TT&MS

total test and measurement support

Test & Measurement is our Knowledge,
Supporting customers our Business

Harmonic Distortion
&
Network pollution

René Bos

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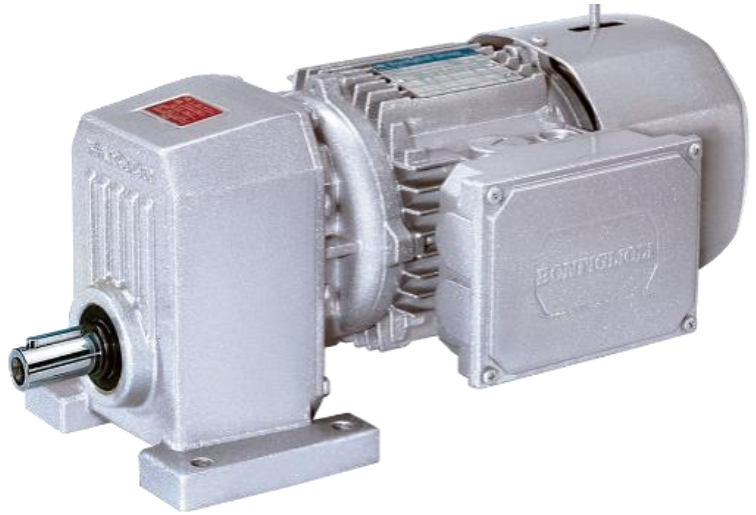
Introduction

What are the returns?

Mechanical
Hydraulic
Pneumatic

ELECTRICAL



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Introduction

‘The capriciousness of sun, wind and increasing grid pollution threaten the stability of the electricity grid'.

"Now is the time for the industry to take a serious look at new energy-saving solutions that are currently or will be offered in the near future by manufacturers and suppliers within the energy transition."

Increase in million fires first half of 2019

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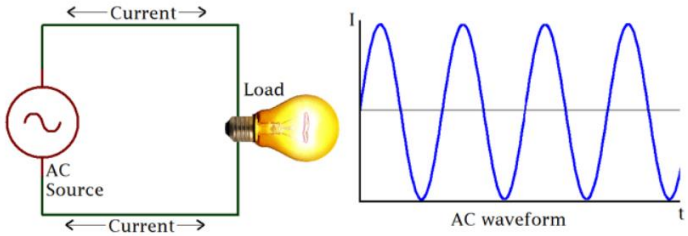
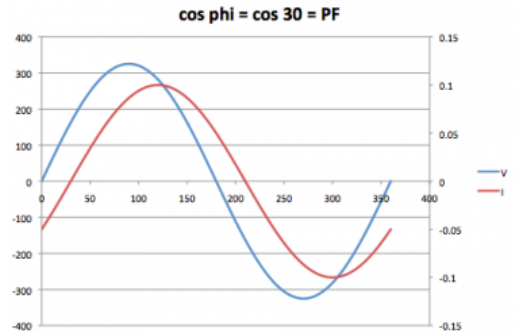
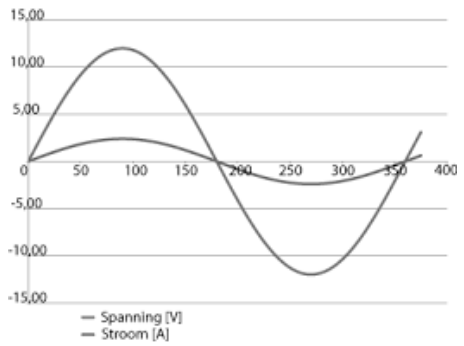
A few figures







1 Petajoule [PJ] =

2,777 778 ×10^8 Kilowatt [kWh]

With more than 1375 PJ (40%), industry has the largest share

(Netherlands Environmental Assessment Agency)

