Development of measuring systems for precision transducer characterization

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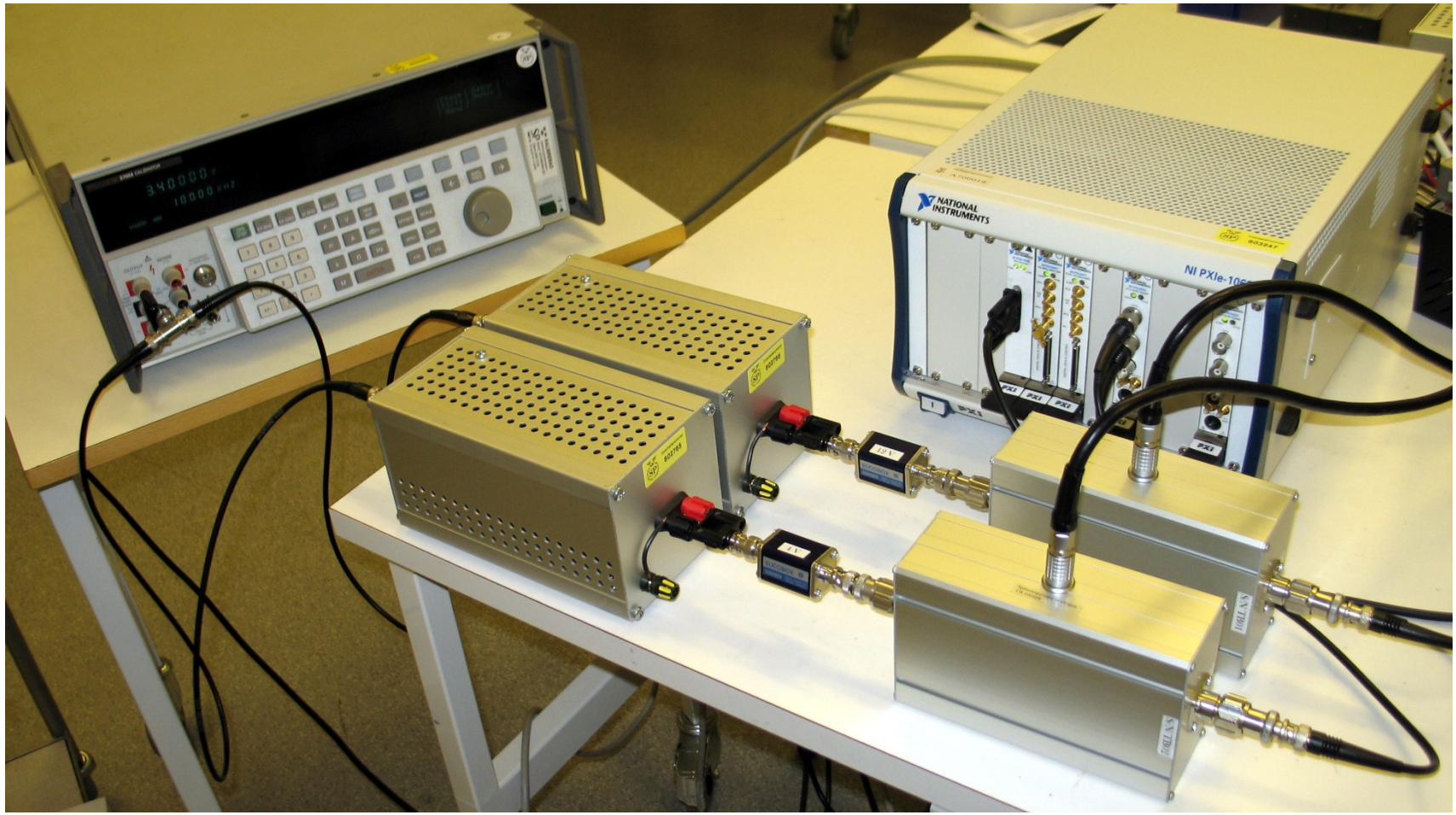
Objectives

- Establish traceability for electrical power measurements up to 1 MHz
  - Characterisation method for phase response of voltage dividers up to 1 MHz @ 20 V and 100 kHz @ 1 kV
  - Characterisation method for phase response of current shunts up to 1 MHz @ 1 A and 100 kHz @ 100 A

