MEASUREMENT REPORT / APPLICATION NOTE / CASE STUDY

MESSTECHNIK

Used Equipment:

NEO PQA8000H-P:
Supraharmonic Power Quality Analyser

NEO GIA-1:
Supraharmonic Grid Impedance Analyser

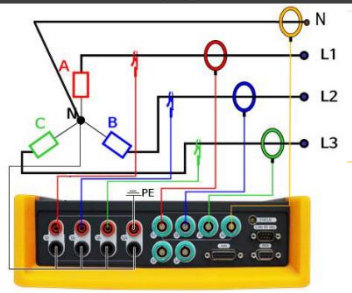
www.neo-messtechnik.com

Initial Situation: The connection of an Hybrid Photovoltaic Inverter with zero feed-in causes problems to equipment connected close by such as a water pump station in the neighboorhood or the malfunction of Smart meters and distortion of the digital PLC communication.

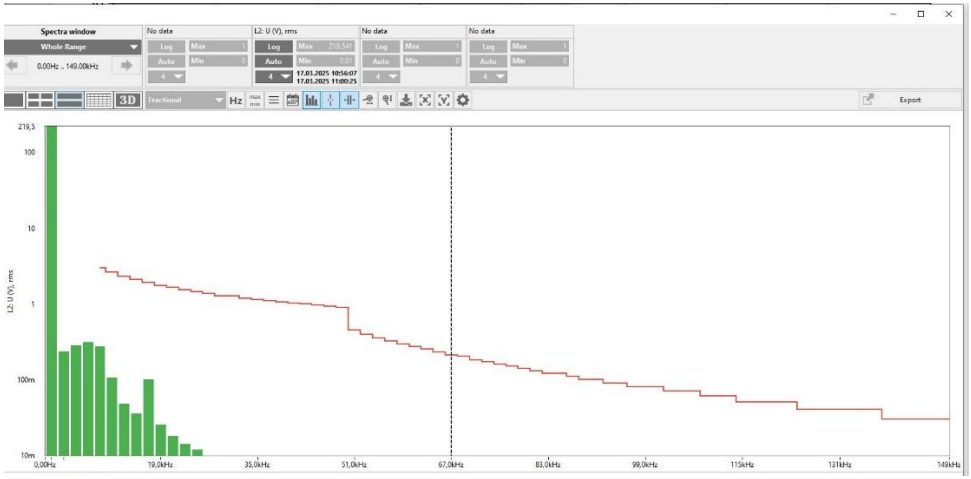
Key Findings and Conclusions:

- Harmonic emissions (IEC61000-3-2) are within limits
- Supraharmonic emissions 2-9 kHz (IEC61000-3-10) are within limits.
- High Supraharmonic emissions between 10 kHz - 150 kHz and above 500 kHz
- There are no supraharmonic emission limits for devices between 9-150 kHz
- Compatibility levels of IEC61000-2-2 and -2-4 are exceed at switching frequency of 15 kHz (6 V) and for all frequencies above 72 kHz
- Conducted emissions are too high so there is a violation of LVD and CE
- Suparharmonic Grid Impedance change between 6 – 12 kHz (LCL filter and DC link capacitor)
- Power Line Communication for Smart metering not possible in CENELEC bands
- Possible Mitigation: 1) Inverter exchange 2) Additional filter for inverter
  3) Change of frequency for power line communication
  Ineffecitve mitigation: 1) PLC filter 2) PLC repeater