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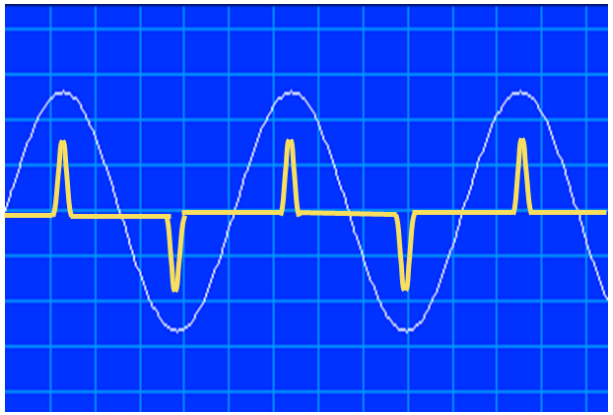
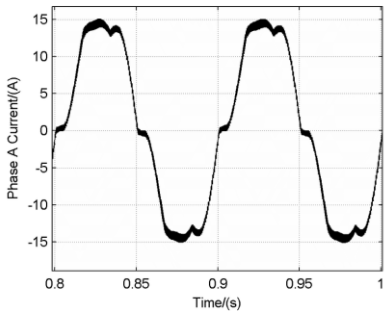
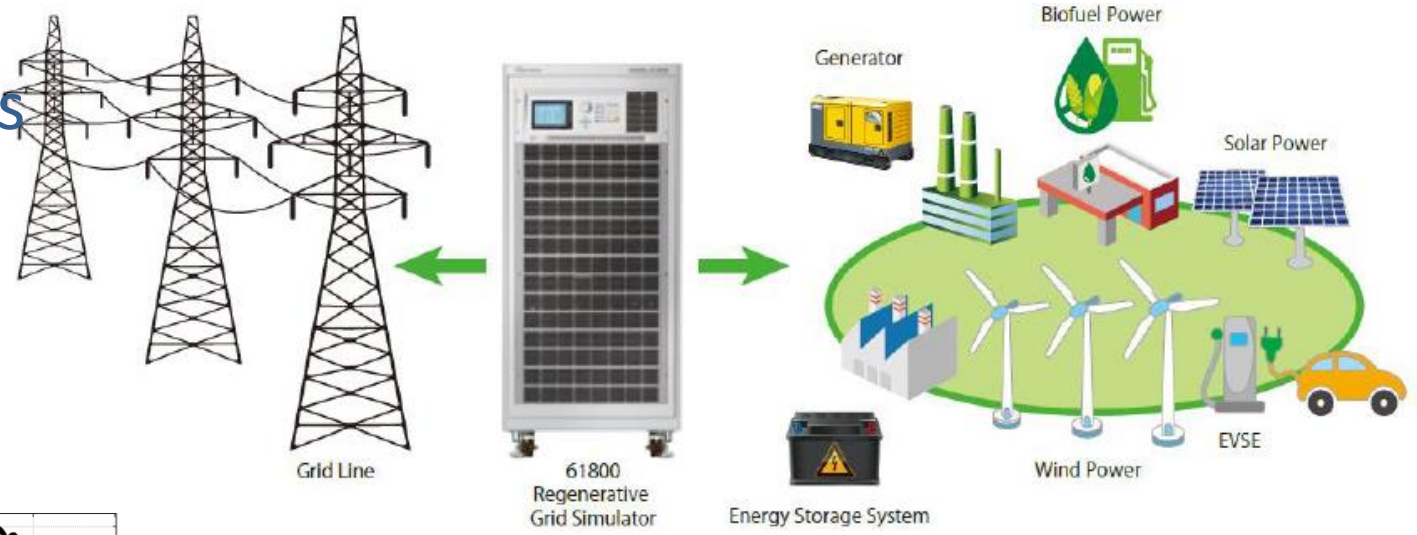
Electrical pollution

Modern Electronics

- Frequency regulators
- Switched-mode power supplies
- Motor controllers
- Power conversion equipment







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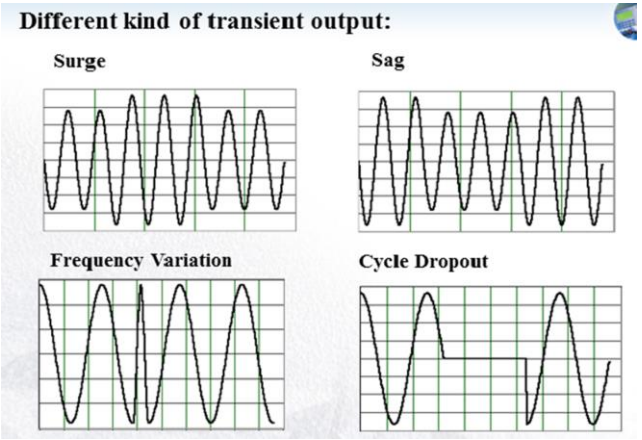
Voltage fluctuations

According to Netbeheer Nederland

- Slow voltage variation: between 207 and 253 V!
- Fast variation in voltage: Flicker
- Voltage asymmetry: imbalance in 3 phase grid
- Voltage dips: below 207 V! (meter box)



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Harmonic distortion

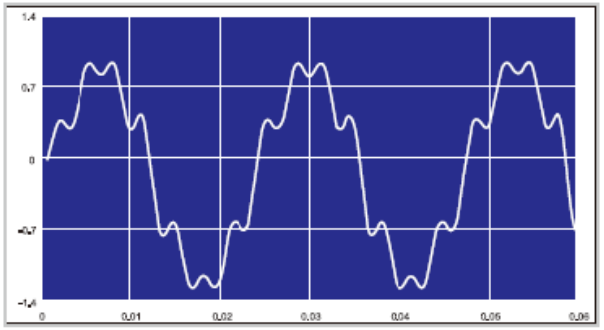
Harmonic distortion:

50 Hz (ground wave) + other frequencies

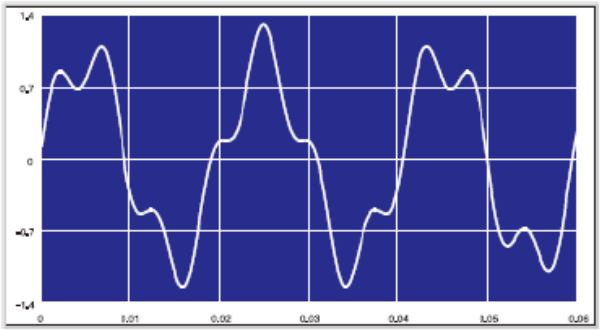
Next Network Code: THD ≤ 8 - 12%

In Practice:

Deformations of up to 25% are already being measured locally



Harmonics Waveform



Interharmonics Waveform

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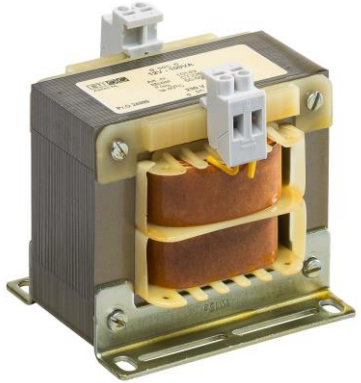
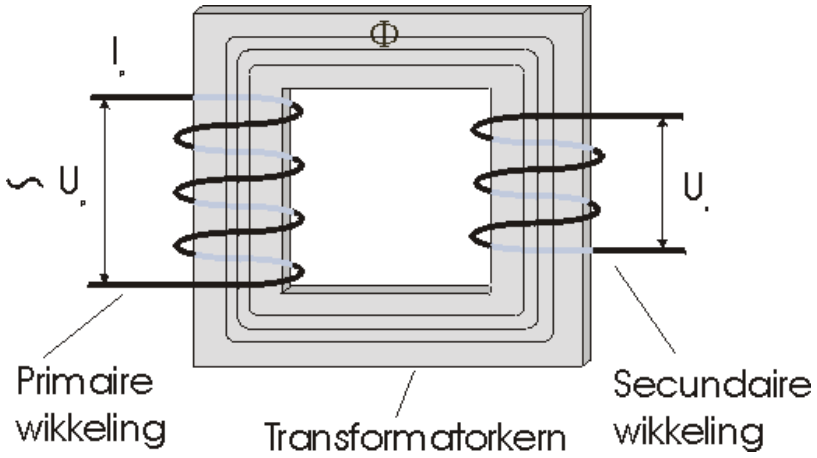
Grid pollution (consequences)

Transformers:

- Overheating due to eddy currents
- Vibration and buzzing noises
- Less efficient
- No longer delivers the expected power





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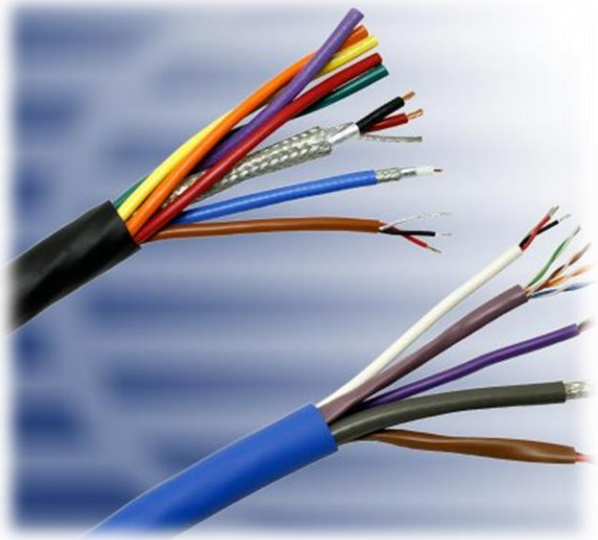
Grid pollution (consequences)

Cabling:

- Overheating due to the so-called "skin effect" at higher frequencies
- Specific resistance increases with heating
- Insulation resistance can be considerably lower



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Grid pollution (consequences)

Safety devices:

- Regular unintentional tripping of vending machines
- Unsafe situations
- Production process comes to a standstill
- This is often caused by the summation of flows

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Grid pollution (consequences)

Elektric motors:

- Oververhitting
- Geluidstoename
- Naast harmonische vervorming is ook een onbalans in het net een boosdoener
- Hogere harmonische in tegenfase werkt draairichting tegen

(met trillingen en extra slijtage als gevolg)

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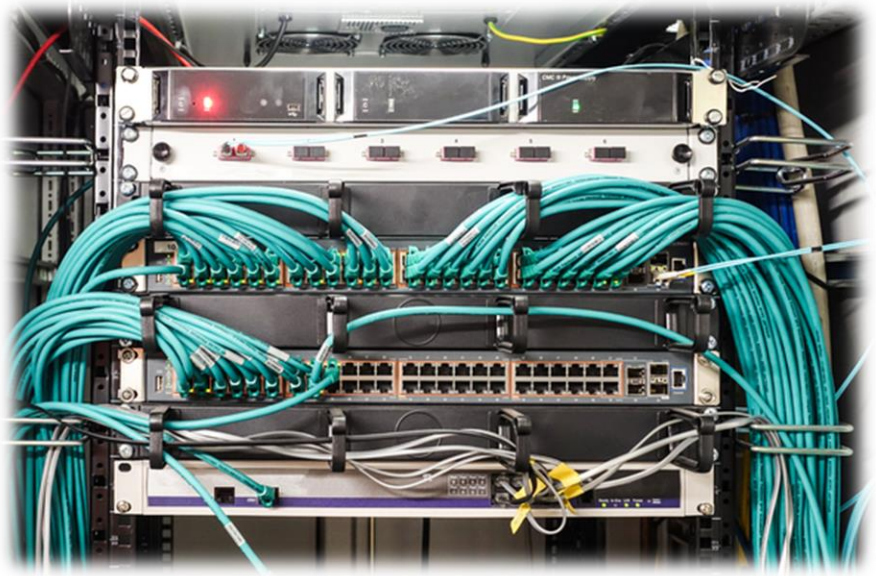
Grid pollution (consequences)