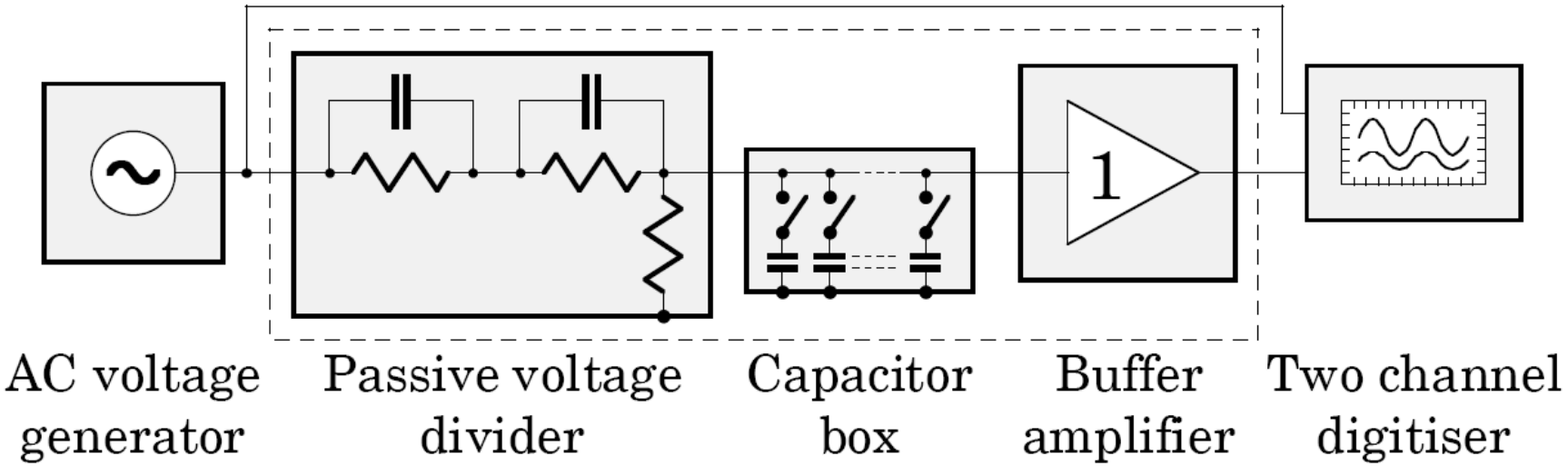
Measurement principle-voltage dividers

- Characterise frequency dependence of the amplitude ratio using thermal converter
- Measure a low ratio divider (e.g. 5:1) with divider input signal as reference signal, using a 2 channel digitiser
- Measure the next higher ratio divider with the previous divider in parallel as reference and continue up the chain.
- Characterise linear voltage dependence of the phase by measuring against a voltage independent divider (resistive divider with guard or gas capacitor divider)
- Characterise power dependence of the phase by warmup method