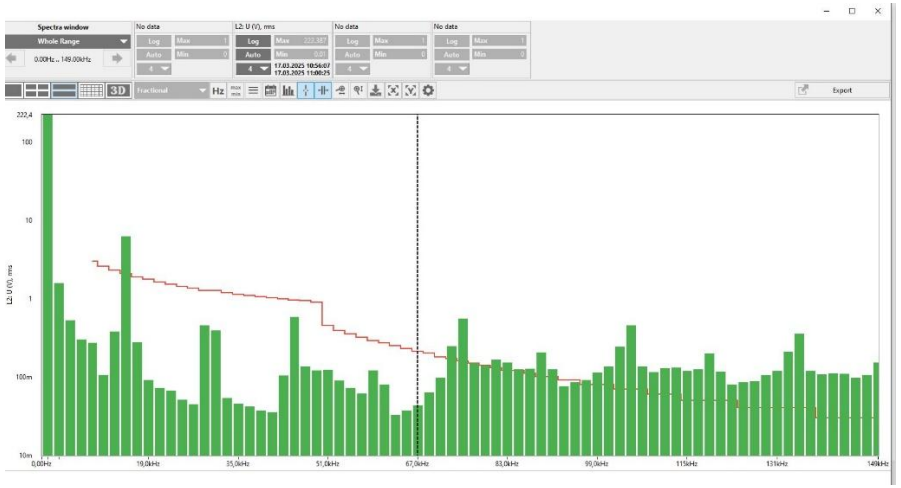
Scope after connection of PV inverter



Supraharmonic FFT with IEC61000-2-2 limits before connection



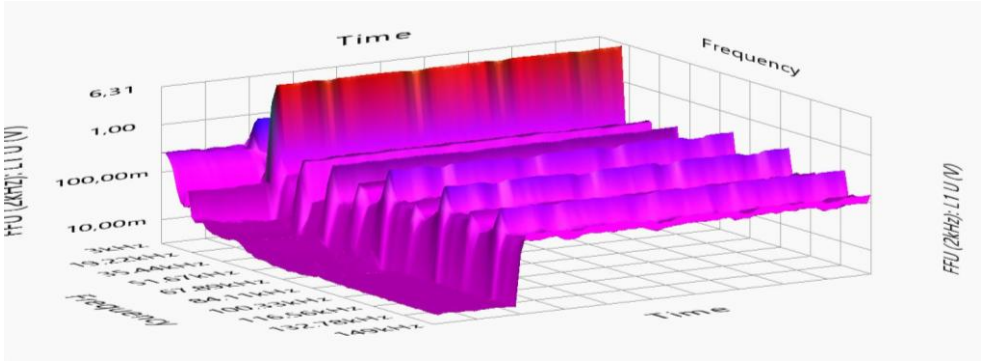
Supraharmonic FFT with IEC61000-2-2 limits after connection



Violation of compatibility limits at Switching frequency of 15 kHz and all above 73 kHz

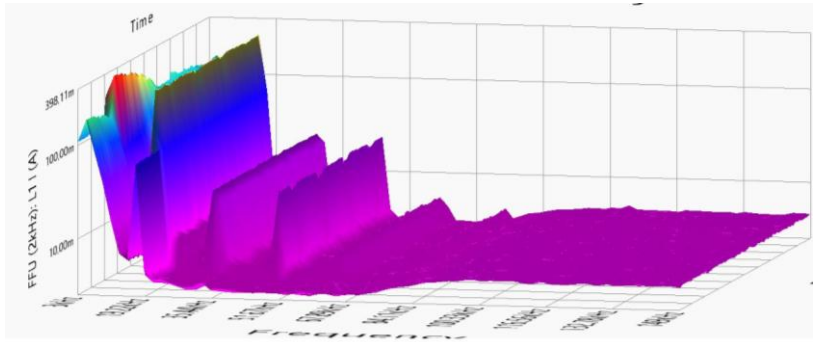
Supraharmonic 3D FFT Voltage before and after connection

3 second aggregation



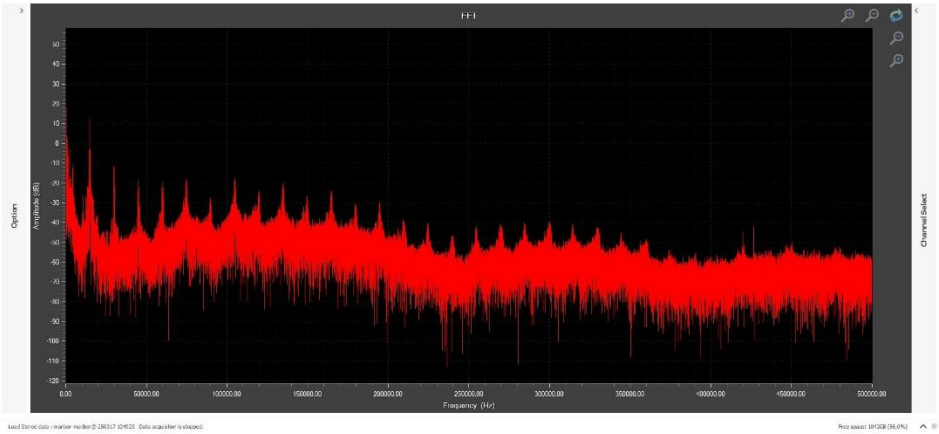
Supraharmonic 3D FFT Current before and after connection

