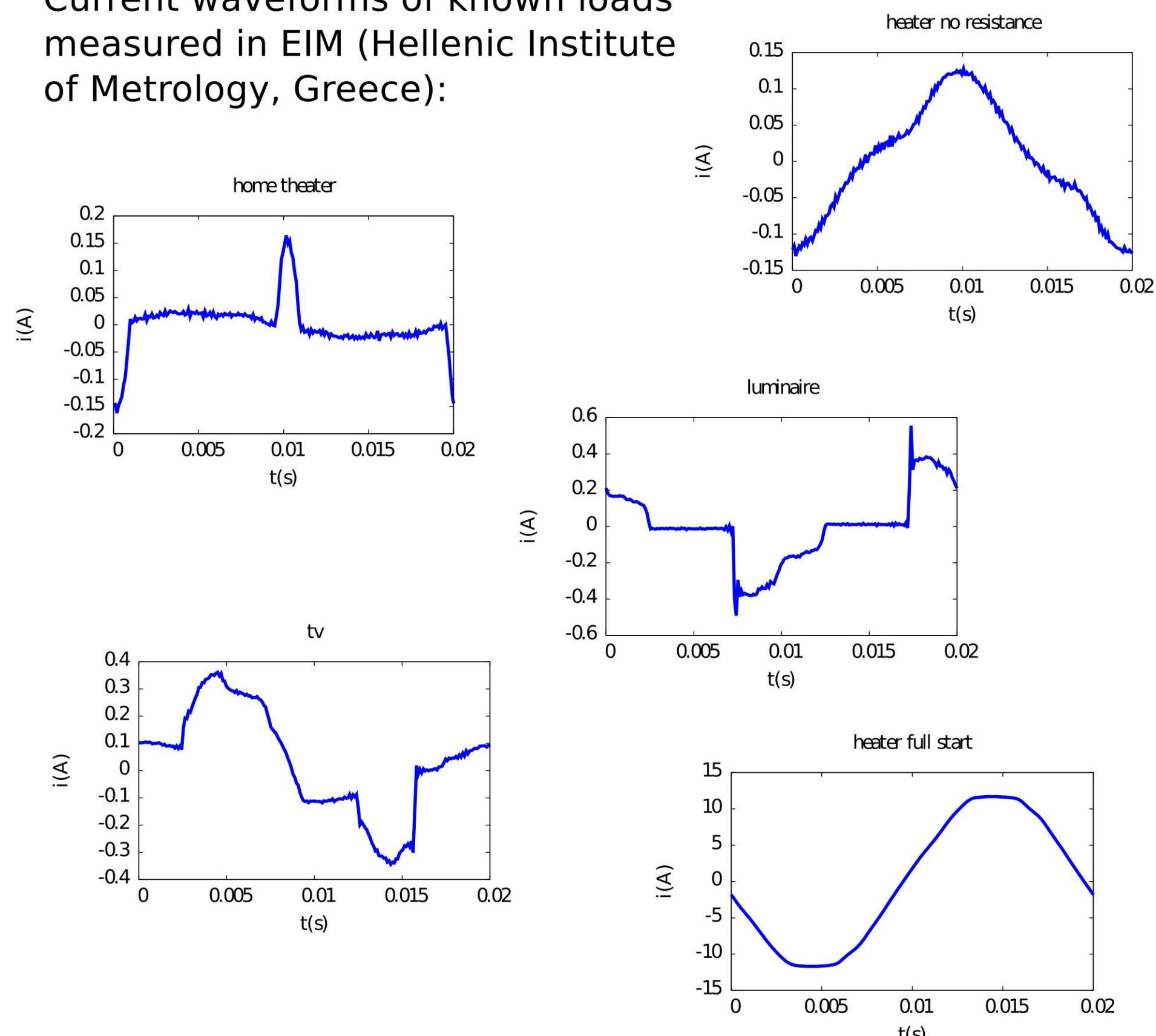


HOW CALIBRATE AND TEST SMARTMETERS WITH LOAD RECOGNITION ABILITY?

Previously measured current waveforms of known loads are generated. NILM has to identify loads. Other properties of NILM are calibrated by calibrator.

