Precision transducers for power and energy measurements

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WP3: Precision Transducers For Laboratory Measurements of Power and Power Quality.

- Partners: **BEV** (Austria), **CMI** (Czech Republic), **INRiM** (Italy), **JV** (Norway), **MIRS/SIQ** (Slovenia), **SP** (Sweden), **VSL** (The Netherlands)
- Why (wideband) transducers?
- Requirements for novel voltage dividers and current shunts
- Work done

Why (wideband) transducers?

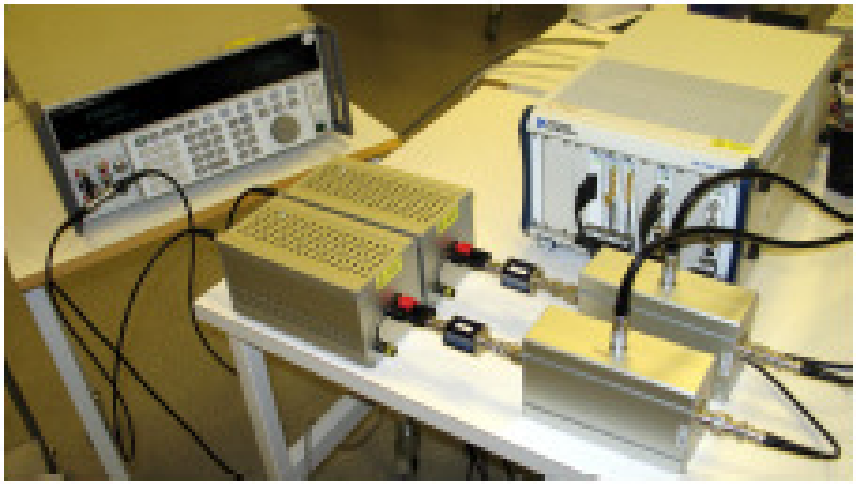
- The traceable measurement of electrical power and power quality signals should cover:
  - A broad range of voltages and currents
  - A broad frequency spectrum
  - Various waveforms, phase differences and discontinuities
- Digitizers/sampling measuring systems operate at limited moderate levels of voltage and current
- Transducers are necessary for scaling down the “raw” input signal to a level measurable by the measuring systems, with high precision

Specifications for the transducers

Deliverables	Ranges	Target specifications
3.1: Voltage dividers	10V @ 1 MHz to 1000 V @ 100 kHz	Voltage: 20 ppm, Phase: 200 µrad, @ 240 V and 100 kHz
3.2: Low current shunts	0.1A @ 1 MHz to 20 A @ 100 kHz	Current: 10 ppm, Phase: 100 µrad, @ 5 A and 100 kHz
3.3: High Current shunts	10A to 100 A @ 100 kHz	Current: 50 ppm, Phase: 500 µrad, @ 100 A and 100 kHz

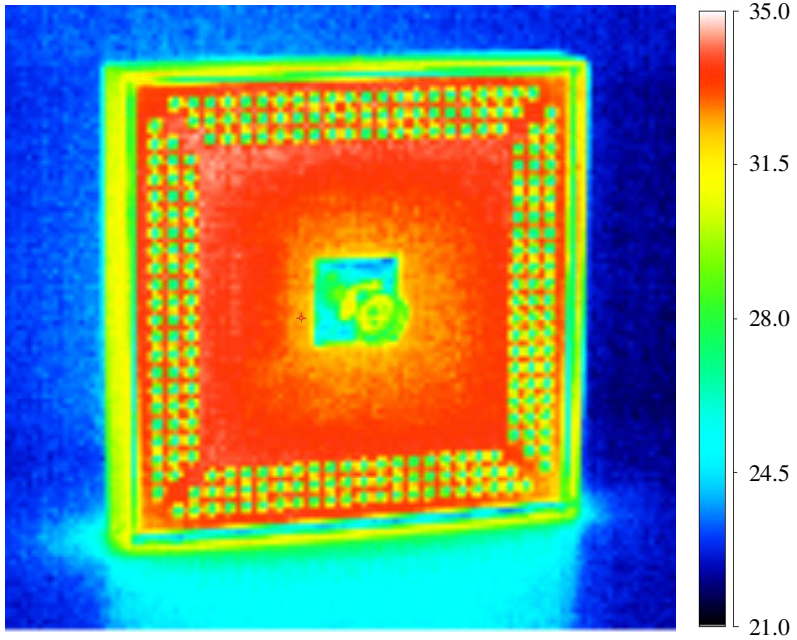
Tasks performed

- Creation of an overview of the state of the art of transducers
- Development of testing facilities for temperature coefficients, power coefficients, phase response etc.
- Tests of available transducers performed, also with focus on DC-parameters (temperature and power dependence), in addition to AC/DC and phase characterisation
- Modelling and design of new transducers
- Construction and testing of new transducers
- One more iteration: Modelling, design, construction
- Final tests, including in particular overlap of low-current and high current ranges (10 A to 20 A).