Data traffic:

Faults as a consequence of unwanted currents in the data cables



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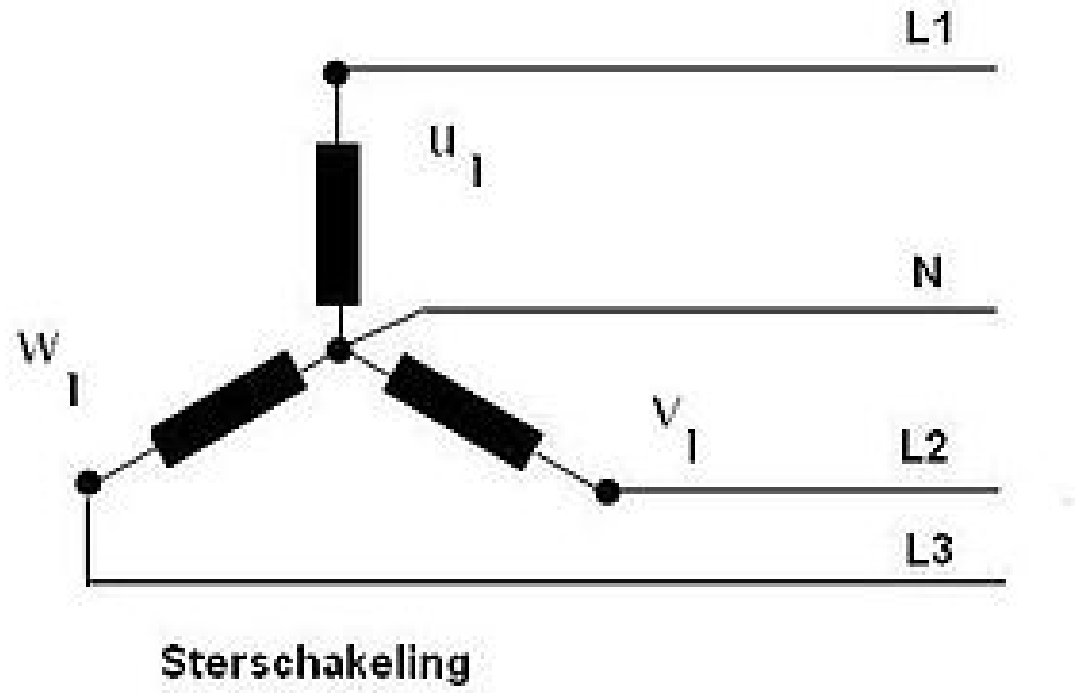
Grid pollution (consequences)

Nulleider:

The 3rd, 5th, 7th harmonics cause a larger current through the neutral. If under-dimensioned, this can heat up.



Sterschakeling

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Grid pollution summarised

The effects of harmonic distortion;

- Energy loss (faster ageing)
- Normal operation may be disturbed
- Vibrations (transformers and motors)
- Overheating

Consequences that may undermine an efficient and reliable drive

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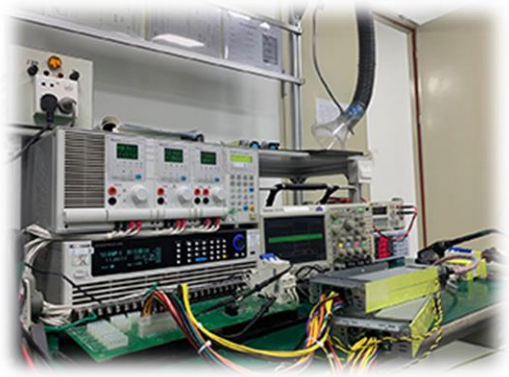
Your product/production department/R&D or test lab?

- Does your product contribute to harmonic distortion or pollution?
- Does your product comply with the standards?

- Is your grid stable enough to guarantee quality during production/testing?
- Is your grid stable enough to guarantee quality during production/testing?



- Is failure due to the device or grid pollution?

- Impact grid pollution and grid variations?

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Increasing need for testing and measuring in Power applications

- In R&D development
- During production
- Before and after installation
- In operation
- On site
- Central/Decentral

PPA5531 Harmonics and Flicker Analyzer

+

IMP163 Impedance Network

+

UKAS CALIBRATION
7949

+

N4A18 AC Power Source

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Increasing need for testing and measuring in Power applications

- Measurement and analysis of grid stability
- Measurement and analysis of harmonic distortions
- Emulation / generation of a 1/3 phase grid.
- Aware application of PQ and harmonic distortions
- Possibly according to standard and regulations
- Stabilisation and compensation