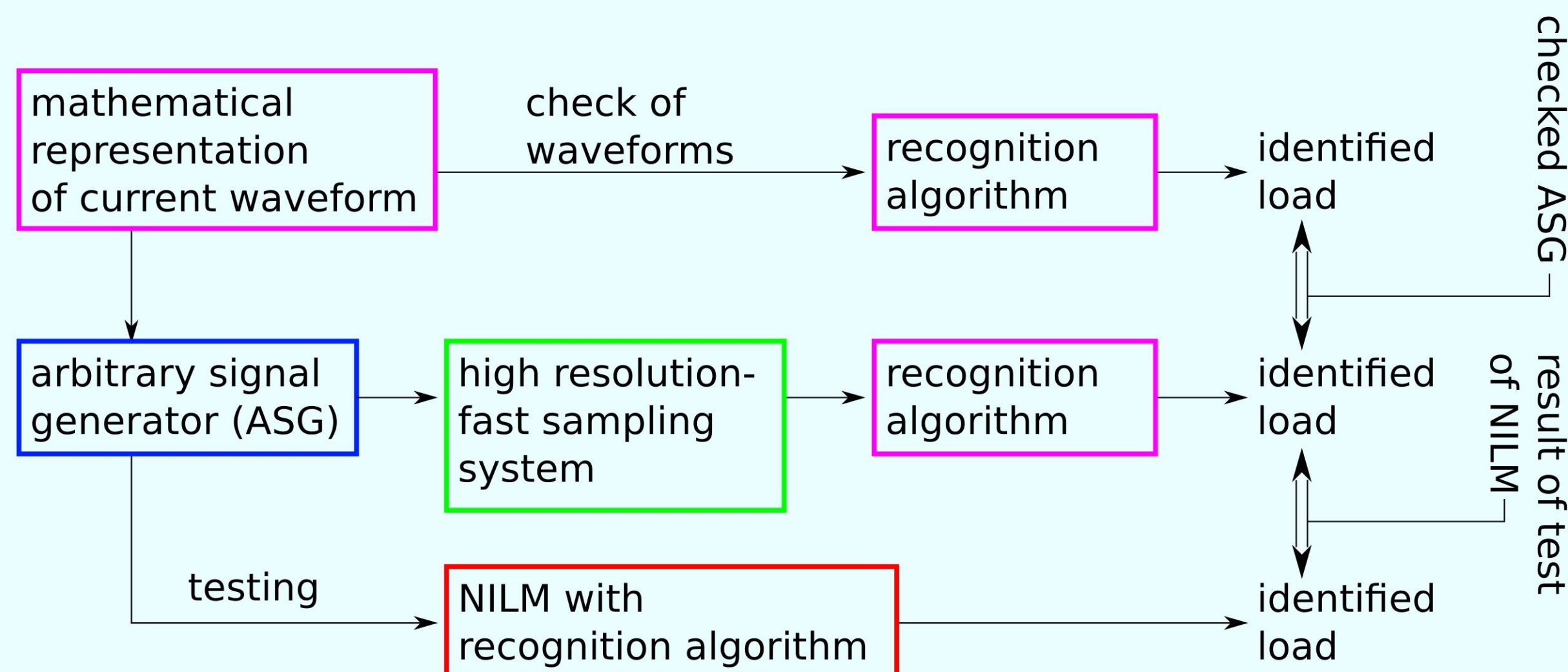
INPUT

Current waveforms of known loads measured in EIM (Hellenic Institute of Metrology, Greece):



THREE STAGES OF THE TEST

- 1, Upsampled waveforms are tested by recognition algorithm (created by EIM) in computer.
- 2, Generated waveforms are sampled by high quality sampling system and tested by recognition algorithm.
- 3, Generated waveforms are measured by NILM with recognition algorithm.

