonic voltages, overheating of devices, noise, additional losses or malfunction of equipment or malfunction of digital communication.

Grid codes (for example DACH-CZ, TOR, TAR) first time allow the consideration of resonance factors for the determination of harmonic emission limits for each individual harmonic.

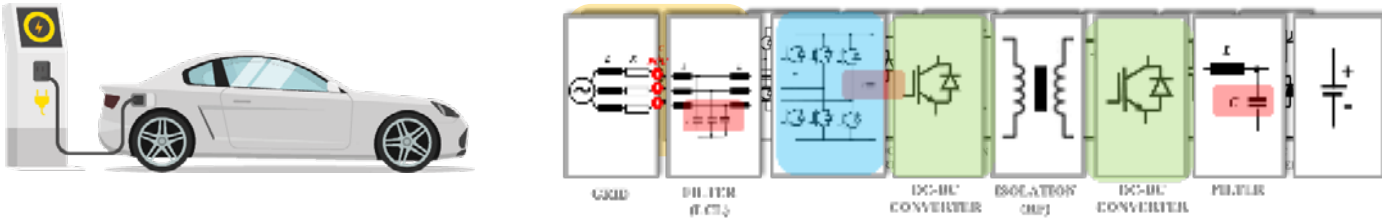
- *Definition of Harmonic Emission limits considering resonance factors*
- *Optimization of inverter control (Wind, PV, Motor etc.), filter (EMC) and reactive power control*



GRID at PCC

EV CHARGER connected (but not in operation)

CONNECTED BUT NO CHARGING
→ LCL filter will cause **parallel** and **series resonance**



Picture 1: Example of connecting a V2G charging station
(Source Grasel 2023 The impact of V2G charger to the frequency dependent grid impedance CIRED Rom)

Reference Grid *V2G charger connected*

Picture 1 shows how resonance points appear while connecting a V2G charging station. Note: Even if the charging station is not in operation, resonance points are caused due to the LCL input filter.

Example Harmonic emission limit allocation based on DACH-CZ grid code

$$I_{v\,zul} = \frac{1}{k_v} \cdot \frac{1}{k_{XR}} \cdot \frac{p_v}{1000} \cdot \frac{1}{\sqrt{k_B + k_E + k_S}} \cdot \sqrt{\frac{S_{kV}}{S_A}} \cdot I_A$$

- I_{vzul} emission limit of the harmonic current [A]
- I_A nominal current [A]
- S_{KV} short circuit power [MVA]
- S_A nominal apparent power [MVA]
- k_V Factor to consider the grid impedance
- k_{XR} factor to consider the X/R ratio
- p_V Proportional constant to be selected out of a table
- k_B factor to consider load
- k_E factor to consider generation units
- k_S factor to consider energy storage

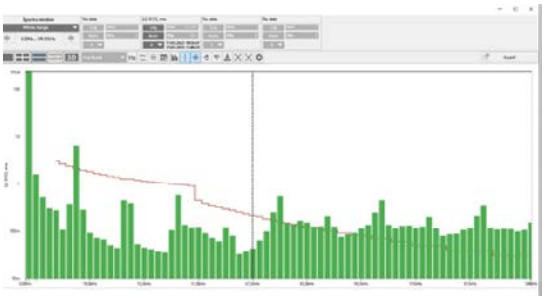
Grid Impedance Analyser
GIA1 and GIA3

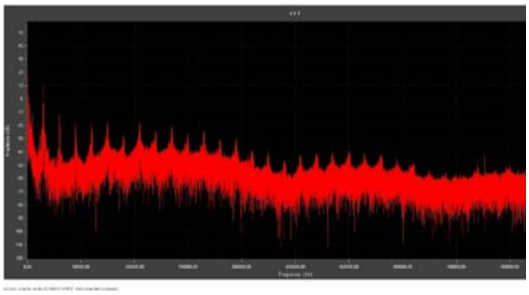
USE CASE - Power Line Communication
Supraharmonic emission & grid impedance measurement

