



MESSTECHNIK

GRID IMPEDANCE ANALYZER

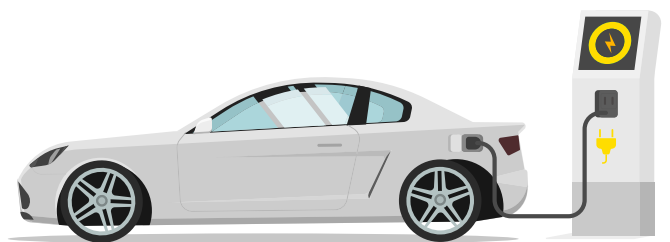
150 kHz / 450 kHz



Power Quality



Grid Impedance



Resonance Detection

Series resonances -> High Harmonic Voltages
Parallel resonances -> High Harmonic Currents

Power Line Comm. (PLC)

Troubleshooting (e.g. Detection of signal loss)
for CENELEC A,B,C,D / FCC / ARIB / EPRI

Grid Codes

Assessment of harmonic emission limits according to national grid codes (DACH-CZ, TOR, TAR, etc.)

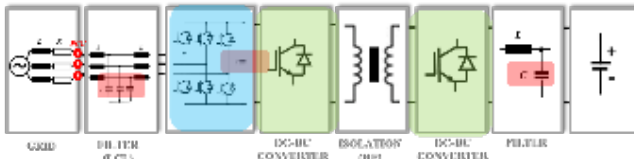
Mobile Operation

Battery powered by PQA8000H for up to 4 hours
Perfect for long- and short term measurement



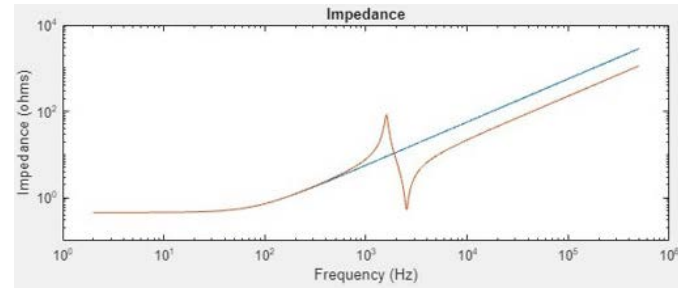
Use Case 1: Resonance Detection & Grid Codes

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



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.

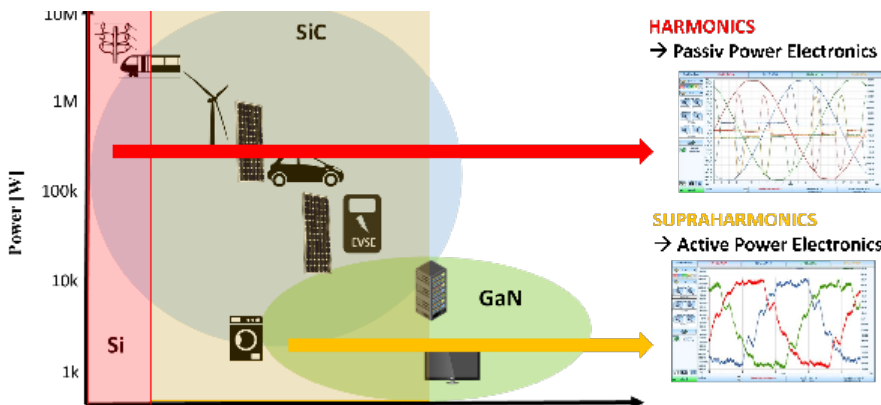


Use Case 2: Supraharmonic Propagation

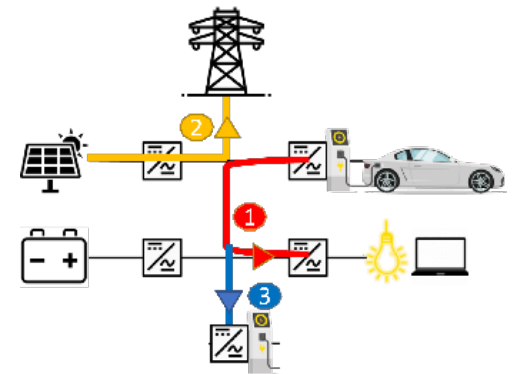
Supraharmonic emissions in the range of 10 kHz to 500 kHz due to active power electronics such as Photovoltaics, Electric vehicle chargers, Wind power, heatpump and others

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



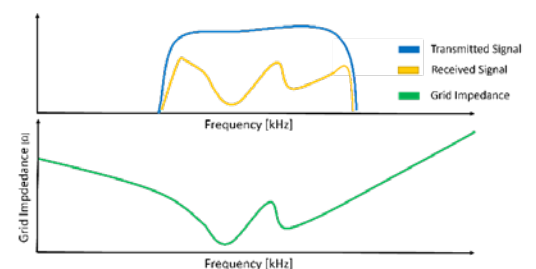
Picture 4: Exemplary Propagation of Supraharmonic Emissions

Use Case 3: Power Line Communication (PLC)

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 communication purposes but represent a "harsh" medium. Communication 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