PPA5531 Harmonics and Flicker Analyzer

+

IMP163 Impedance Network

+

UKAS CALIBRATION 7949

+

N4A18 AC Power Source

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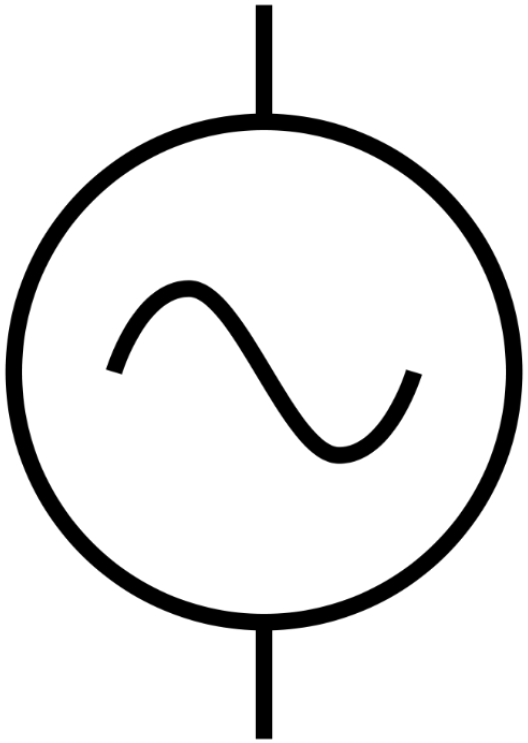
AC Voltage source

- Stable and clean AC voltage
- 1 - 3 phase
- Adjustable voltage and frequency
- Can be used as: stabiliser or grid simulator.

- Power Line Disturbance (Dips/interruptions etc.)
- Harmonics Generation
- Normtesting: e.g. IEC 61000-3-2/3-3/4, SEMI-F47



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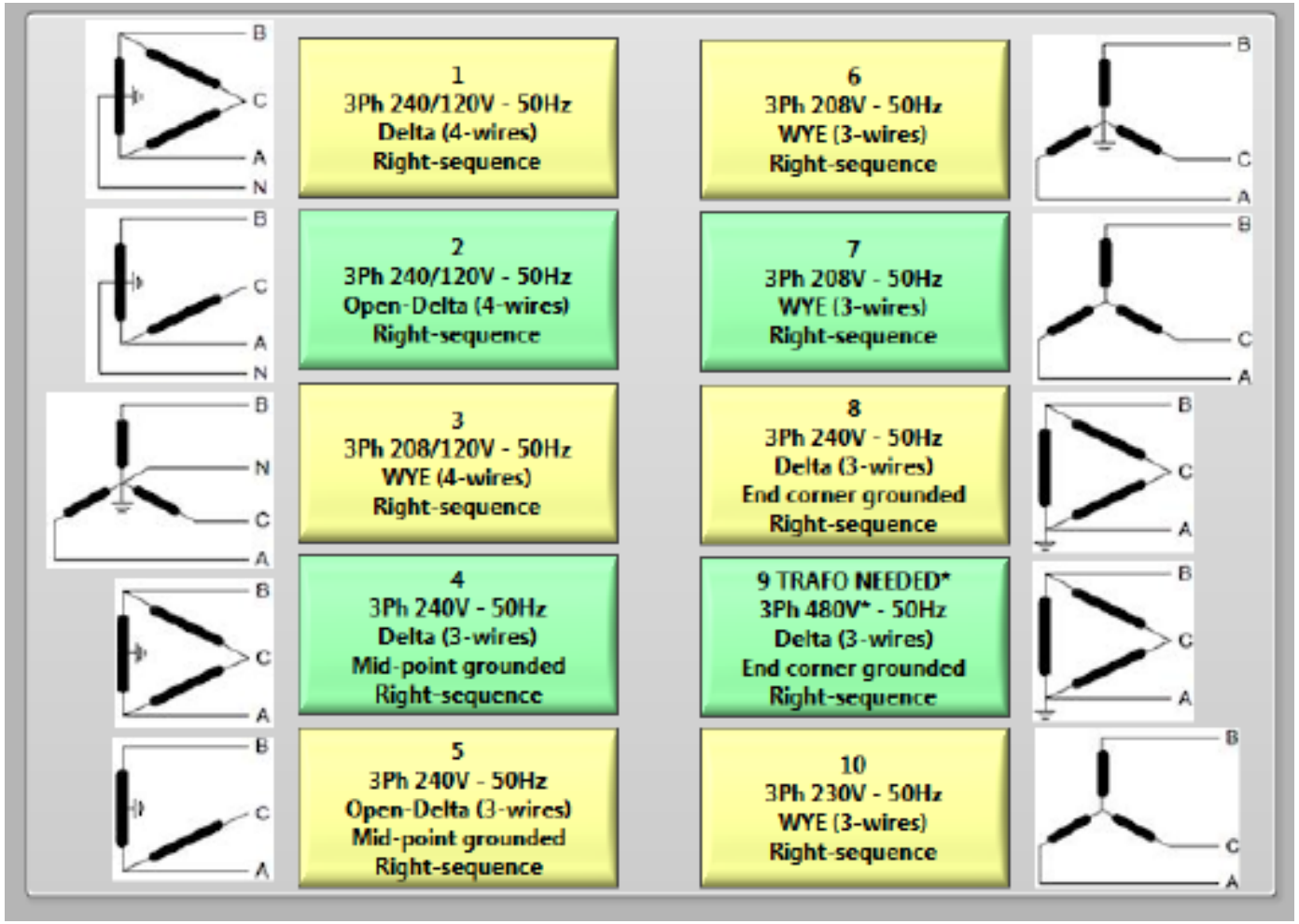
AC Power grid networks (50-60 Hz)