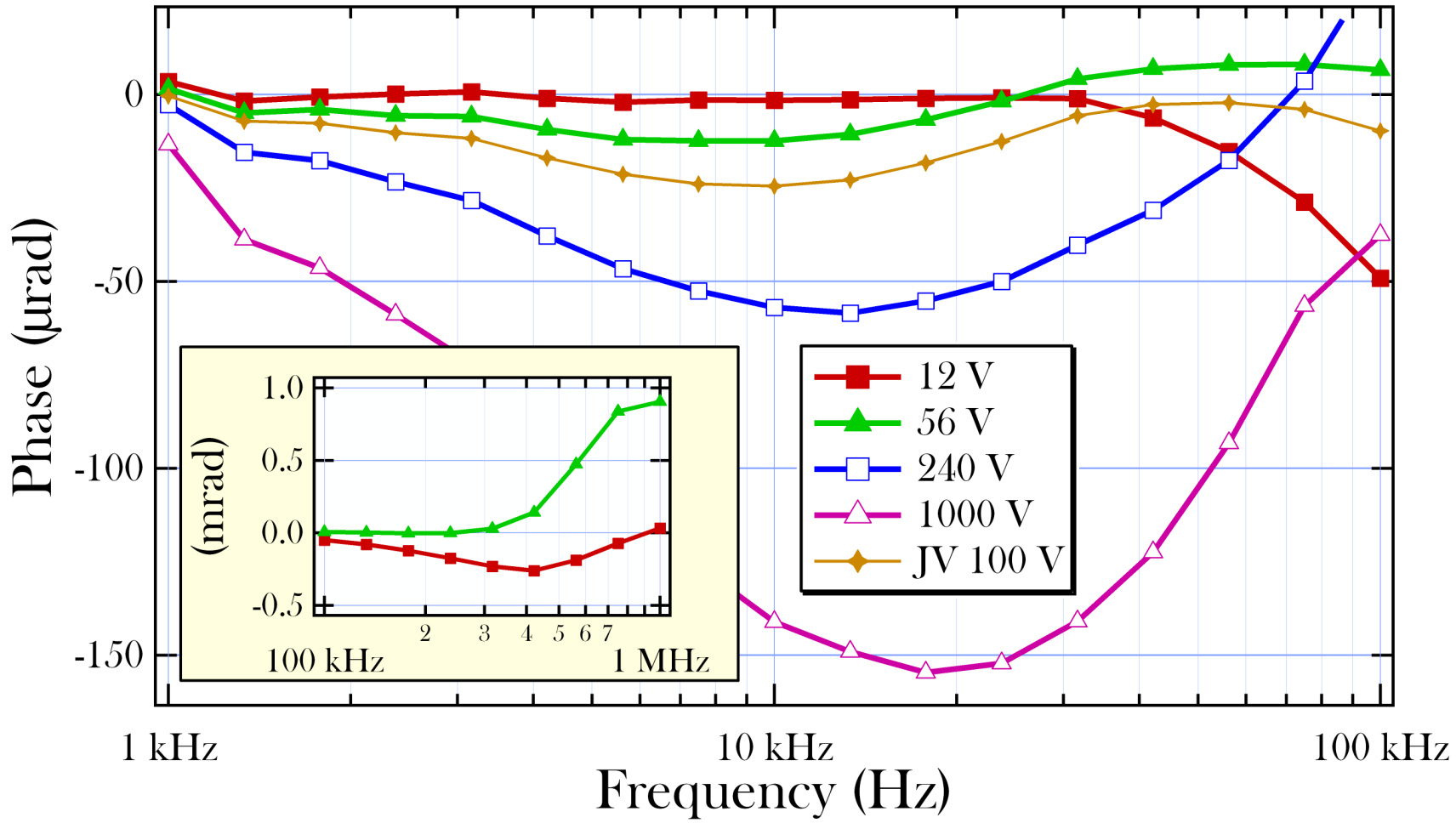
Voltage dividers setup



Voltage dividers setup



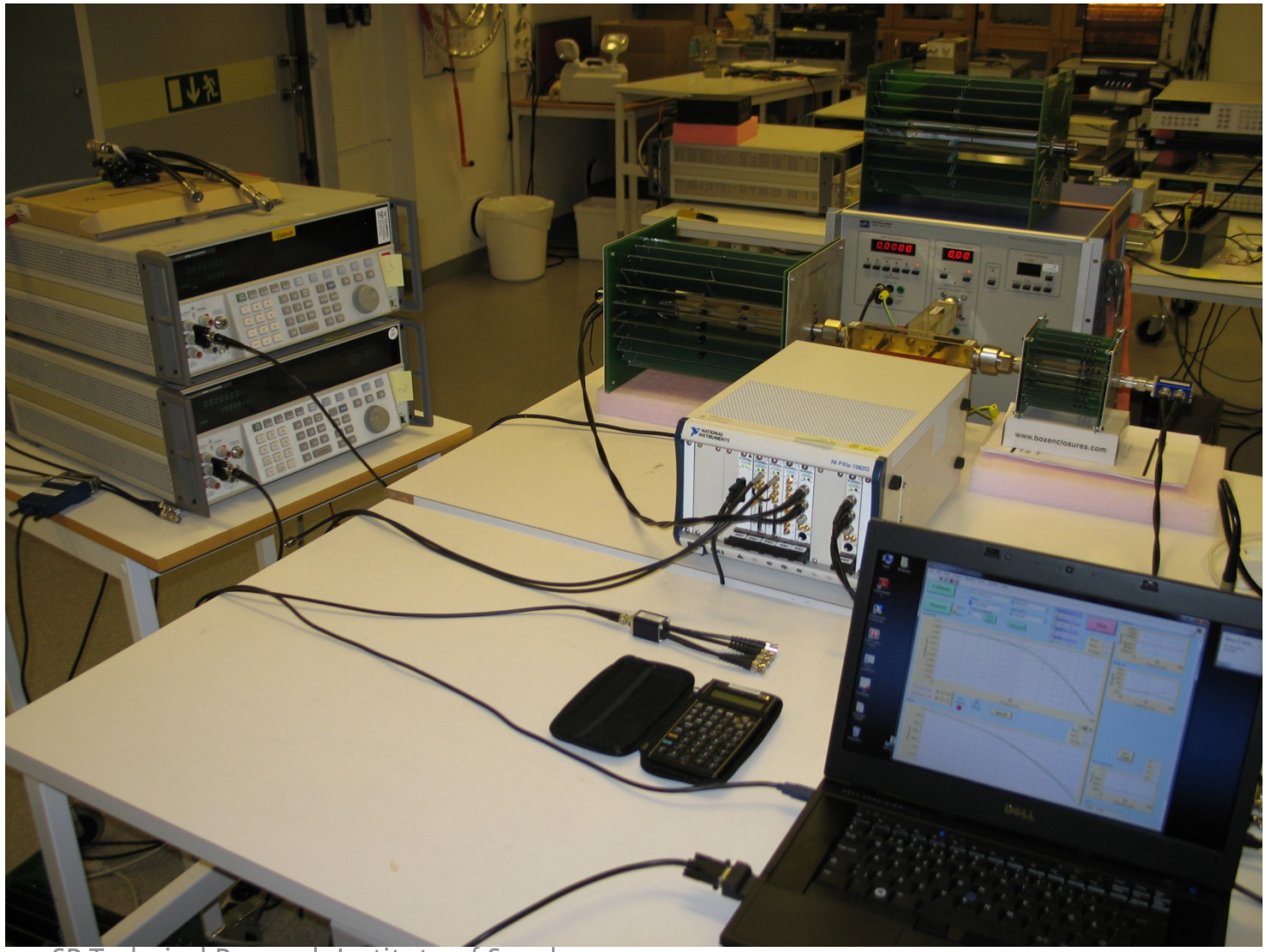
Results voltage dividers



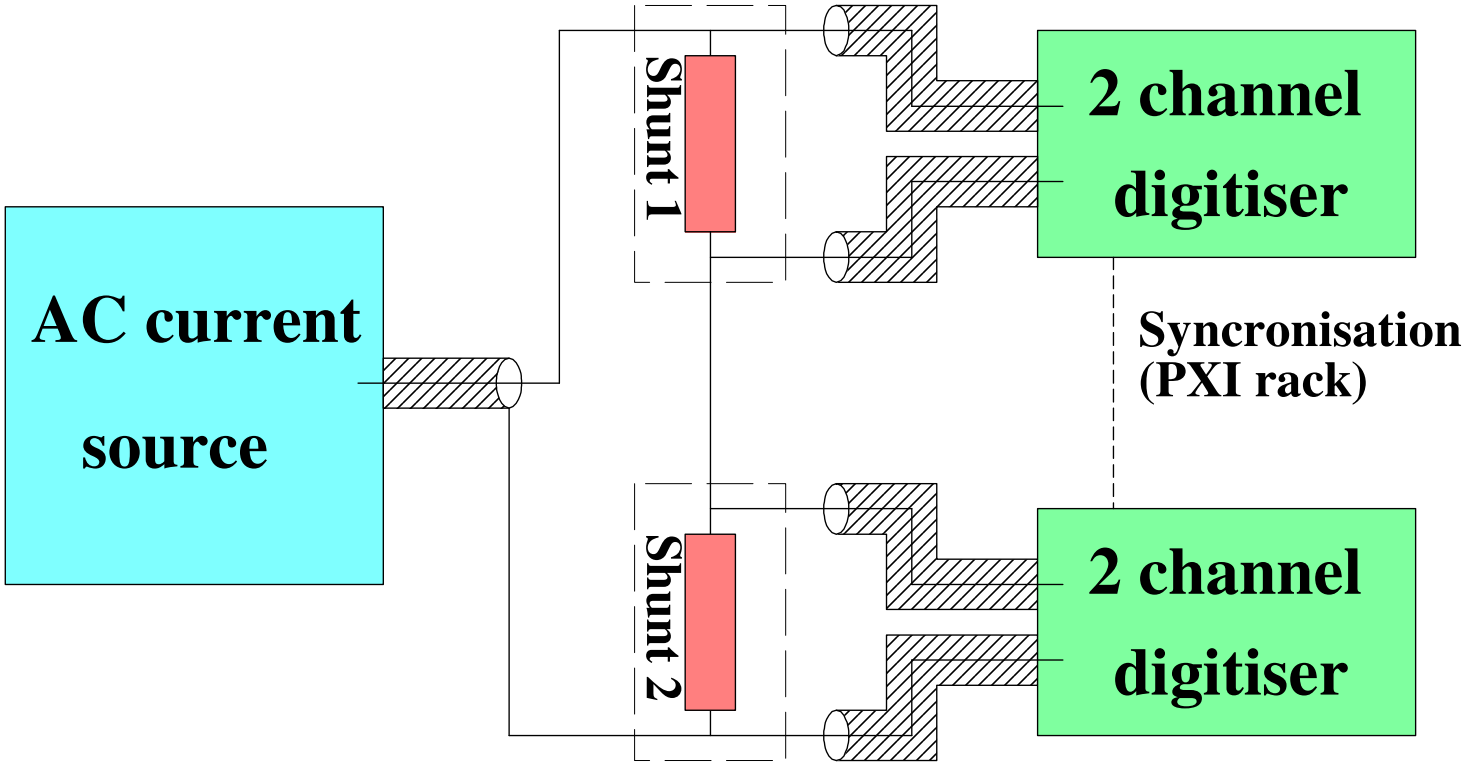
Current shunts – characterisation strategy

- Characterise frequency dependence of the amplitude ratio using thermal converter
- Establish traceability of inductance at the pH level, for details see todays poster session
- Measure inductance of shunts from 5 A, 160 mΩ to 100 A, 8 mΩ and calculate phase angle error
- Measure the phase angle error of shunts by performin a step-up using shunt ratio measurements with a 4 channel digitiser setup
- Compare the phase angle errors determined from inductance measurement and from shunt step-up.