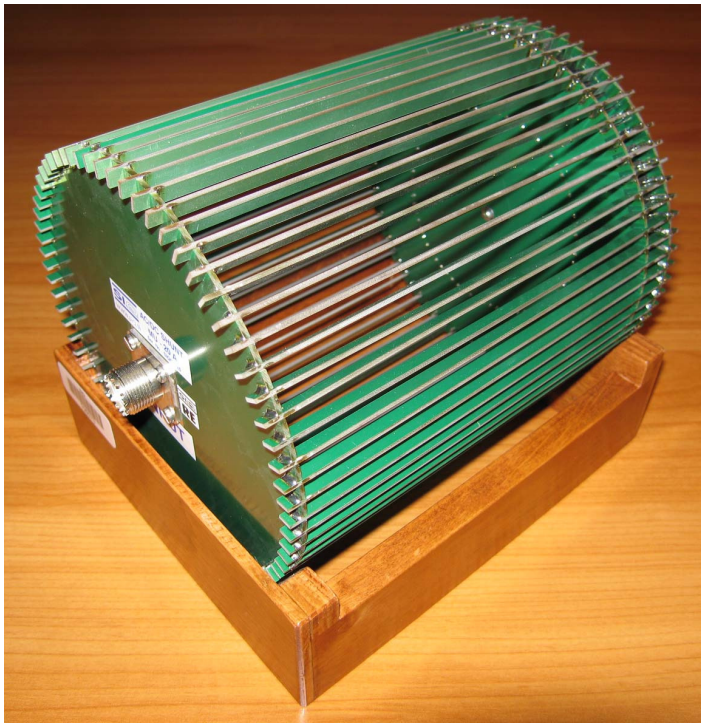
SP phase measuring system for voltage dividers

BEV current shunts

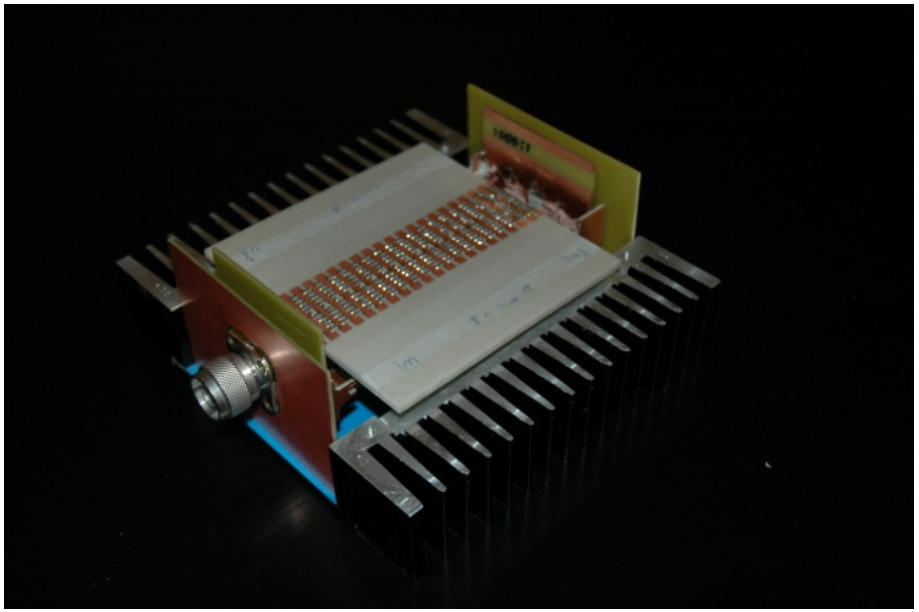


Nom.current [A]	Nom.power [W]	Actual value [Ω]	TCR [μΩ/Ω/°C]	Drift [μΩ/Ω/yr]	PCR [μΩ/Ω/W]
10	9	0.0896	1.8	5.8	2.7
5	4.5	0.1792	1.3	7.7	2.6
3	2.7	0.3072	1.3	8.3	3.6
1	0.9	0.9036	-7.9	-42	
0.3	0.27	3.031	3.3	7.7	
0.1	0.09	10.002	0.6	11	
0.03	0.027	41.672	-8.8	5.8	

VSL DC tests of original JV shunts



MIRS/SIQ current shunt



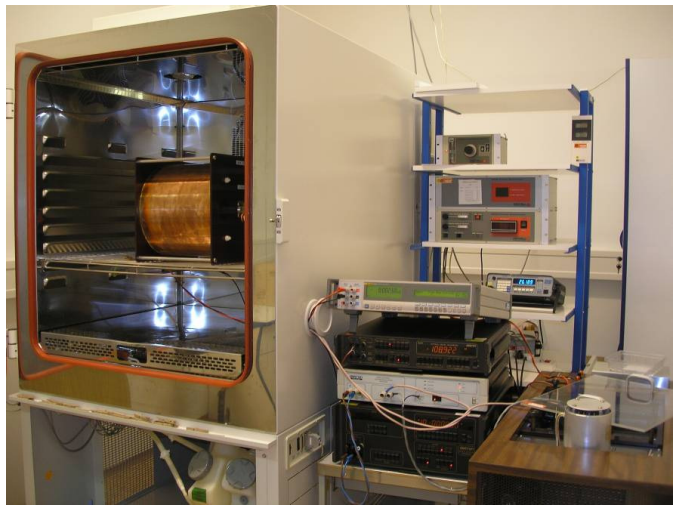
JV Voltage divider

DC CHARACTERISATION OF THE SHUNTS

- **Method: measurement of ratio of output voltages of the tested and the reference standard**
- PC measured **in current range of 50% - 100% of nominal current**
- TC measured **in temperature range from 18 °C up to 28(30) °C at 1/10 of nominal current**
- **More in poster presentation:**

  V. Novakova Zachovalova, M. Sira, J.Streit: "Measurement System for High Current Shunts DC Characterization at CMI"

- **Typical values for foil shunts:**
  PC < ± 4 ppm
  TC from -2.8 ppm to +8 ppm
- **Typical values for cage shunts:**
  PC < ± 4 ppm
  TC from -0.8 ppm to +4 ppm



Set up for TC measurement

Thank you