Picture 2 shows the relation between transmitted signal and grid impedance



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

HARD- & SOFTWARE

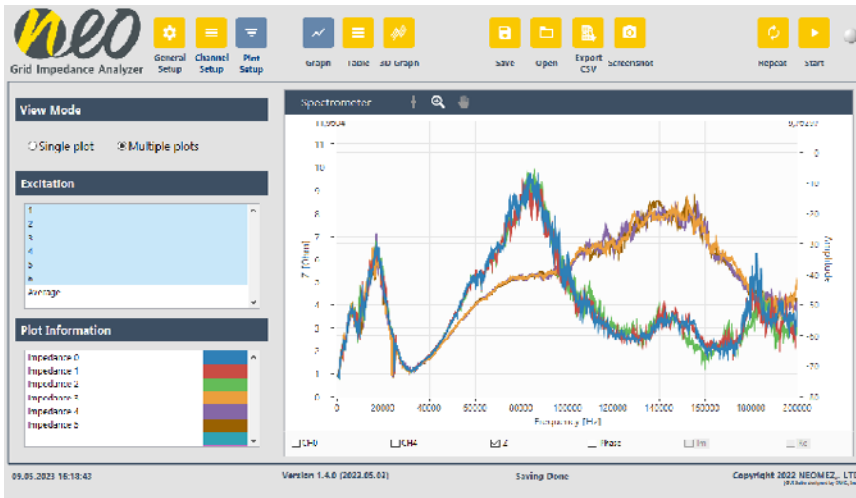
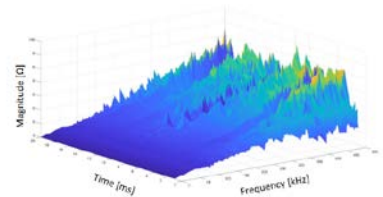


Table View



3D Chart & Subcycle

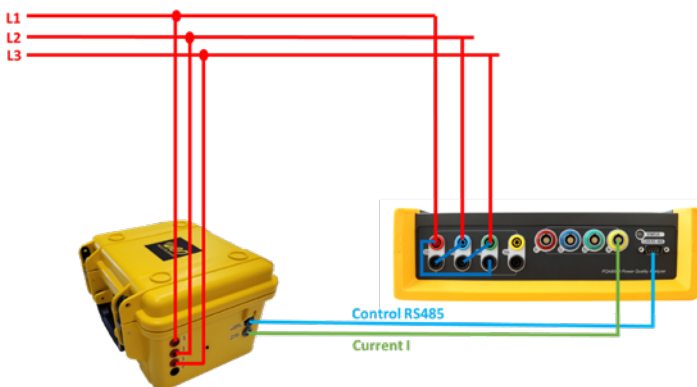
Zeit- und frequenzabhängige Charakterisierung der Netzimpedanz (Netzimpedanz) des elektrischen Niederspannungsnetzes

Specifications

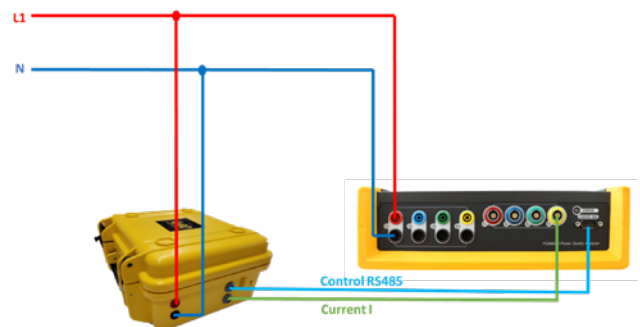
Measurement Range	230 V / 400 V / (Option 690 V)
Safety Category	CAT IV 300V (Option 600V)
Frequency Range	up to 150 kHz (Option 450 kHz)
Frequency Nominal	50 Hz / 60 Hz / 16.7 Hz / DC
Resolution	18 bit
Signal-to-Noise Ratio (SNR)	>100 dB
Excitation time	400ms
Max. Current	5A rms
Wiring	L-N / L-L (Option: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

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

PERFECT EXTENSION FOR PQA8000H



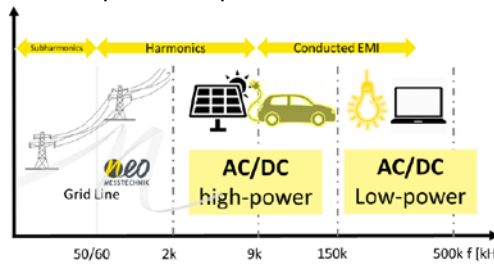
GIA3



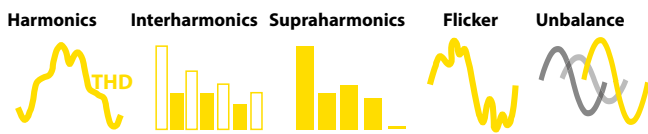
GIA1

PQA8000H - DC to 500 kHz for voltage and current

- Harmonics / Interharmonics / THD / TDD
- Subharmonics / DC
- Supraharmonics 2 - 9 kHz (IEC61000-4-7)
- Supraharmonics 8 - 500 kHz (IEC61000-4-30)
- Raw FFT and PLC Digital Data Stream
- Grid Impedance up to 500 kHz



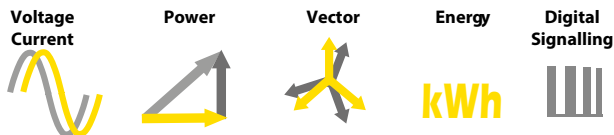
POWER QUALITY



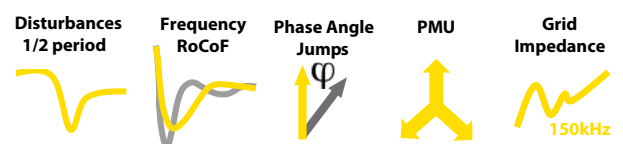
WAVEFORM & TRANSIENTS



POWER



DISTURBANCES AND SYSTEM DYNAMICS



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