Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Future GRID

New calibration services for non-conventional sensors

E. Mohns, S. Fricke, E. Houtzager, B. Ayhan, H. Çaycı

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VSL

TÜBİTAK

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2. Calibration of digital non-conventional sensors
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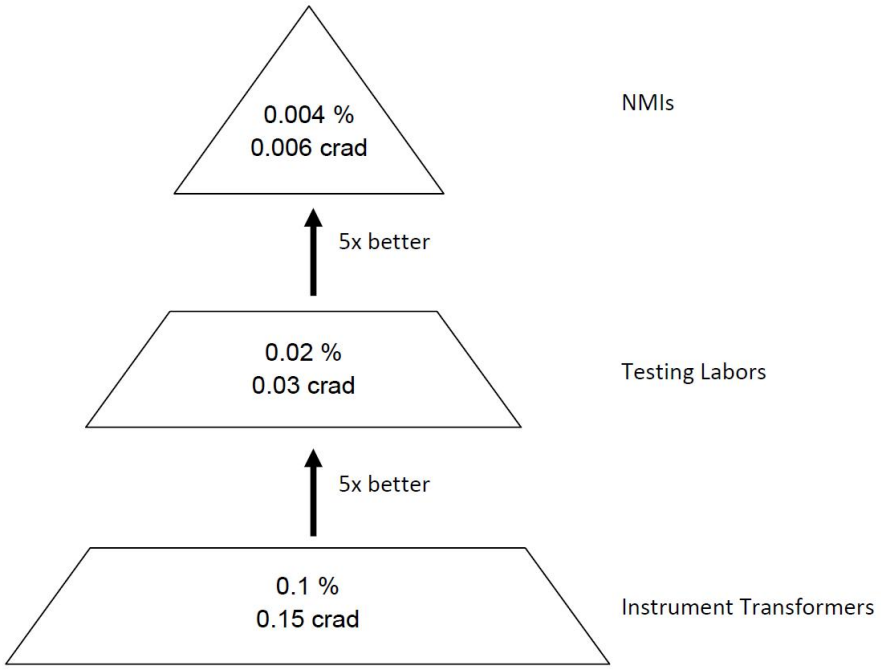
1. Calibration of analogue non-conventional sensors

requirements:

nominal output voltage of voltage- (EVT) and current-sensors (ECT) according to IEC 61869: 22.5 mV – 6.5 V



alternatives for calibrating:

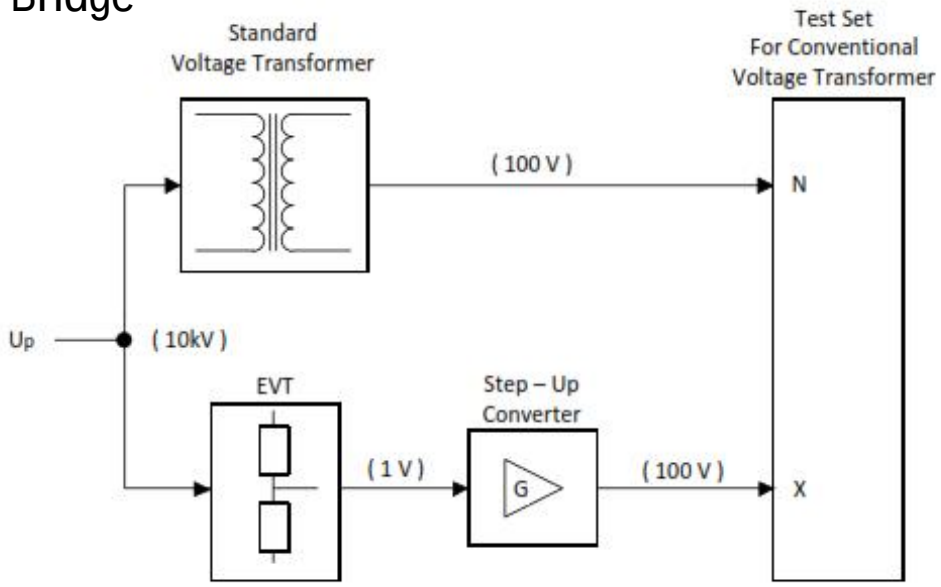
a) stepping-up the output of EVT/ECT and using conventional bridges
b) stepping-down the output of EVT/ECT and using a 2-channel sampling system
c) using of test sets for commercial non-conventional sensors