Power Line Communication (PLC) is widely used for Smart Metering applications in a frequency range from 10 kHz to 450 kHz (CENELEC A, B, C, D, FCC, ARIB). Existing power cables are used for communciation purposes but represent a "harsh" medium. Communciation failures are resulting due to:

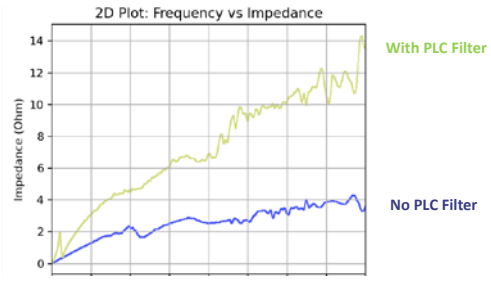
- Increasing Supraharmonic emissions causing a Noise floor
- Series Resonances (e.g. LCL input filter of other devices) representing a low-impedance path for intentional emissions
- Attenuation between transmitter and receiver

Example Supraharmonic background noise exceeding compatibility, emission and immunity level affecting intentional emissions for PLC

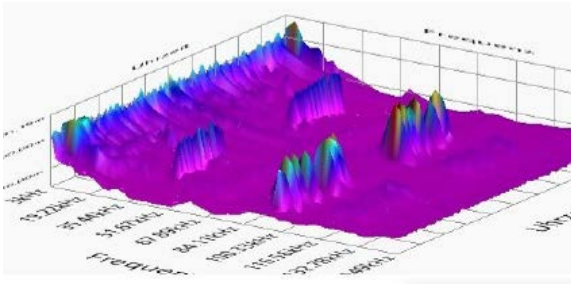




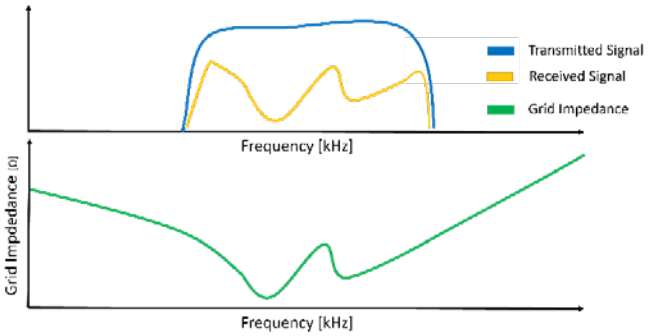
Example of using PLC Filter - Grid impedance measurement before and after



Example Supraharmonic emissions of a Photovoltaic inverter over 2 days



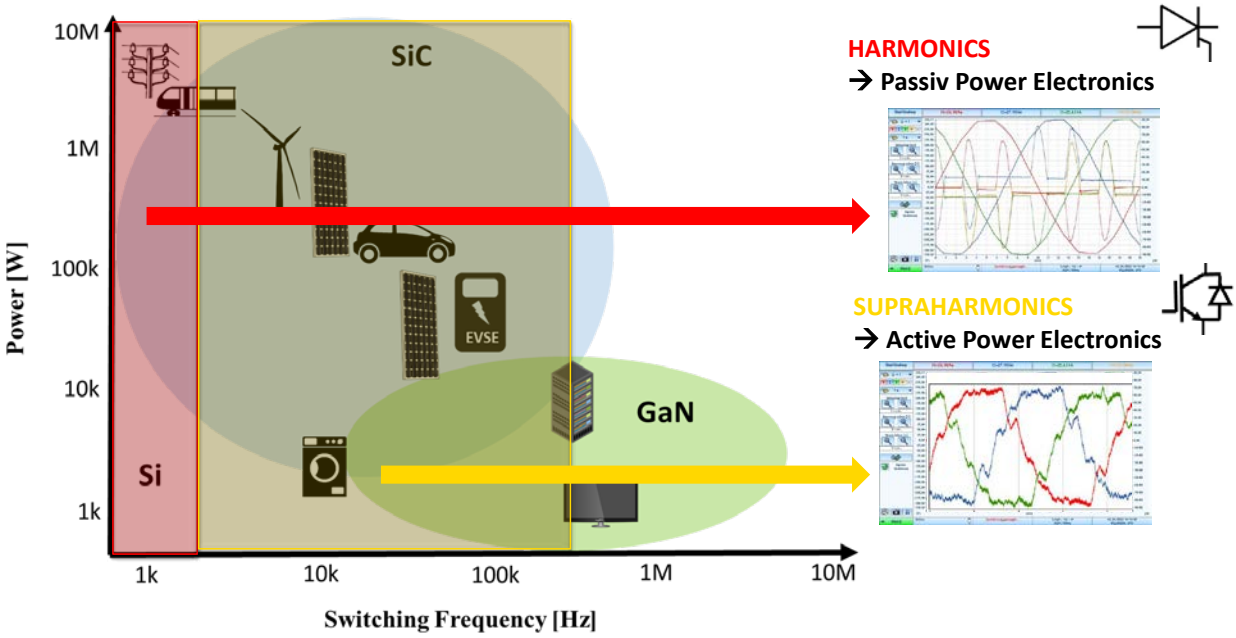
Example damping analysis of PLC transmission by measuring grid impedance at two points (Smart Meter and transformer station) with high precision time synchronisation