3 second aggregation



Supraharmonic 2D FFT Voltage 5 Hz band – linear scaling

1 MS/s

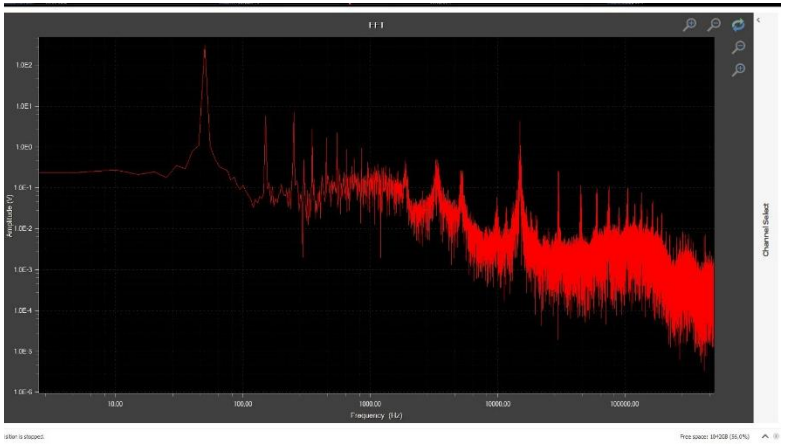


Very high emissions over full frequency range.

Product does not fullfill EMC requirements of LVDC regulation and requirements for CE compliance.

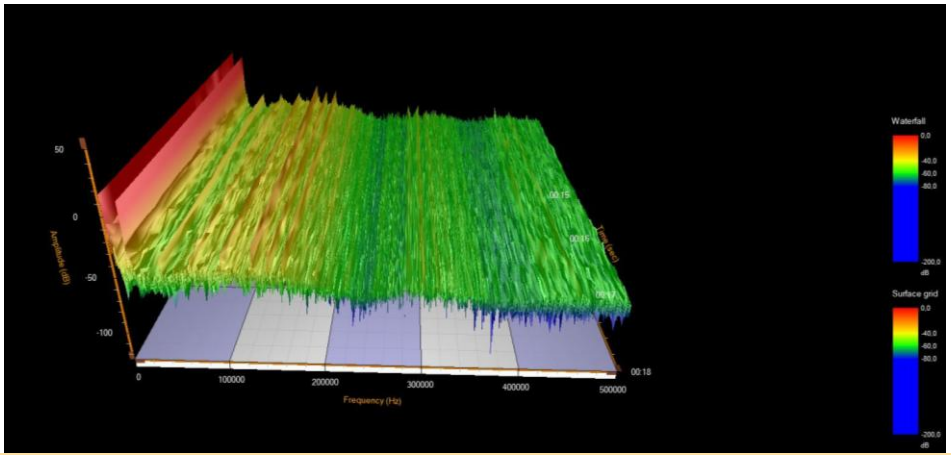
Supraharmonic 2D FFT Voltage 5 Hz band – logarithmic scaling

1 MS/s



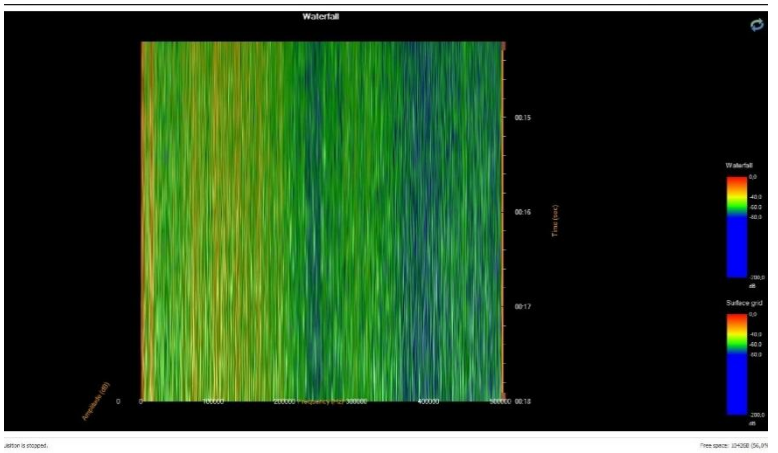
Supraharmonic 3D FFT Voltage 5 Hz band – Waterfall