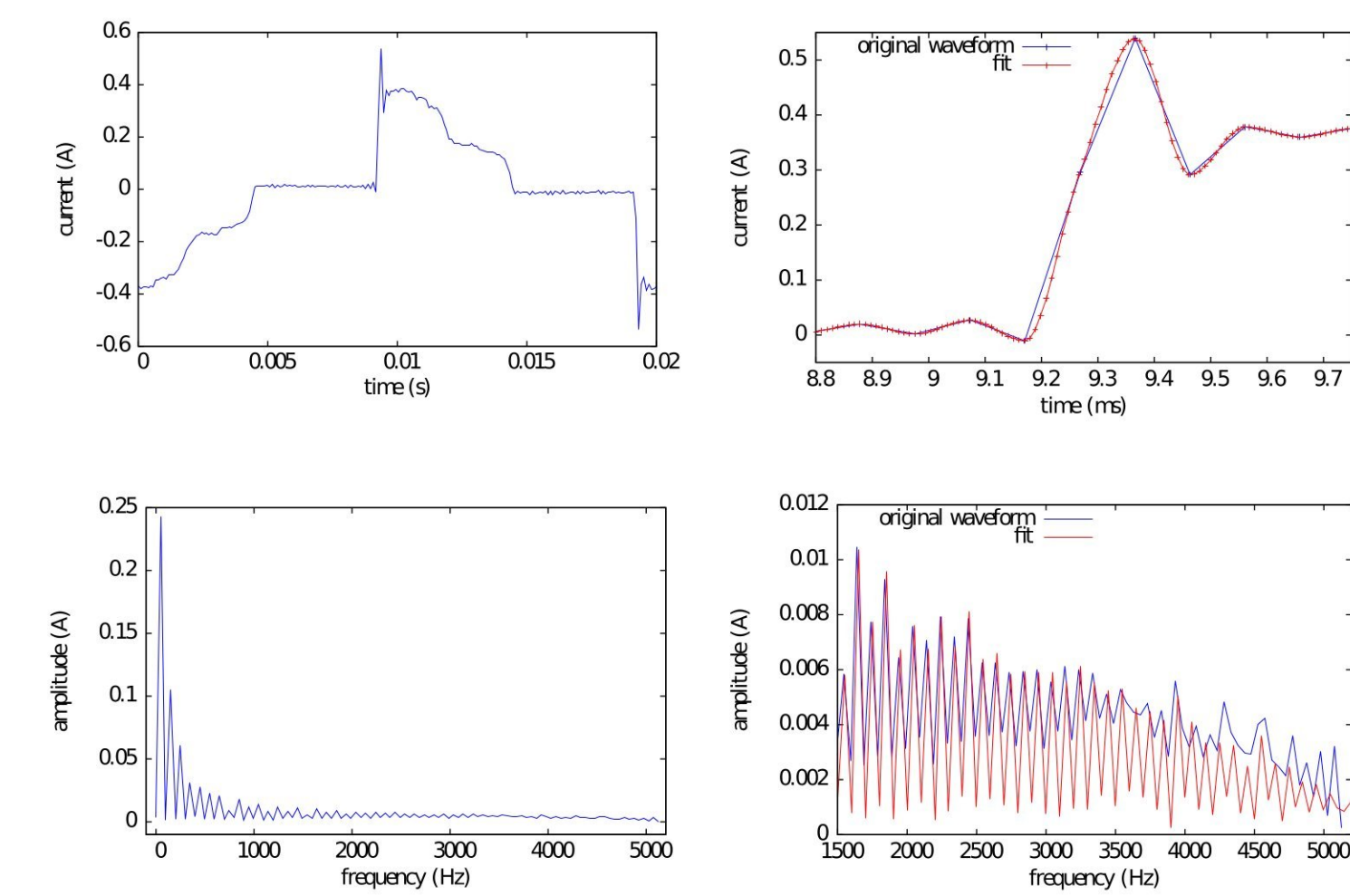


ARBITRARY SIGNAL GENERATOR

- Peak current: up to 30 A (20 A_{rms}) (limited by Fluke 5200 transconductance amplifier)
- Current waveforms: up to 16000 points (limited by HP34420 arbitrary waveform generator)
- Current synchronized to voltage generated by Fluke 6100A
- Voltage waveform can contain dips, swells, harmonics