Picture 2: Relation of PLC transmission losses and higher frequency grid impedance

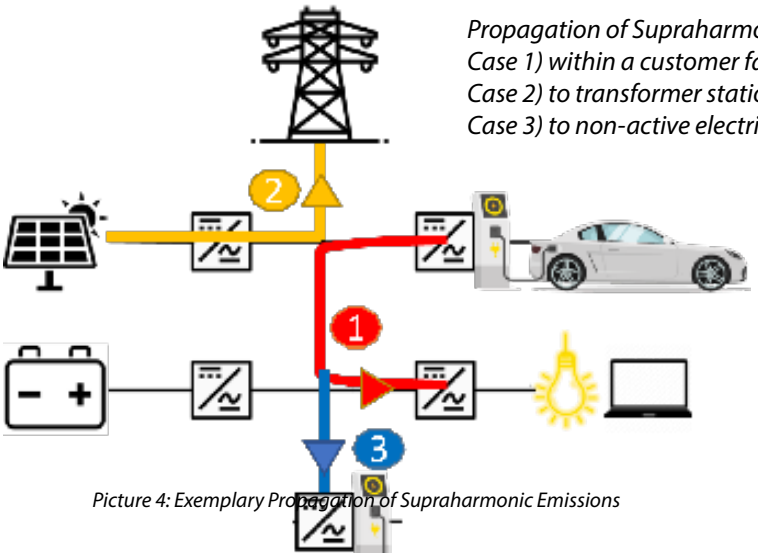
USE CASE - Supraharmonic Propagation

Supraharmonic emissions occour in the range of 10 kHz to 500 kHz due to active power electronics such as Photovoltaics, Electric vehicle chargers, Wind power, heatpump and others. The following picture shows switching frequency ranges for different types of AC/DC or DC/DC converters.



Picture 3: Supraharmonic emissions of active power electronics (Source: Grasel 2021)

The propagation of Supraharmonics is defined by the grid impedance at the certain frequency. For example an emission at 16 kHz might propagate to an connected LCL filter close by, while an emission at 40 kHz can propagate back to the transformer station



Propagation of Supraharmonics Examples
Case 1) within a customer facility
Case 2) to transformer station (e.g. up to 16 km)
Case 3) to non-active electric vehicle charging station

Picture 4: Exemplary Propagation of Supraharmonic Emissions

AC CLAMPS

CLAMP-5AC

Type	Iron-Core
Range	5 A
Bandwidth	20 kHz
Accuracy	0,5 - 6A: ± 0,5 % of reading (with NEO calibration typ. ≤ 0.2 %) 0,1 - 0,5A: ± 1 % of reading (with NEO calibration typ. ≤ 0.3 %) 5mA -0,1 A: ± 2 % of reading (with NEO calibration typ. ≤ 0.8 %)
Phase	1 - 12A: ± 0,5 ° (with NEO calibration typ. ≤ 0.5 °) 0,5 - 1A: ± 1 ° (with NEO calibration typ. ≤ 0.5 °) 5mA - 0,5 A: ± 2 ° (with NEO calibration typ. ≤ 1 °)
Sensitivity	100 mV/A
Dimensions	102 x 34 x 24 mm (Clamp Opening d = 15mm)