1 MS/s



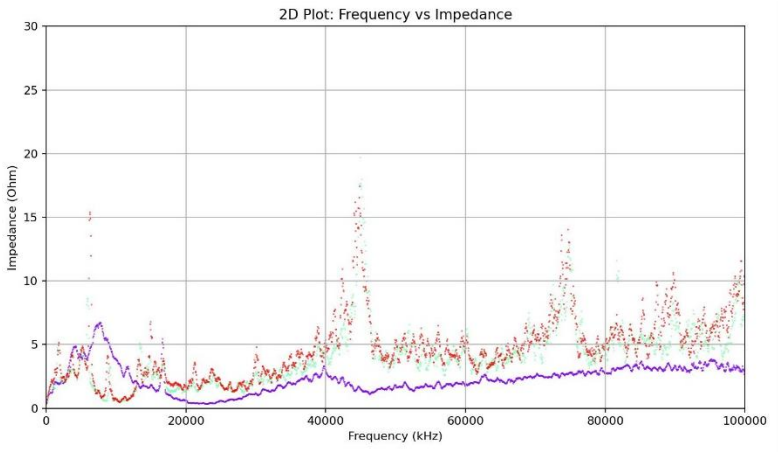
Supraharmonic 3D FFT Voltage 5 Hz band – Waterfall Top

1 MS/s



Supraharmonic Impedance up to 100 kHz

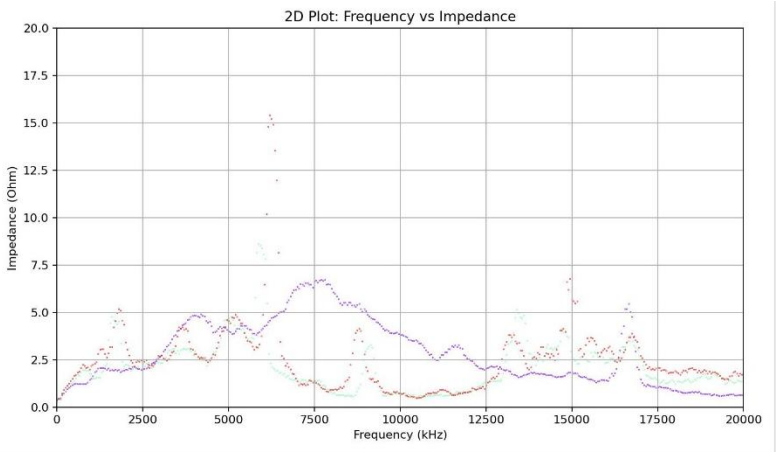
1 MS/s



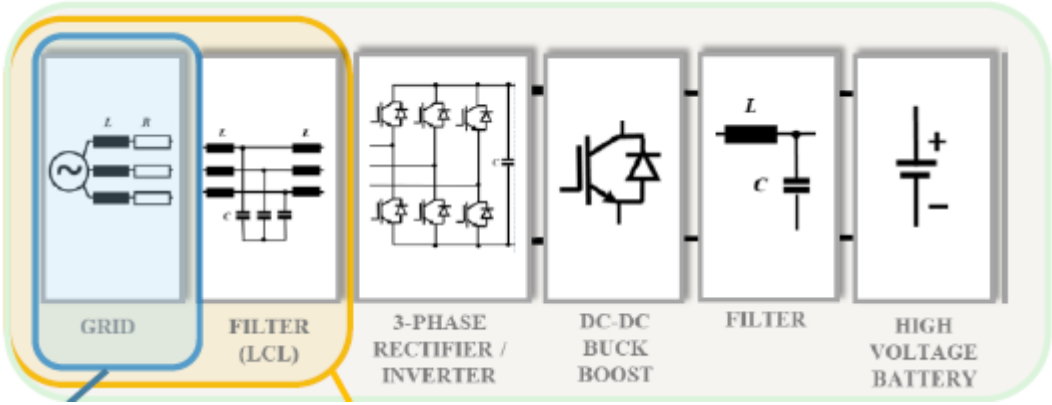
Impedance behaviour changed after connection of PV inverter between 6 kHz and 12 kHz

Supraharmonic Impedance up to 9 kHz

1 MS/s



Capacitive behaviour between 6 kHz and 12 kHz due to LCL input filter and DC link capacitor of PV inverter



Source: Grasel 2023 / The impact of V2G charging stations (active power electronics) to the higher frequency grid impedance
https://doi.org/10.1016/j.segan.2024.101306