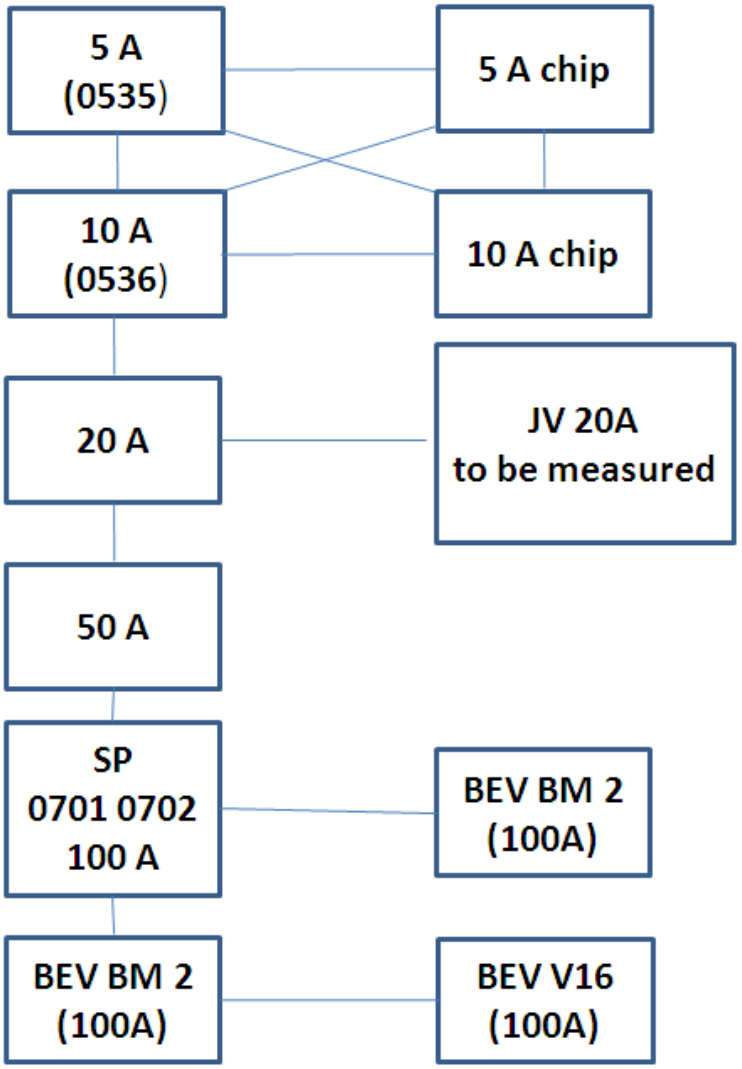
Current shunt phase measurement setup



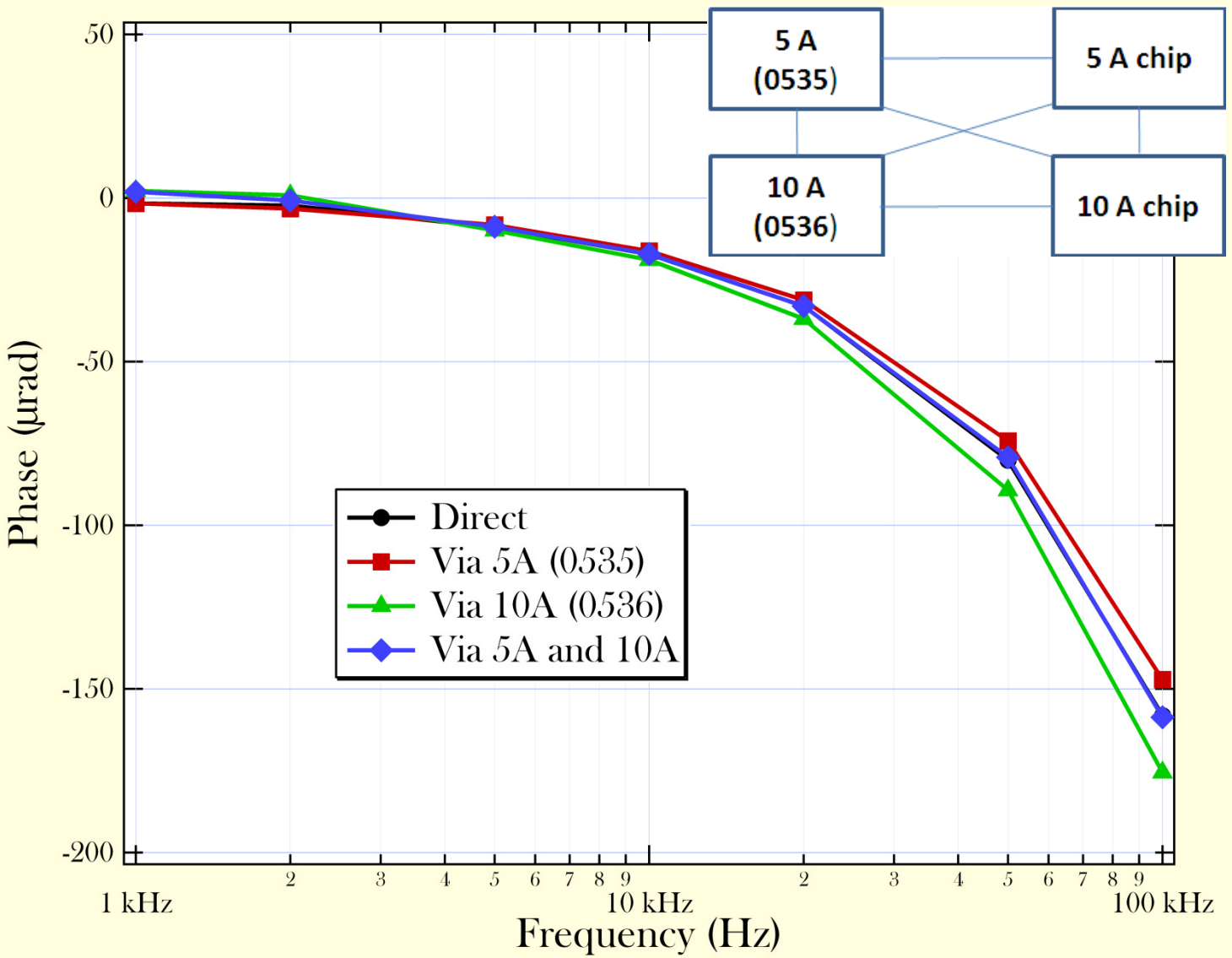
Current shunt ratio(phase) measurement setup