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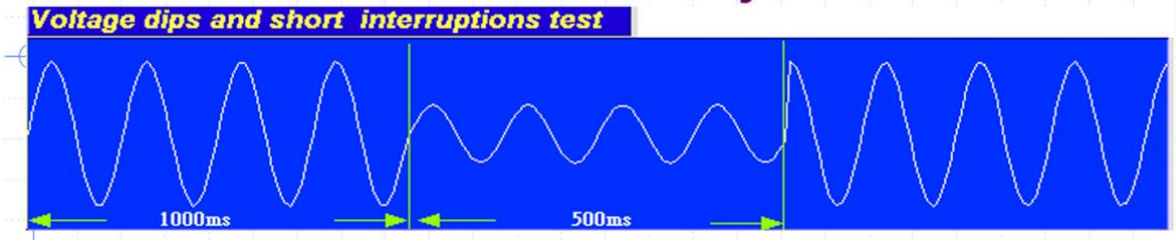
Generation of PQ distortion

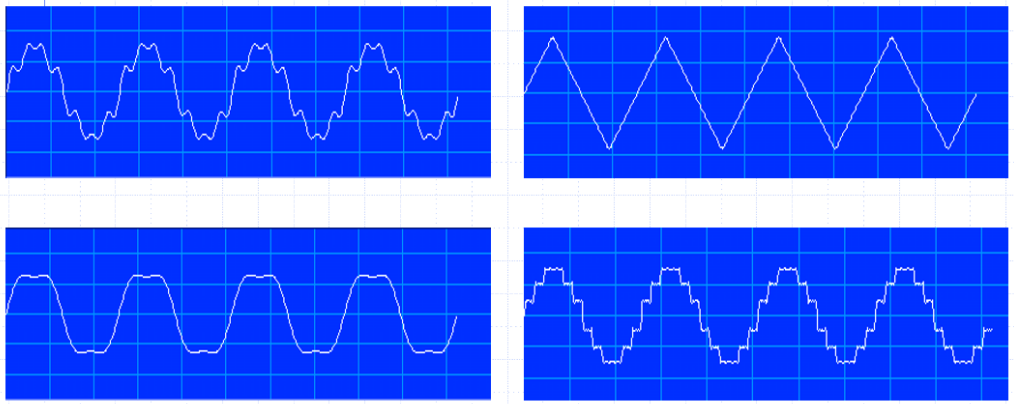
IEC1000-4-11 Voltage dips,short interruption and variation immunity test



