High Voltage Measurement Challenges

KEMA Labs

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Labs Development

EURAMET workshop
May 15, 2024
VSL, Delft




THE LARGEST MAN MADE MACHINE ON EARTH IS CHANGING FAST

Into a … Renewable Rich Inverter Dominated Grid

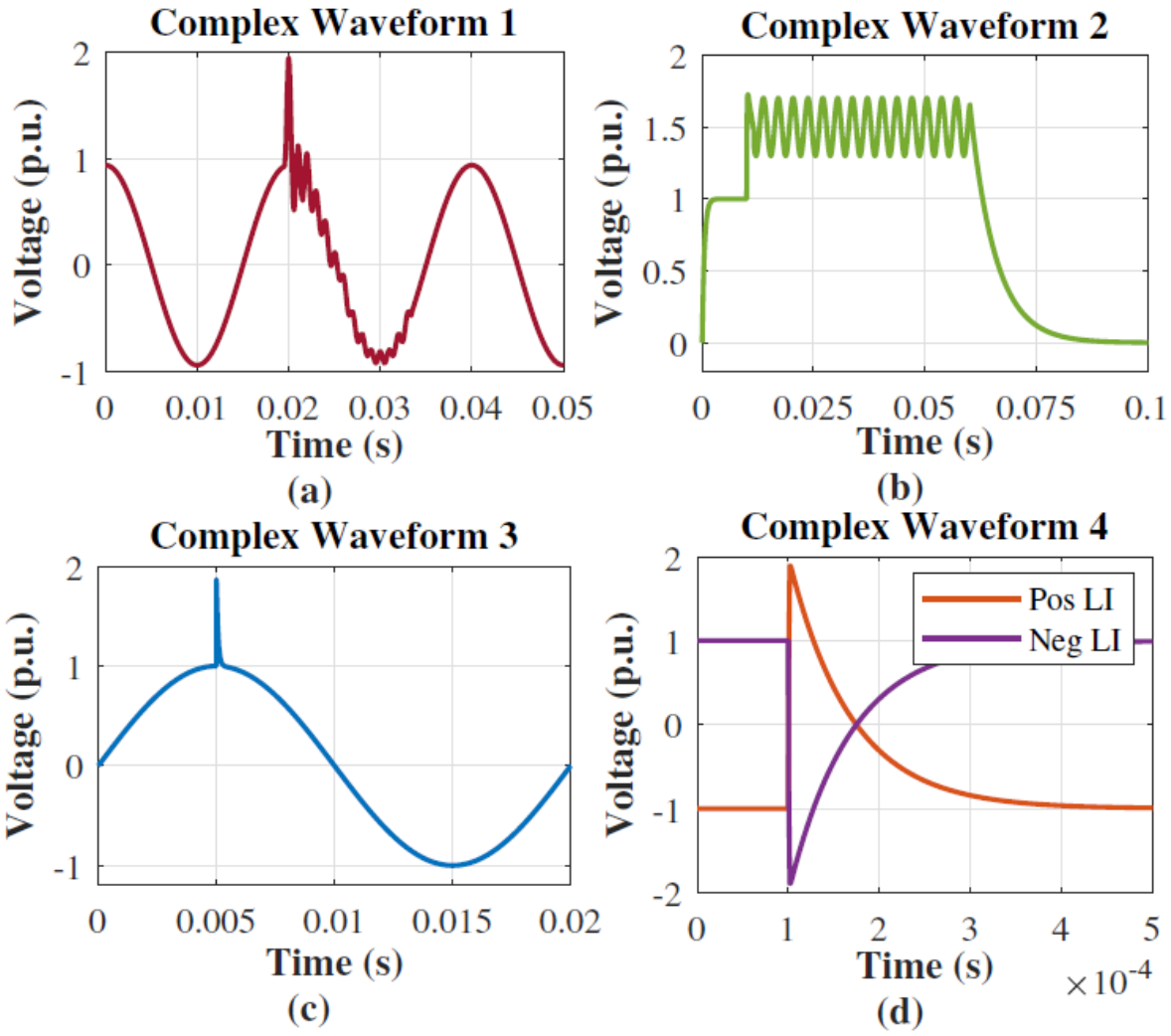
Advanced power electronic converters are software-controlled compact configurations of *fast solid-state switches* capable of transforming electric energy with *high efficiency* in numerous applications in the electric power system. Advanced power electronics enable *precise power flow control and advanced protection*.