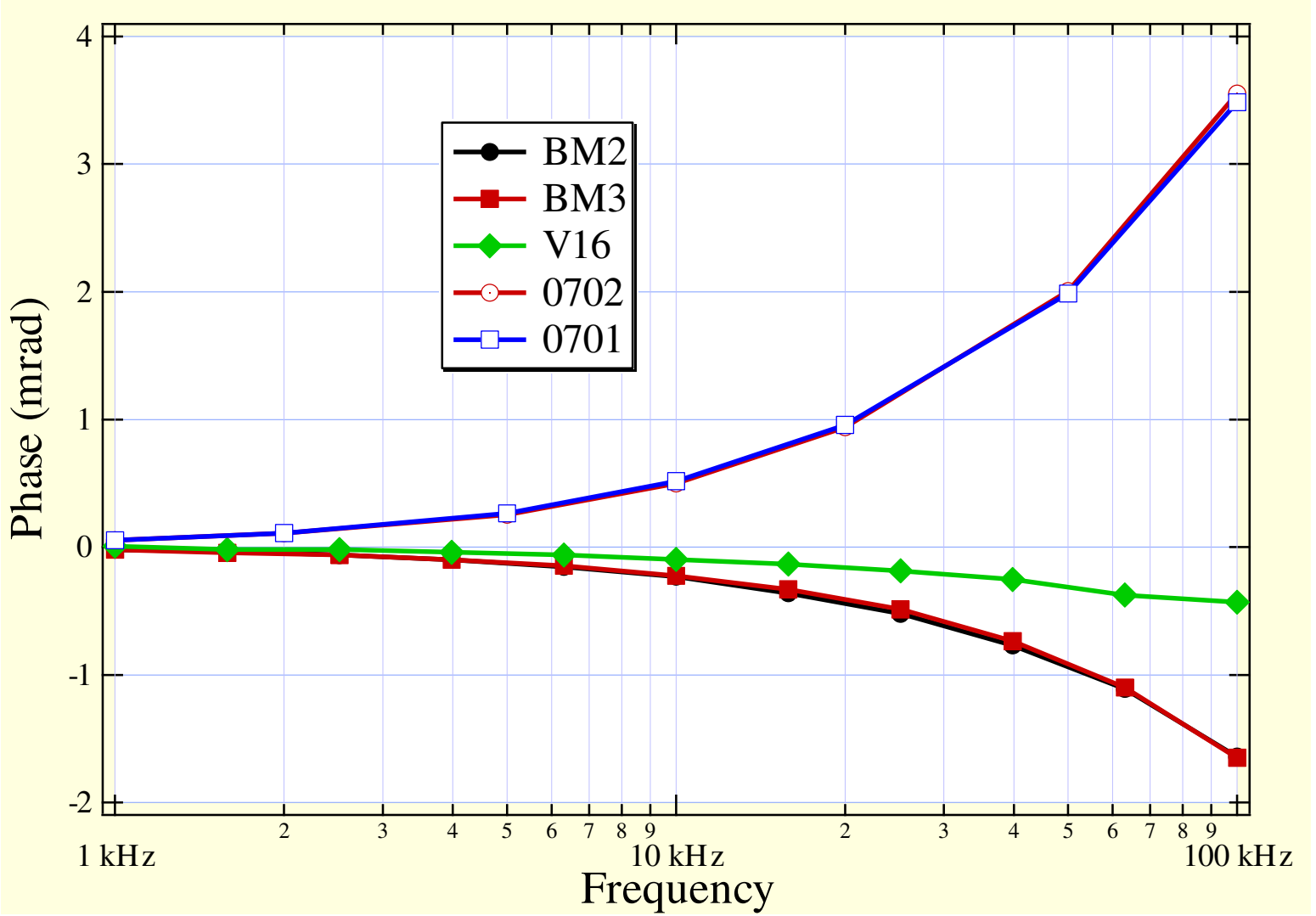
Step sequences for phase on shunts



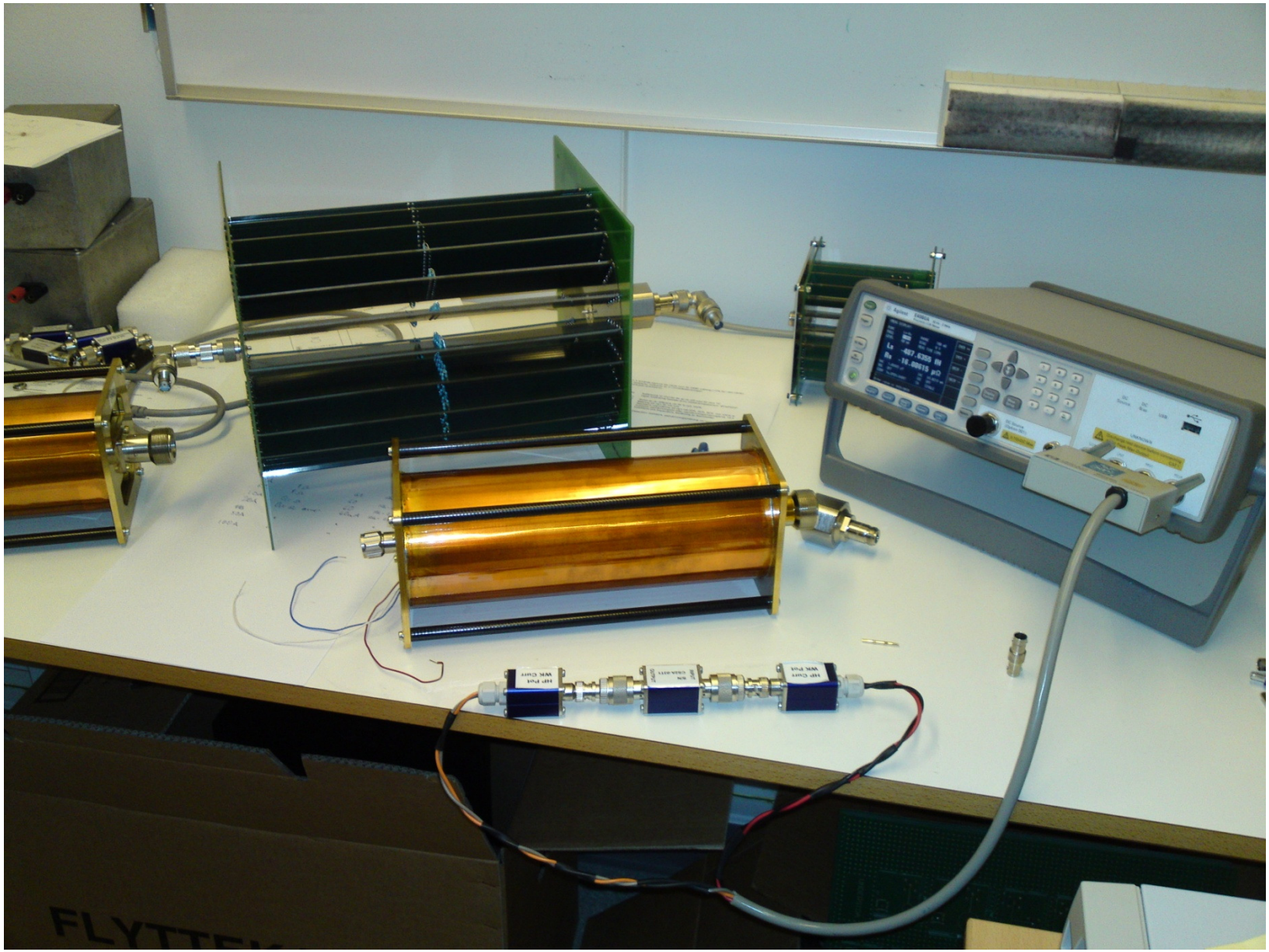
Step sequence 5-10 A



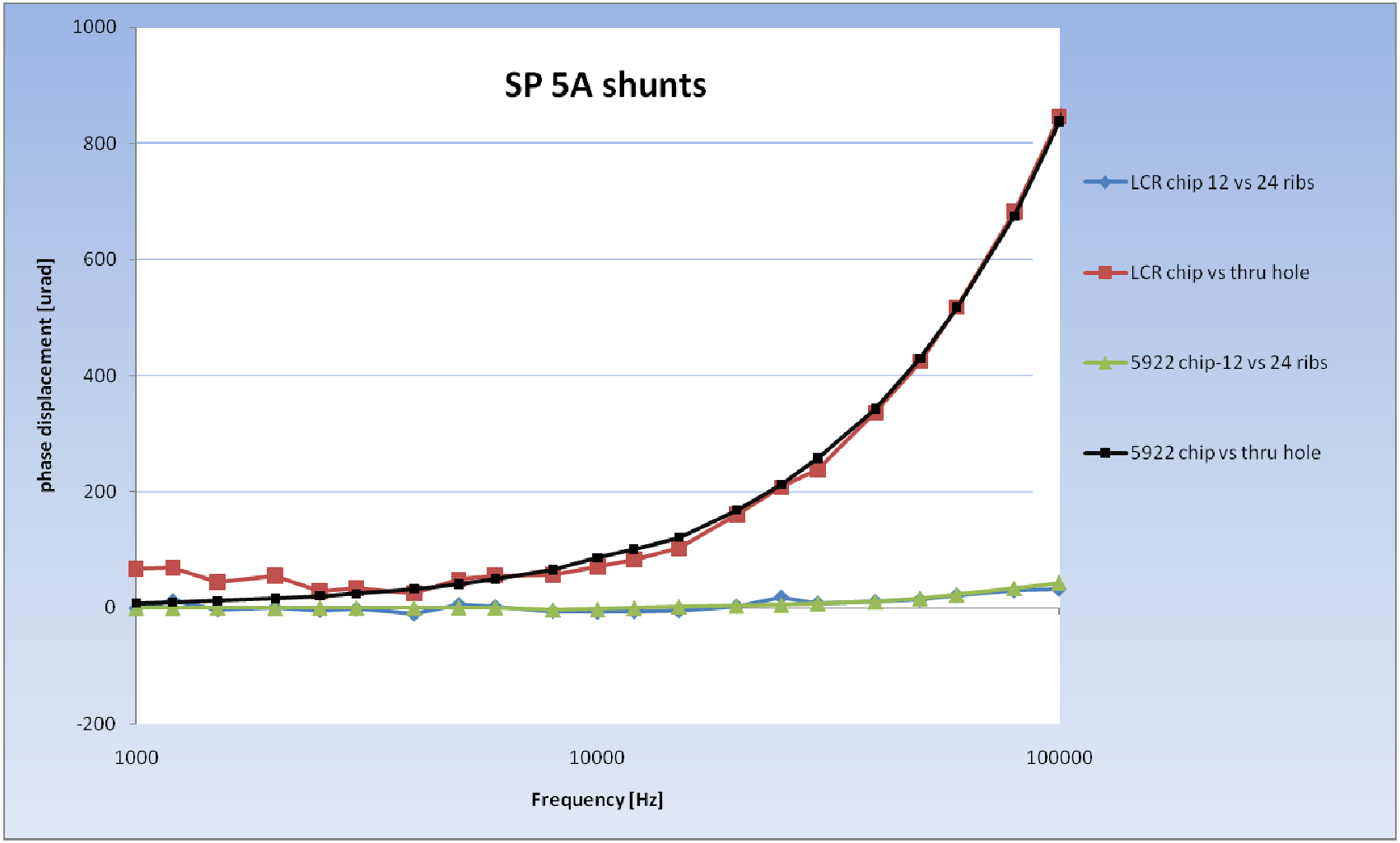
Phase results 100 A shunts



LCR measurements of inductance of shunts



Comparison LCR vs ”5922” phase measurements



To conclude

- We can verify phase displacement:

  -Voltage dividers 240V 100 kHz: 200 urad

  -Current shunts 5A 100 kHz: 100 urad (preliminary)

  -Current shunts 100A 100 kHz: 500 urad (preliminary)
  (comparison to INRIM's phase system is ongoing)