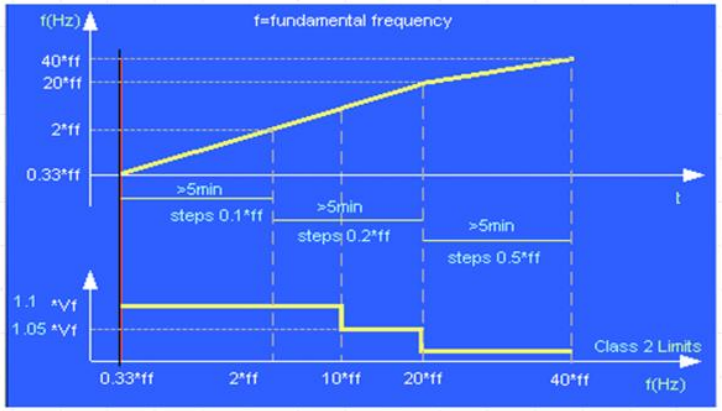
Power Line Disturbance simulation

Simulation function➔ *almost all kinds of power line disturbance conditions.*

Waveform library ➔ built in 30 different distortion waveform



IEC1000-4-13 Harmonics and inter-harmonics immunity test



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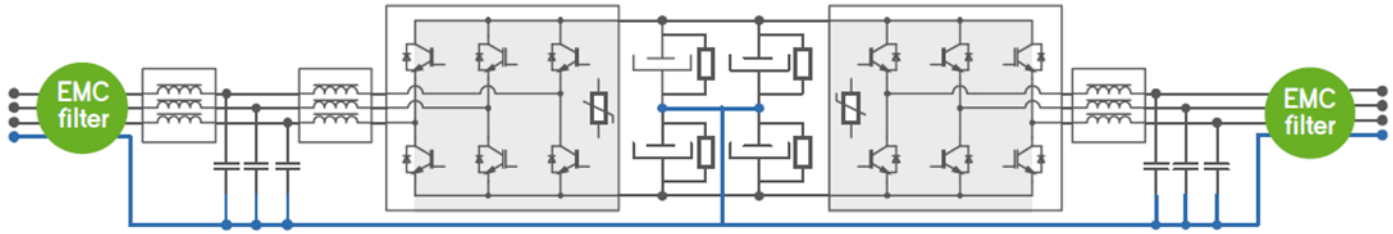
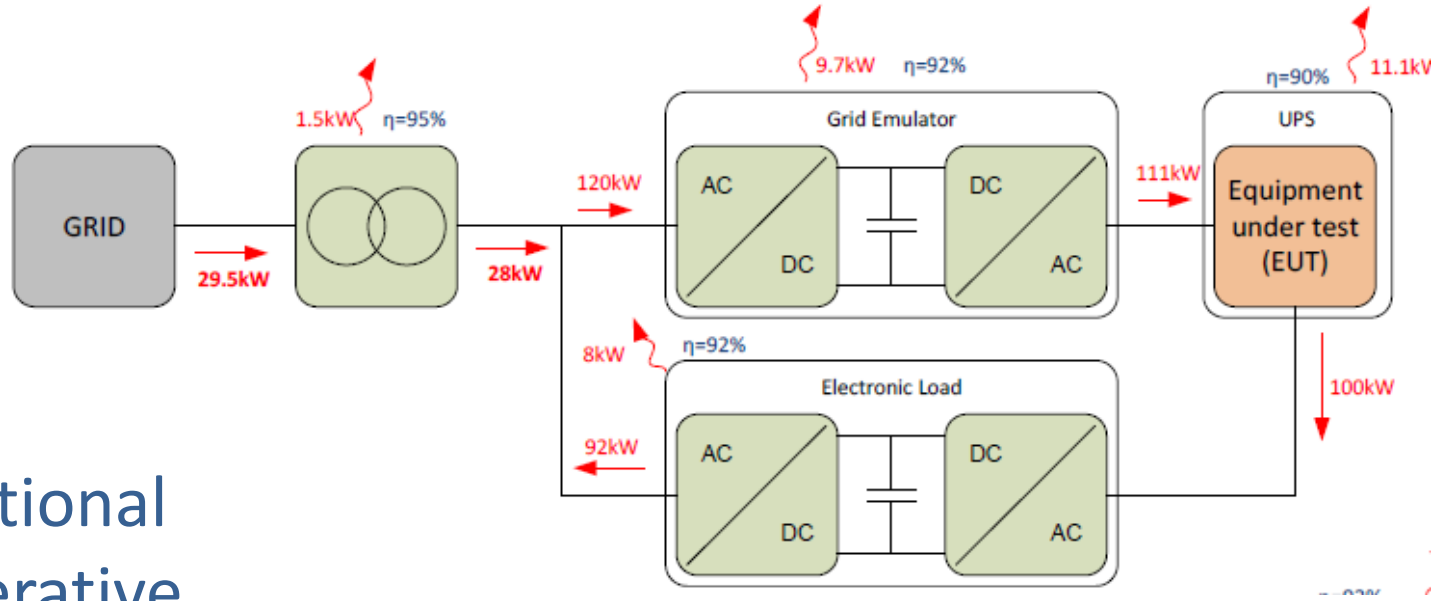
AC Source + AC Load (4 kwadrant), regenerative





- Bidirectional
- Regenerative

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AC (DC) current load

Electronic loads are programmable current sources with which the behaviour of a load can be emulated.

- 1 of 3 phases
- Programmable power factor
- Harmonics
- Emulation of an RLC circuit.

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Measurement and analysis

Power of power quality analyzer

- Voltage & Current
- Phase
- Harmonic analysis
- Efficiency measurements
- Loss measurements

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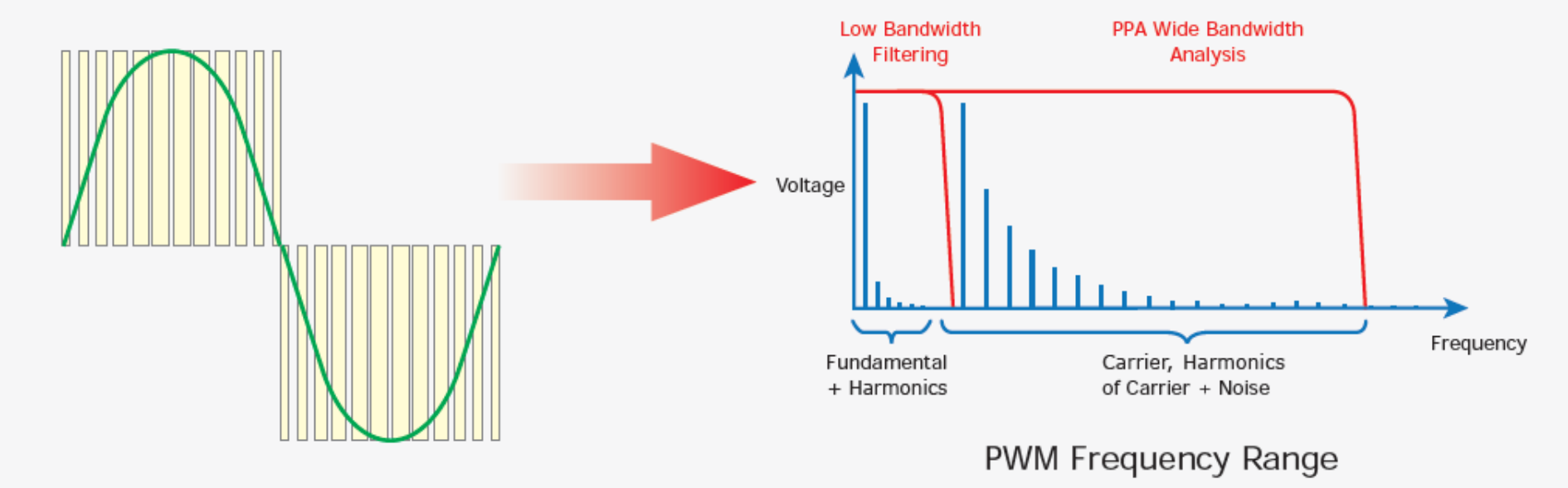
Measurement and analysis