1. Calibration of analogue non-conventional sensors

a) step-up technique:

voltage sensors (EVT):

1. Amplification of EVT's small output voltage up to the voltage level of secondary of Reference Voltage Transformer (VT)
2. Compare the output voltage with the Ref VT's secondary via conventional Test Set or Bridge

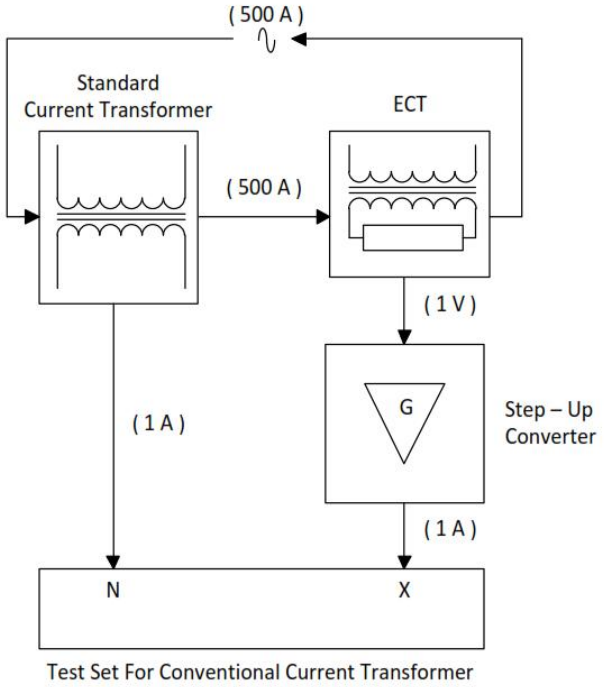


1. Calibration of analogue non-conventional sensors

a) step-up technique:

current sensors (ECT):

1. Amplification of ECT's small output voltage to a current with a transconductance amplifier
2. Compare the output current with the Ref CT's secondary via commercial Test Set or Bridge



1. Calibration of analogue non-conventional sensors

a) step-up technique:

Single Range Voltage Amplifier

Input = 1 V @ 50-60 Hz
Output = 100 V @ 50-60 Hz

Single Range Voltage-to-Current Amplifier

Input = 1 V @ 50 Hz
Output = 1 A @ 50 Hz

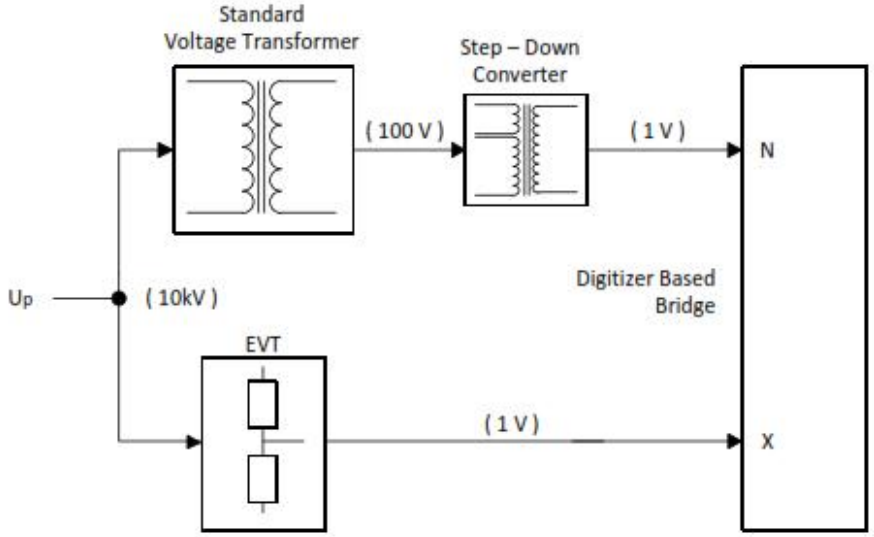
Accuracy: < 10 ppm / µrad at 100% of nominal voltage / current