CLAMP-20AC

Type	Iron-Core
Range	20 A
Bandwidth	20 kHz
Accuracy	0,5 - 20A: ± 1 % of reading (with NEO calibration typ. ≤ 0.5 %) 5mA - 0,5 A: ± 2 % of reading (with NEO calibration typ. ≤ 1 %)
Phase	0,5 - 20A: ± 2 ° (with NEO calibration typ. ± 0.5 °) 5mA - 0,5 A: ± 2 ° (with NEO calibration typ. ± 1 °)
Sensitivity	10 mV/A
Dimensions	102 x 34 x 24 mm (Clamp Opening d = 15mm)

CLAMP-200AC

Type	Iron-Core
Range	200 A
Bandwidth	10 kHz
Accuracy	100 - 240 A: ± 1% of reading (with NEO calibration typ. ≤ 0.8 %) 10 - 100 A : ± 2,5% of reading (with NEO calibration typ. ≤ 1 %) 0,5 - 10 A: ± 3,5% of reading (with NEO calibration typ. ≤ 2 %)
Phase	100 - 240 A: ≤ 2,5° (with NEO calibration typ. ≤ 1.5°) 10 - 100 A : ≤ 5° (with NEO calibration typ. ≤ 3°) 0,5 - 10 A: not specified
Sensitivity	10 mV/A
Dimensions	135 x 51 x 30 mm (Clamp Opening d = 22mm)

CLAMP-1000AC

Type	Iron-Core
Range	1000 A
Bandwidth	10 kHz
Accuracy	100A - 1200 A : 0,3% (with NEO calibration typ. ≤ 0.2 %) 10A - 100 A: 0,5% (with NEO calibration typ. ≤ 0.3 %) < 1A: 2 % (with NEO calibration typ. ≤ 1 %)
Phase	100A - 1200 A: 0,7° (with NEO calibration typ. ≤ 0.3°) 10A - 100 A: 1° (with NEO calibration typ. ≤ 0.5°) < 1A: not specified
Sensitivity	1 mV/A
Dimensions	216 x 111 x 45 mm (Clamp Opening d = 53mm)

CENTER ADAPTER

This adapter can be used for small cable diameters to optimize the cable position and improve accuracy. This adapter is available upon request for all current sensors.

AC COILS & SPLIT-CORE

AC ROGOWSKI COILS

FLEX-MINI-3000

Type	Rogowski coil
Range	30A / 300A / 3000A / 30kA
Bandwidth	PQA7000: up to 20 kHz PQA8000: up to 70 kHz PQA8000H: up to 500 kHz
Accuracy	1% (with NEO calibration typ. ≤ 0.3 %)
Coil Length	170 mm (Ø 45 mm)

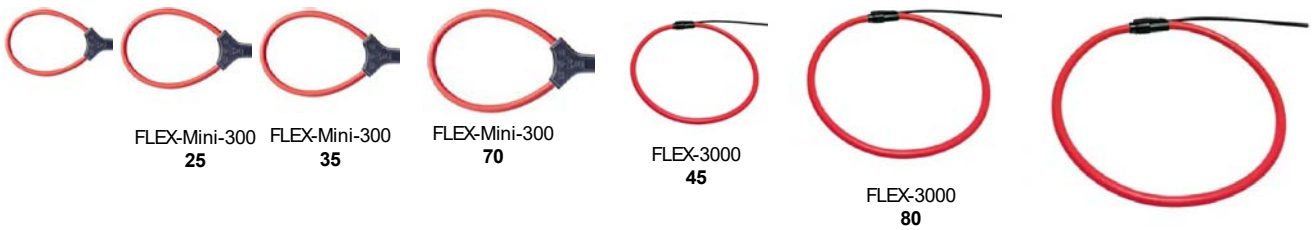
FLEX 3000

Type	Rogowski coil
Range	30A / 300A / 3000A / 30kA
Bandwidth	PQA7000: up to 20 kHz PQA8000: up to 70 kHz PQA8000H: up to 500 kHz
Accuracy	1% (with NEO calibration typ. ≤ 0.3 %)
Coil Length	450 mm (Ø 125 mm)