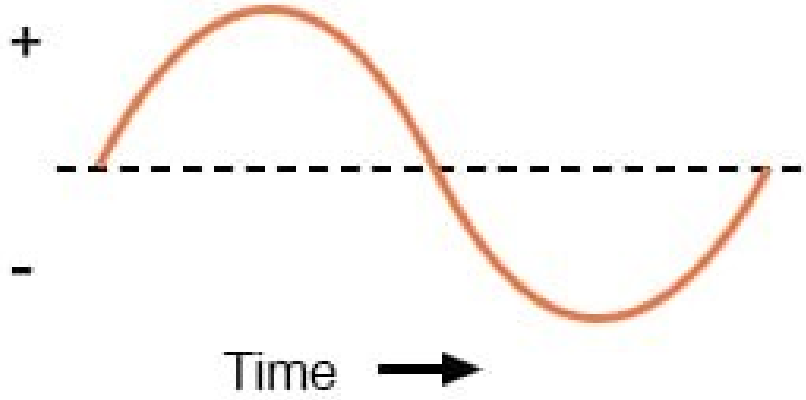


20kW/dm^3
$\eta \geq 97\%$

10kW/m^3
$\eta \geq 99\%$

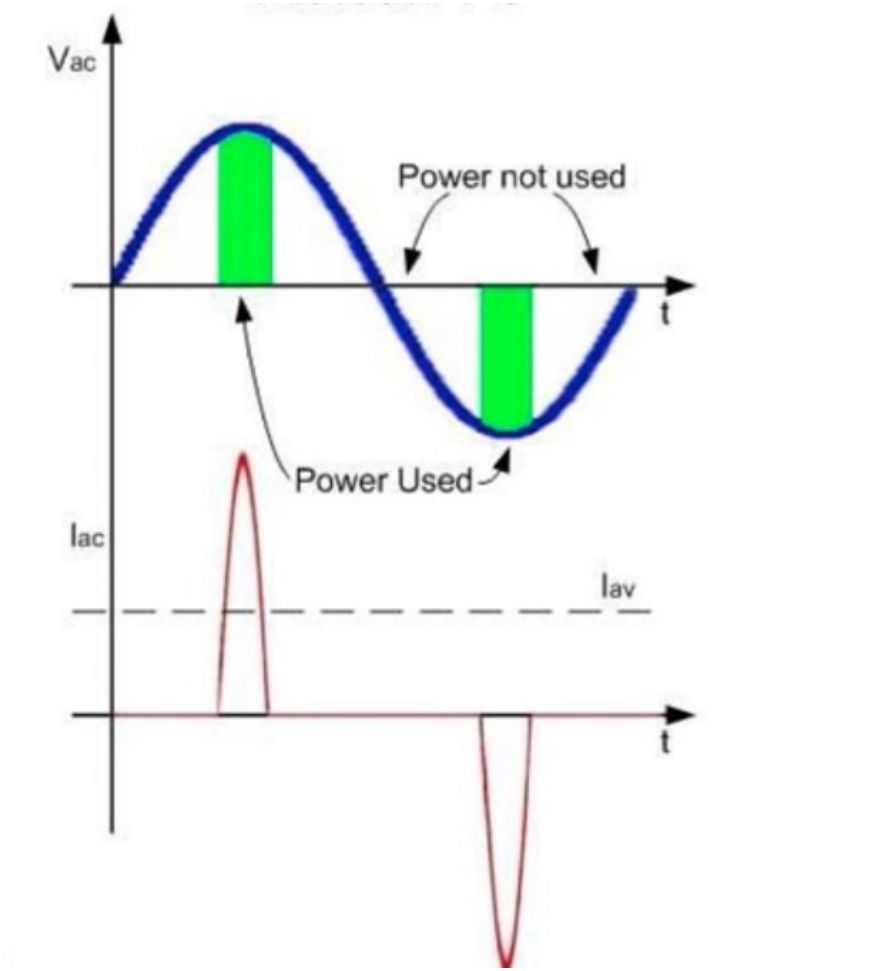
Complex voltage waveforms





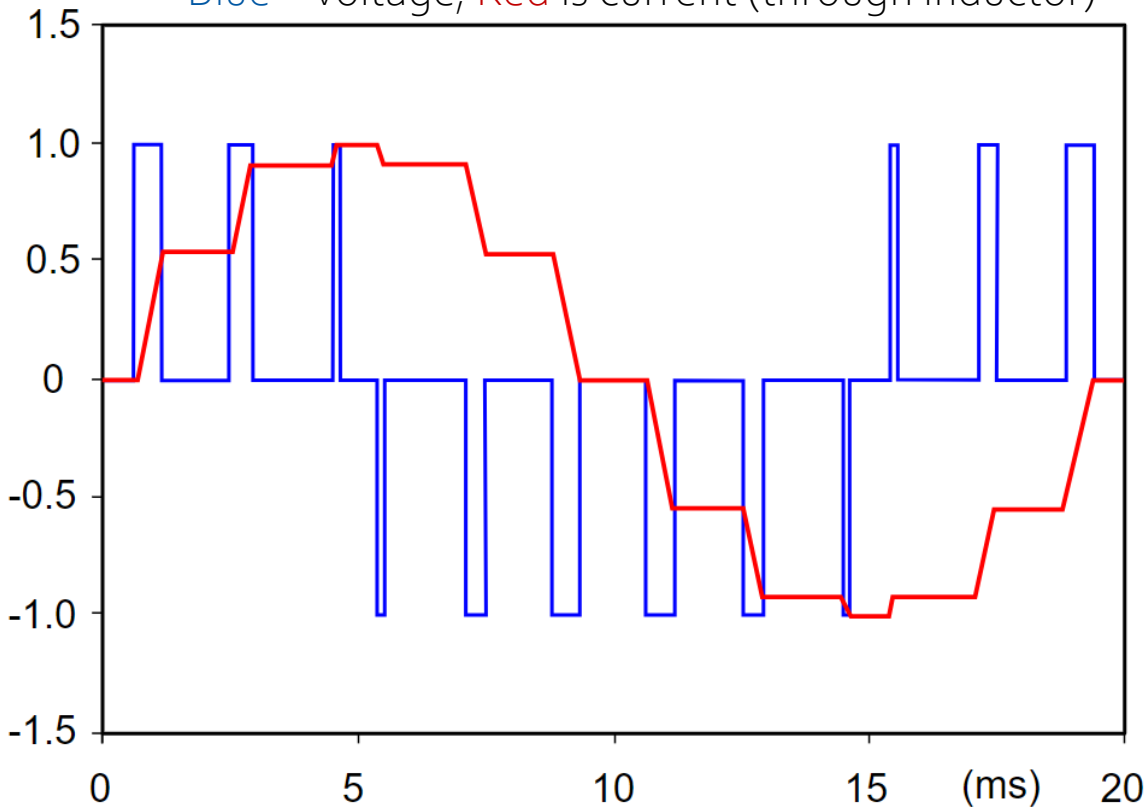
Source: PhD thesis Dhanashree Ashok Ganeshpure, TU Delft 2024

Non-sinusoidal currents



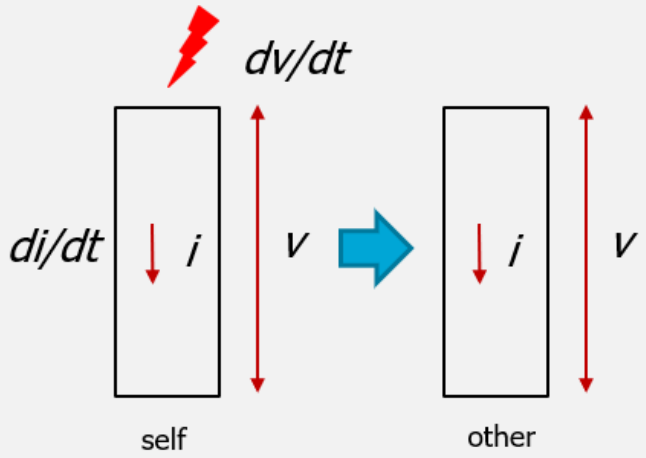
Source: www.everythingpe.com

Blue = voltage, Red is current (through inductor)