1. Calibration of analogue non-conventional sensors

b) step-down technique:

voltage sensors (EVT):

1. Divide the secondary voltage of Ref VT down to the voltage level of EVT via an IVD, precise voltage transformer or a RVD
2. Compare the output voltage with the EVT's output voltage via a two-channel sampling system

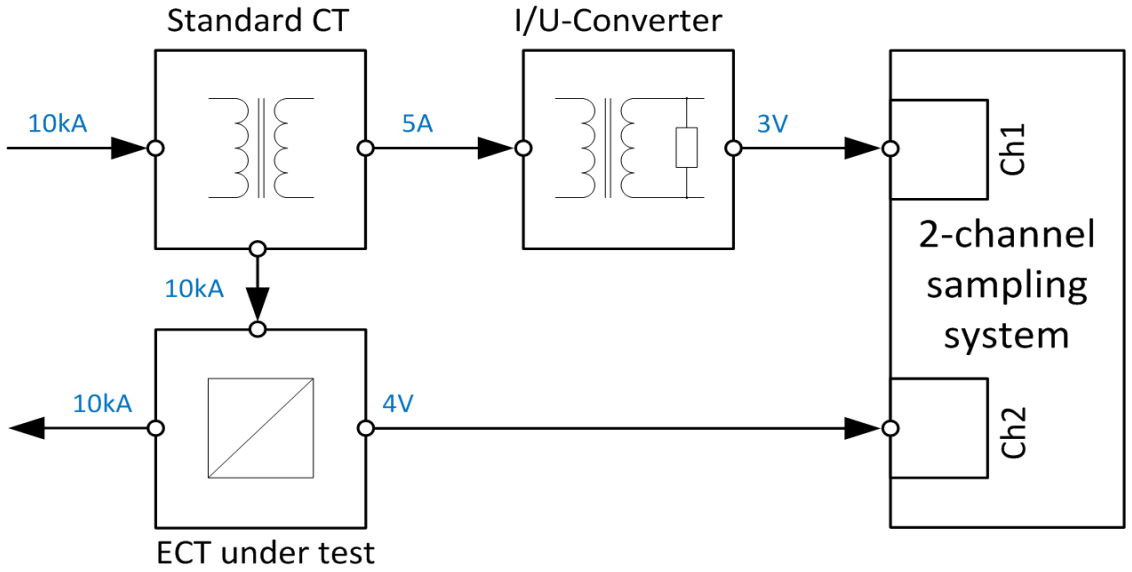


1. Calibration of analogue non-conventional sensors

b) step-down technique:

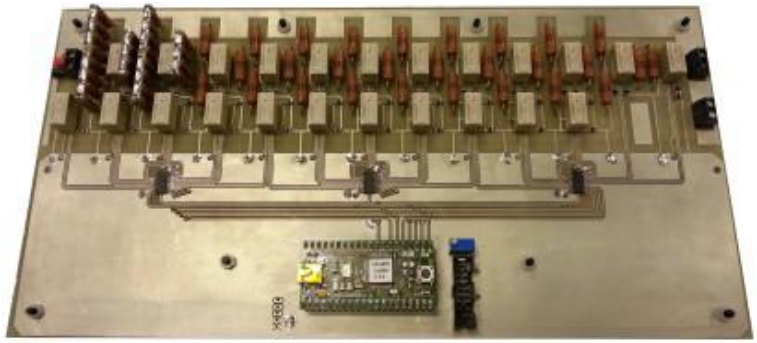
current sensors (ECT):