INTERPOLATING WAVEFORMS

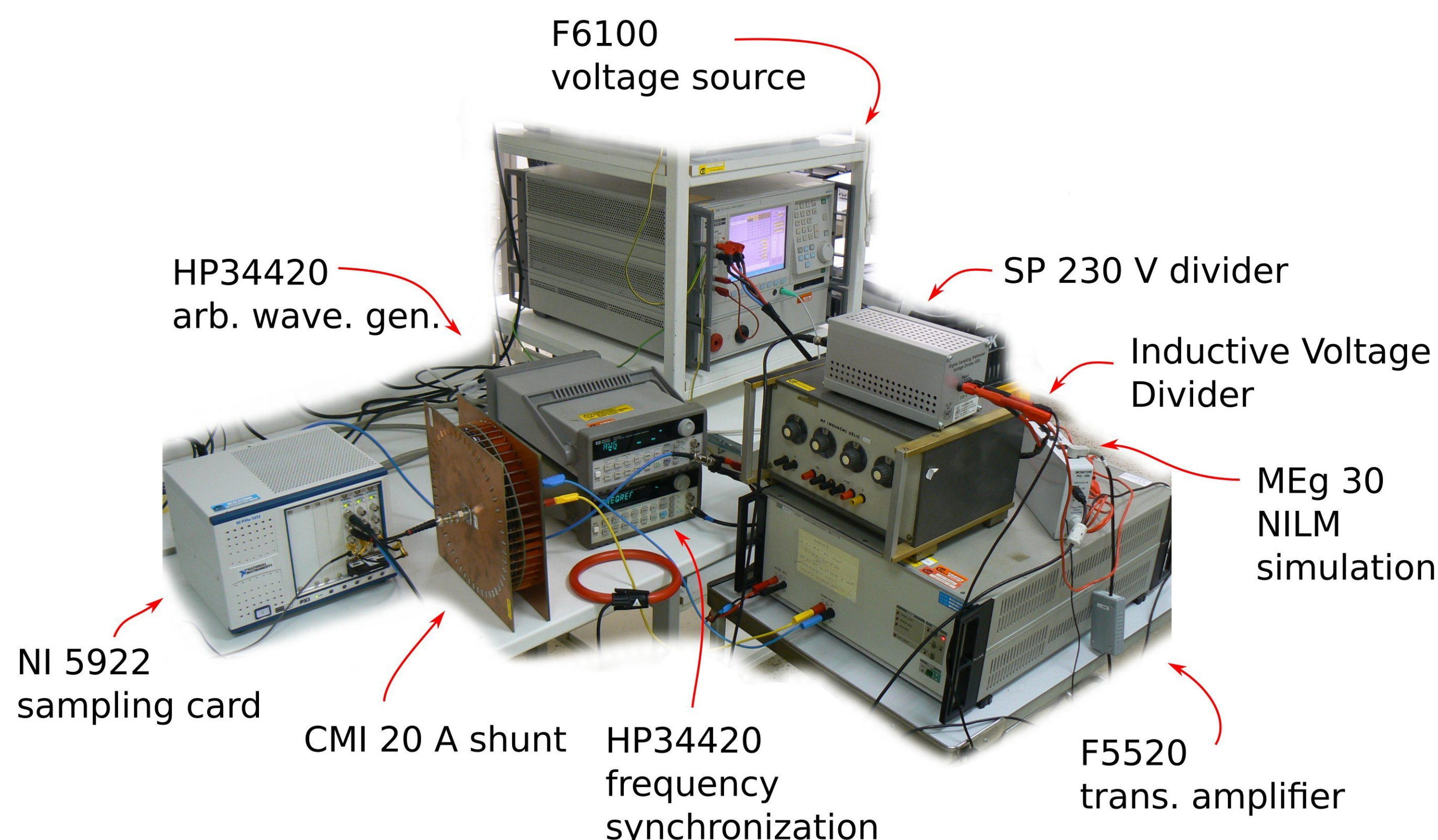
Interpolating waveforms to increase time resolution.