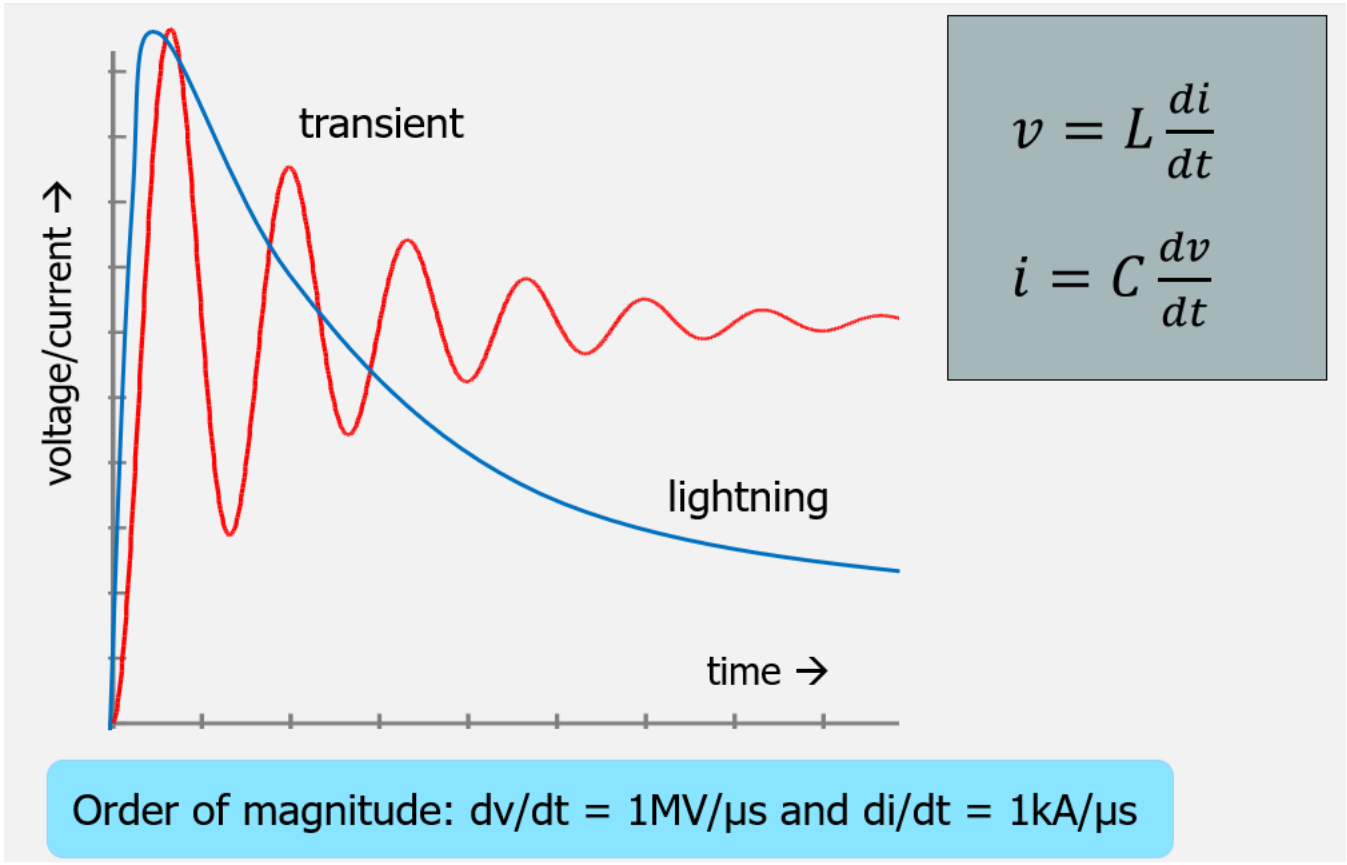


Source: wikipedia

EMI (measurement blinding and breakdown handling)



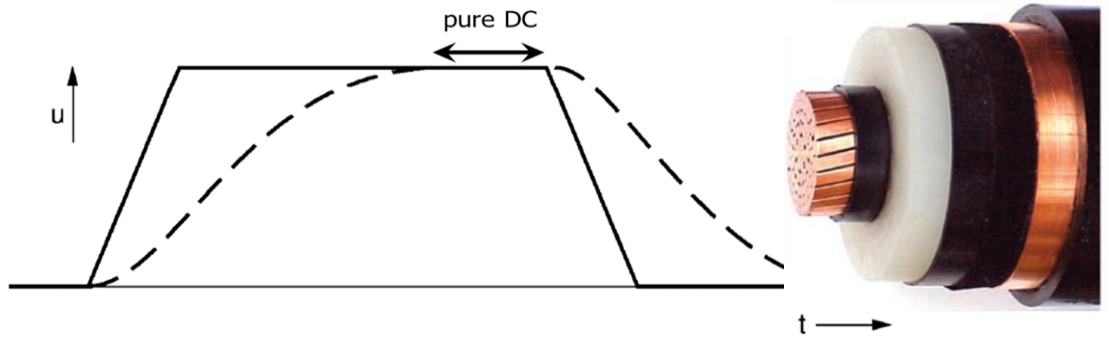
Typical Values	L	C
self magnitudes	mH MV	nF kA
other magnitudes	µH kV	pF A



Other developing areas

- Field establishment measurement (HVDC cable testing)

DC field = AC field + Charge Induced field



Note: dotted line represents the growth of internal charges

- Charge measurements
- Ripple measurement on MW DC power
- High power energy metering
- High Voltage supra harmonics (up to 150kHz)
- Very Fast Transients (vacuum and solid state switching)
- Very high currents (a.o. electrolysers, fuses)
- Very small quantities (power and dielectric losses, resistance)
- Measurement accuracy
- Different solutions/results due to Interpretation of the standard
- Reactive Power measurement



Source: KEMA Labs, HVDC with Superimposed LI

Digital signal processing and AI use, is not obvious



Source: internet

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