FLEX 6000

Type	Rogowski coil
Range	30A / 300A / 3000A / 30kA
Bandwidth	PQA7000: up to 20 kHz PQA8000: up to 70 kHz PQA8000H: up to 500 kHz
Accuracy	1% (with NEO calibration typ. ≤ 0.3 %)
Coil Length	800 mm (Ø 250 mm)

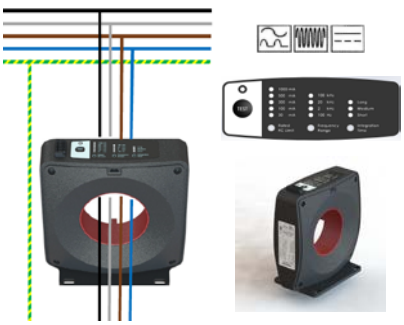
Flexible Length, Flexible Coil Diameter, Flexible Bandwidth, Flexible Scaling, Flexible cable length on request
Rogowski Coils for measurements up to 150kA are available.



FLEX-Mini-300 **25** | FLEX-Mini-300 **35** | FLEX-Mini-300 **70** | FLEX-3000 **45** | FLEX-3000 **80** | FLEX-6000 **120**

All measurement ranges from 30A to 120.000A

RESIDUAL CURRENT SENSOR AC+DC (RCM)



Type	Fluxgate
Range	DC and AC residual current measurement of Type B/B+ in the range 0-2Arms
Bandwidth	100 kHz
Application	Single Phase, 3-Wire, 4-Wire
Rated Voltage	690V
Rated Current	100A / 300A
Output	4-20mA Relay Output (DO/DI)
Power Supply	24V DC
Dimensions	156.1mm x 151.1mm x 69.4mm (Clamp Opening Ø 70 mm)

AC/DC HALL CLAMPS

MESSTECHNIK

AC/DC HALL CLAMPS

CLAMP-300DC

Type	Hall sensor
Range	300A DC
Bandwidth	DC to 150 kHz
Accuracy	1 % + 2 mA (with NEO calibration typ. ≤ 0.3 %)
Sensitivity	20 mV/A
Overload Capability	500A DC (1min)
Dimensions	205 mm x 60 mm x 15 mm (Clamp opening d = 32 mm)

CLAMP-2000DC

Type	Hall sensor
Range	2000A DC
Bandwidth	DC to 20 kHz
Accuracy	2.5 % +/- 0.5A (with NEO calibration typ. ≤ 1.5 %)
Sensitivity	1 mV/A
Dimensions	205 mm x 60 mm x 15 mm (Clamp opening d = 32 mm)

AC/DC SPLIT CORE

SPLIT-300DC

Type	Hall sensor
Range	300A DC
Bandwidth	DC to 150 kHz
Accuracy	1 % + 2 mA (with NEO calibration typ. ≤ 0.3 %)
Sensitivity	10 mV/A
Dimensions	205 mm x 60 mm x 15 mm (Clamp opening d = 32 mm)