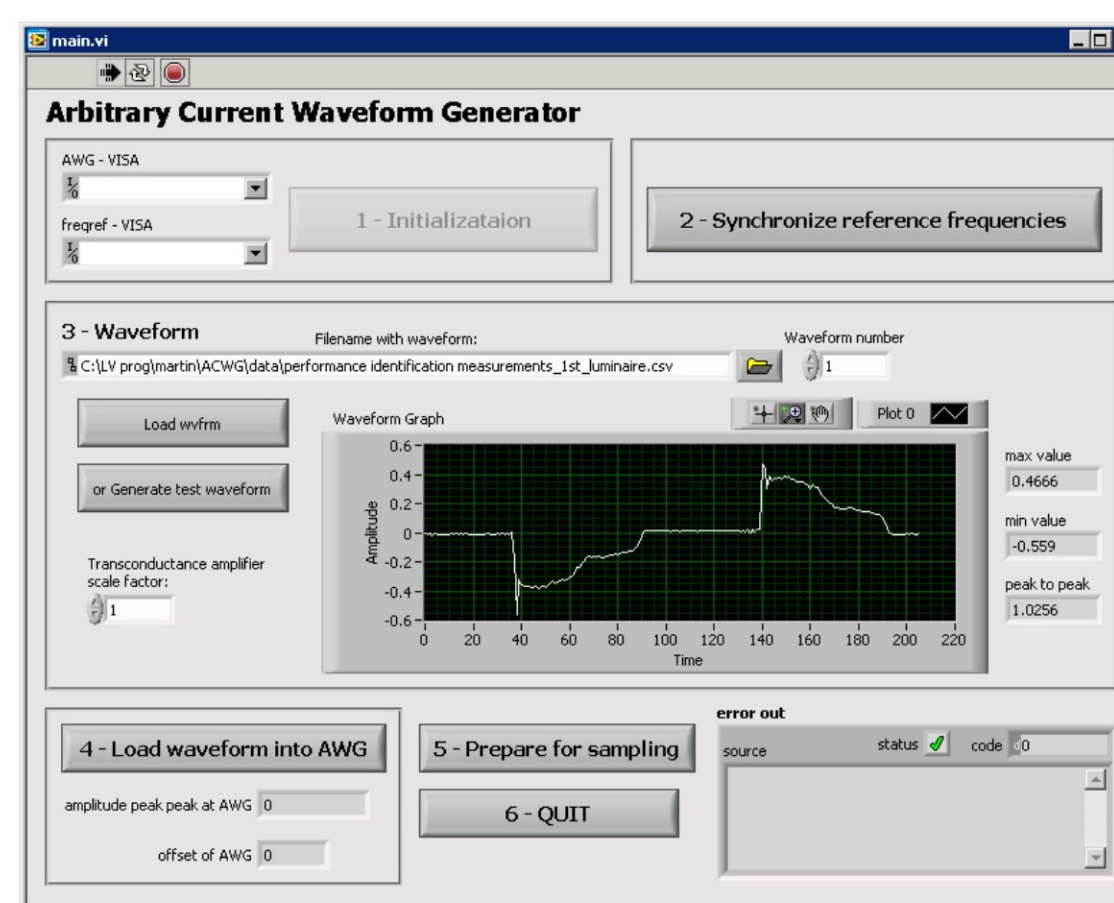
Test of recognition of interpolated waveforms:

waveform name	11 503 points	13 000 points	16 000 points
heater full start	8/10	8/10	8/10
luminaire	9/10	9/10	10/10