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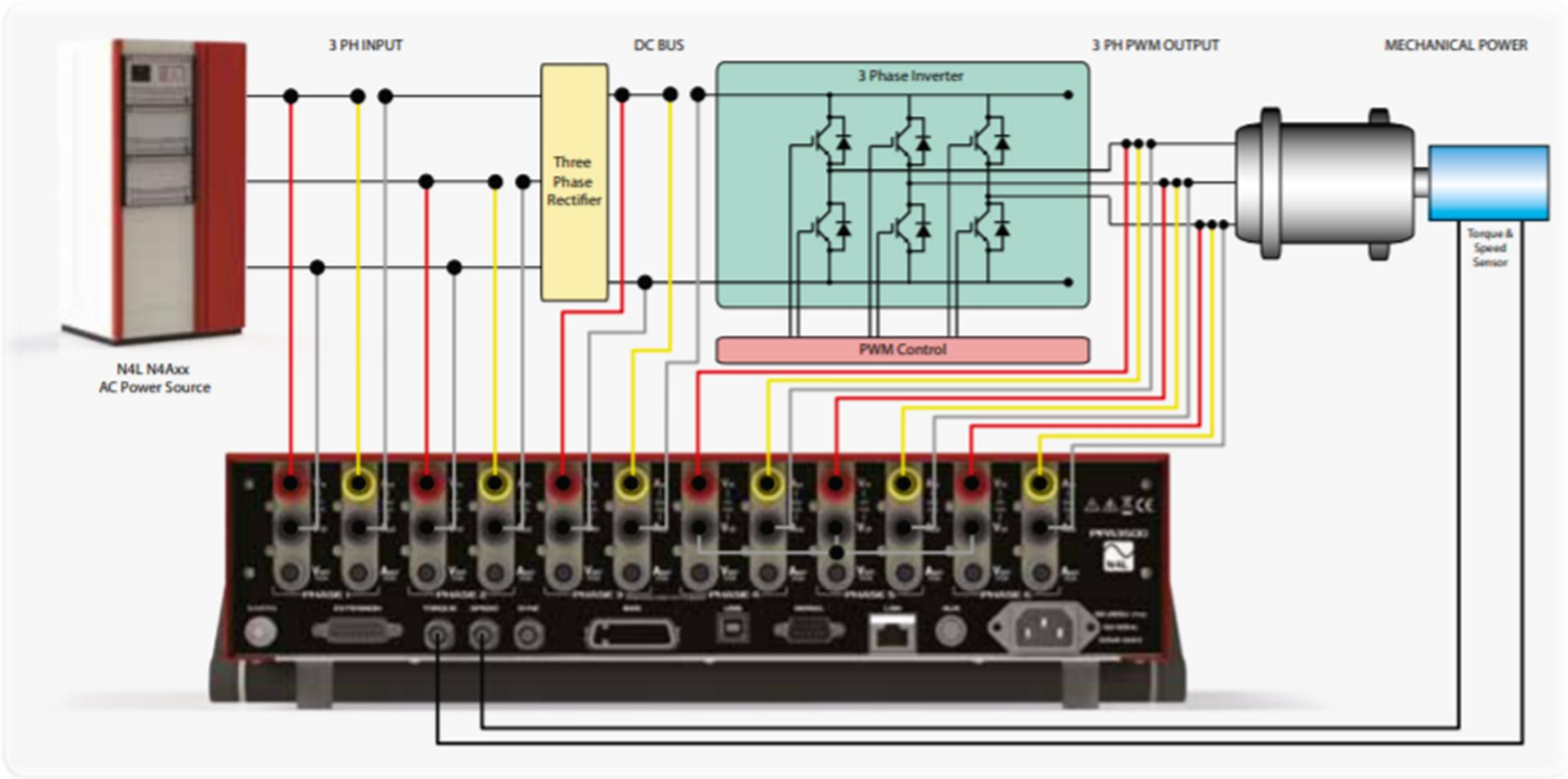
Measurement and analysis



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- We have to deal with (increasing) Grid distortion and instability
- Permissible boundaries will become wider rather than narrower
- Current regulations are lagging behind practice
- AC/DC and DC/AC power conversion is growing
- Increasing demand for proper test and measurement equipment and GRID Emulation
- **More efficient (more reliable) driving is possible**

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Do you have any questions?

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WAT JE NIET MEET, KUN JE OOK NIET VERBETEREN

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