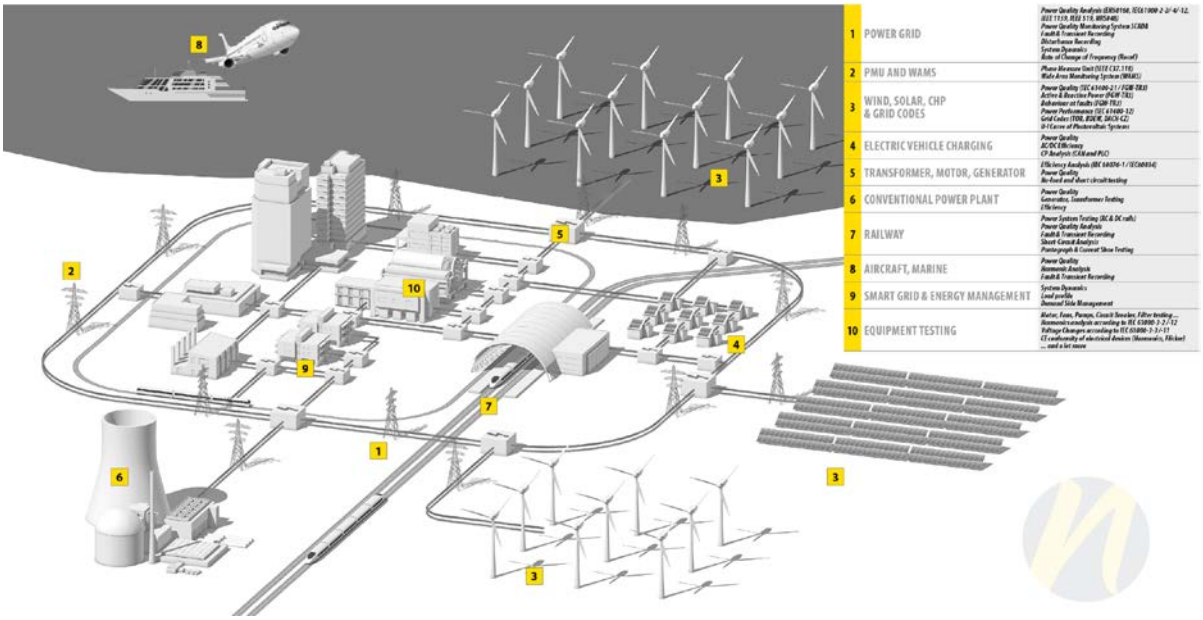
ICS-10A

Type	Hall sensor
Range	10 A peak (Overload Capabilty 80A for 1sec)
Bandwidth	150 kHz
Accuracy	0.5% (with NEO calibration typ. ≤ 0.1 %)
Sensitivity	208 mV/A
Dimensions	62 mm x 42 mm x 25 mm
Safety Category	CAT II 1000V / CAT III 600V

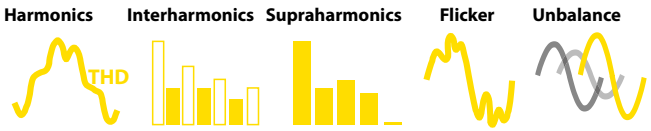
IPCS-XXA

Type	Zero-Flux transducer
Range	IPCS-10A: 10A rms IPCS-25A: 25A rms IPCS-50A: 50A rms
Bandwidth	500 kHz
Accuracy	0.01%
Sensitivity	IPCS-10A: 40 mV/A IPCS-25A: 20 mV/A IPCS-50A: 10 mV/A
Dimensions	130 mm x 65 mm x 50 mm
Safety Category	CAT II 600V

WORLD LEADING TECHNOLOGY

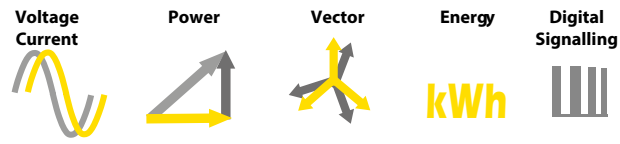


POWER QUALITY

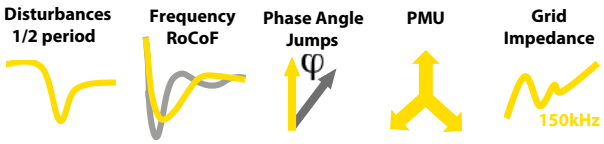


WAVEFORM & TRANSIENTS

POWER



DISTURBANCES AND SYSTEM DYNAMICS



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