Arbitrary signal generator with simulated NILM

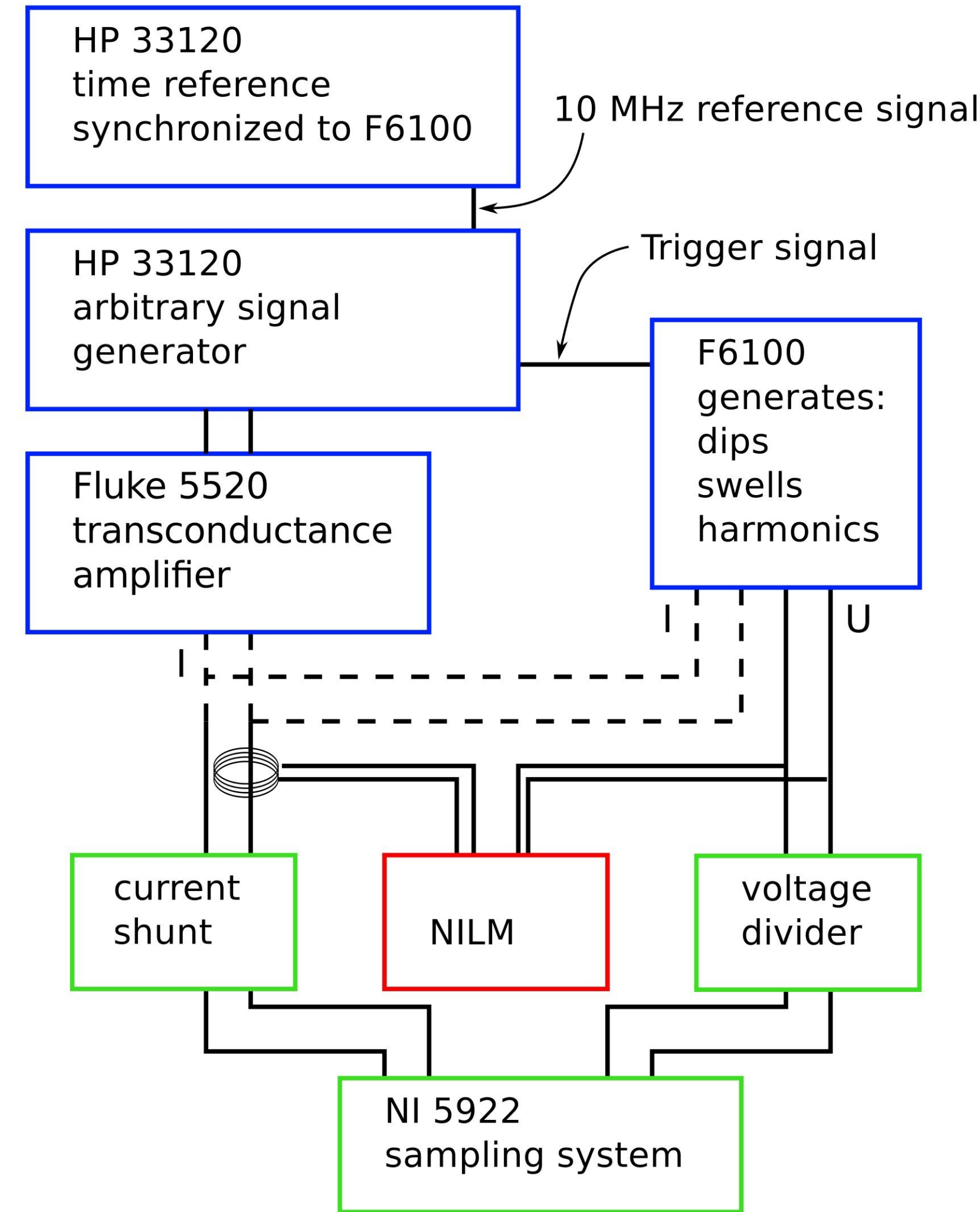


Control software:



Test of recognition of waveforms generated by ASG and sampled by NI 5922:

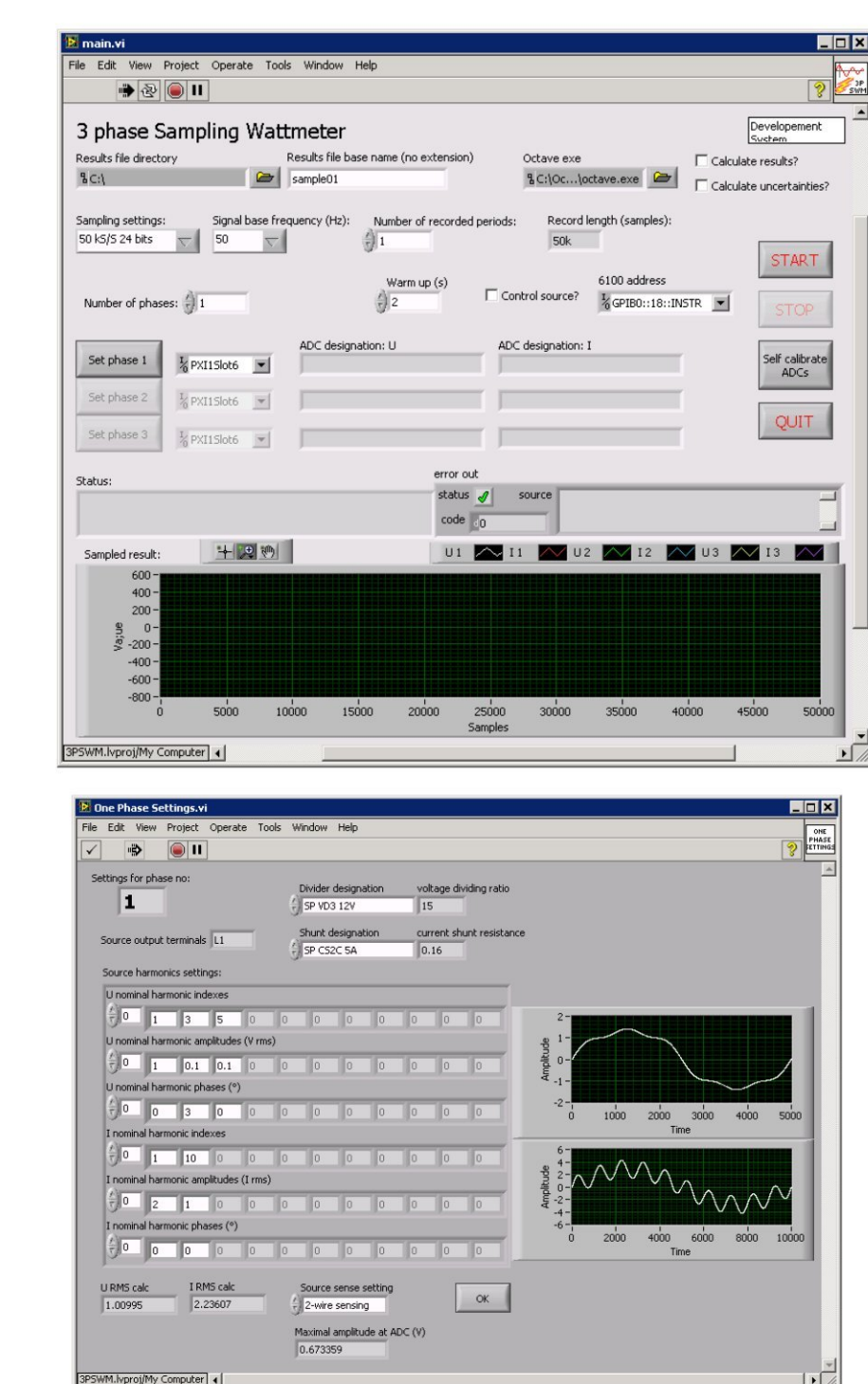
waveform name	11 503 points	13 000 points	16 000 points
heater full start	20/20	20/20	20/20
luminaire	20/20	20/20	20/20



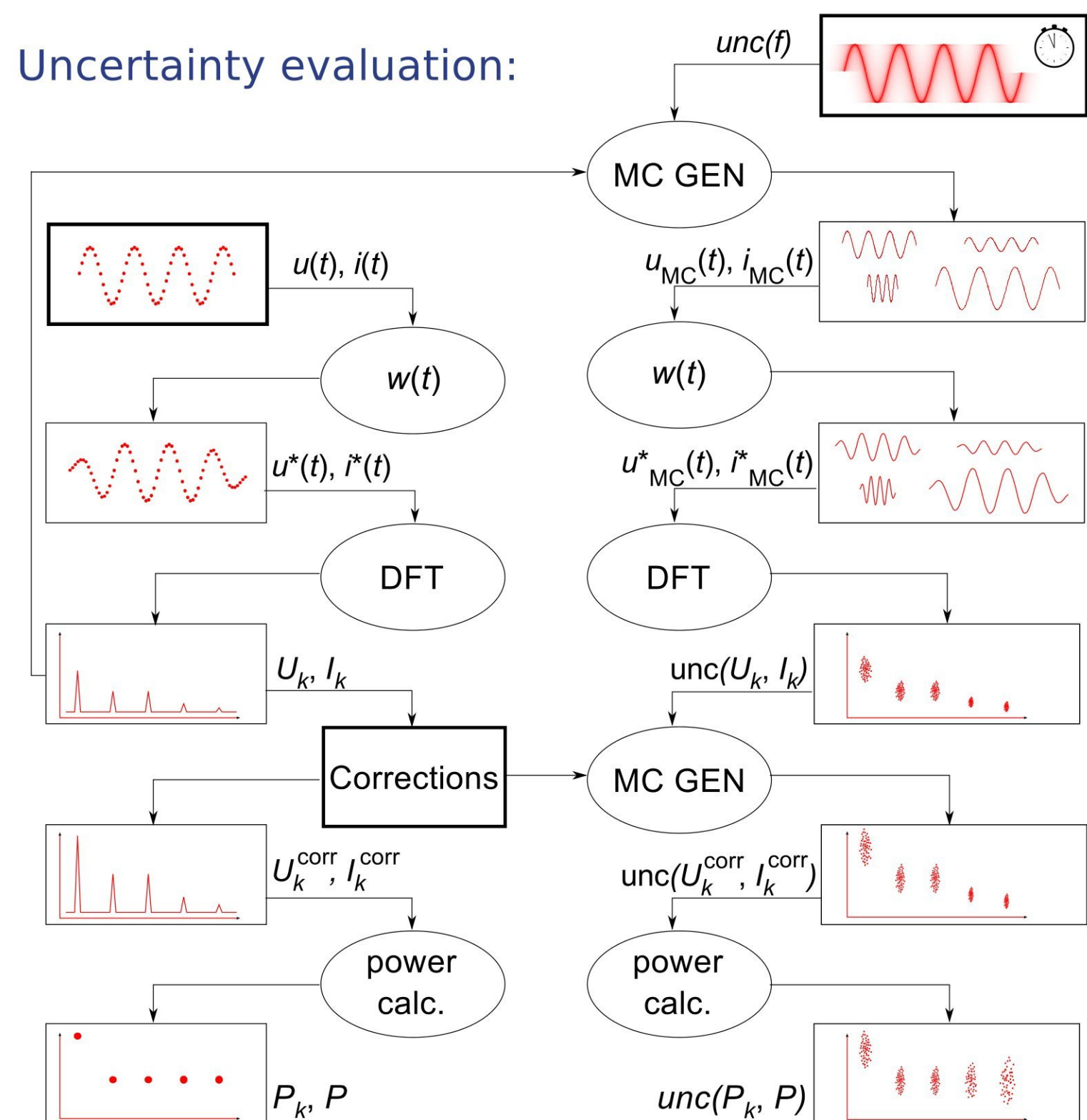
ASYNCHRONOUS SAMPLING WATTMETER

Wattmeter based on NI 5922 ADC, Labview control software and set of GNU Octave calculating scripts:

Control software:



Uncertainty evaluation:



NILM (Simulated)

For test purposes PQ monitor produced by Czech company MEG A has been selected.

Monitor can save sampled data. Data were processed by recognition algorithm afterwards, thus NILM with recognition ability was simulated.

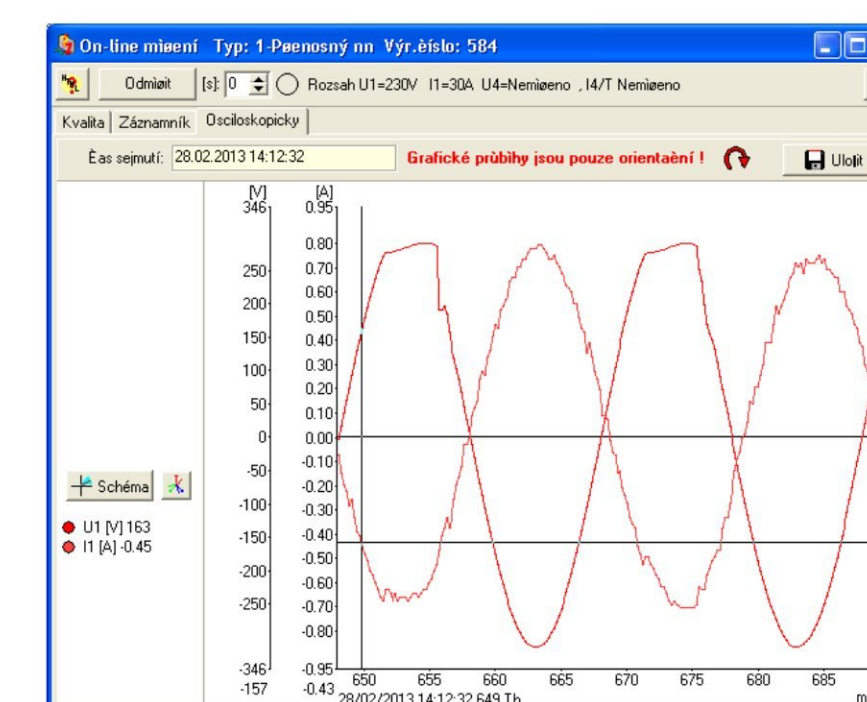
model MEG 30 PQ-NN up to 4 CT PC software

Voltage range: 440 V_{ef}
Voltage resolution: ±0.1%

Current range: 5 A, with CT up to 900 A
Current resolution: 0.2%
Current linearity: <0.5%
Frequency range: 40 Hz to 2 kHz

Power uncertainty: 0.5% at 50 Hz
Measures flickers, THD, harmonics
Power input: 5 VA

Oscilloscopic mode of MEG 30:



Test of NILM simulated by MEG 30

Current range 30 A, good for heater full start, intentionally not good for luminaire.

waveform name	11 503 points	13 000 points	16 000 points
heater full start	19/20	19/20	19/20
luminaire	3/20	3/20	2/20