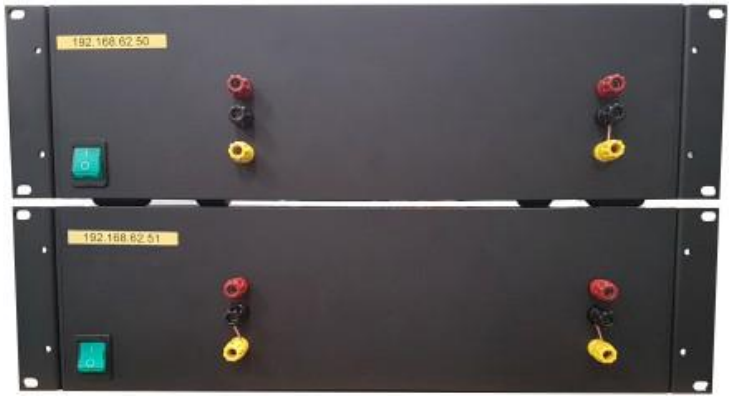
1. Convert the secondary current of Ref CT to the voltage level of ECT via a transformer coupled shunt or a shunt directly
2. Compare the output voltage with the ECT's output voltage via a two-channel sampling system



1. Calibration of analogue non-conventional sensors

b) step-down technique:





R2R-Divider

Input = 1 V – 1000 V
Output = 1 V

Binary divided enhanced core CT‘s

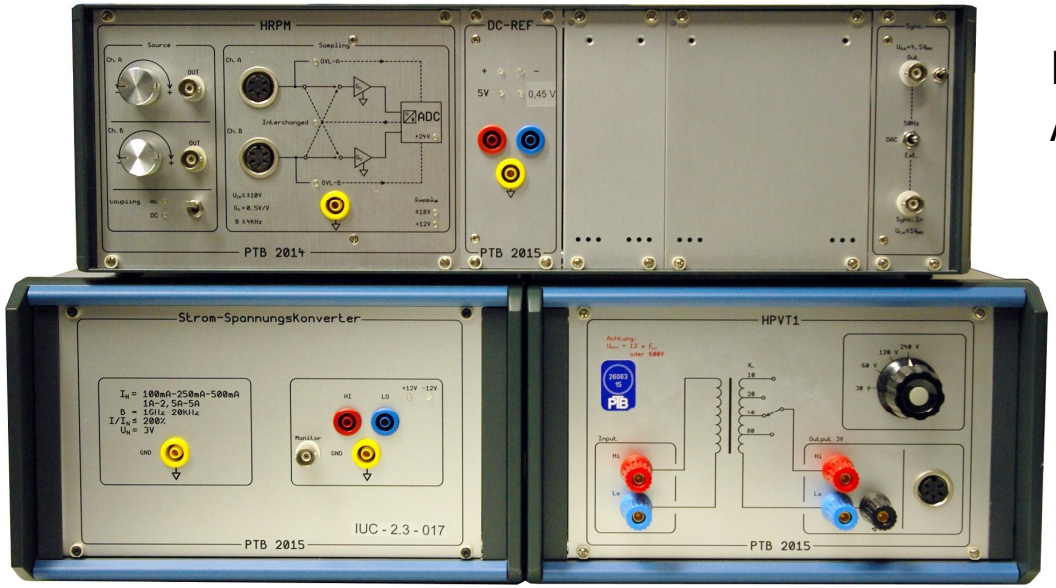
Input = 0 A – 5 A
Output = 10 mA
Accuracy: < 3 ppm / µrad

1. Calibration of analogue non-conventional sensors

b) step-down technique:

2-channel sampling system

Input = 1 V; 10 V
Accuracy: < 10 ppm / µrad



Current-to-Voltage-Converter

Input = 0.1 A – 5 A
Output = 3 V (nominal)

Two-Stage-Voltage-Transformer

Input = 30 V; 60 V; 120 V; 240 V
Output = 3 V (nominal)

Accuracy: < 10 ppm / µrad

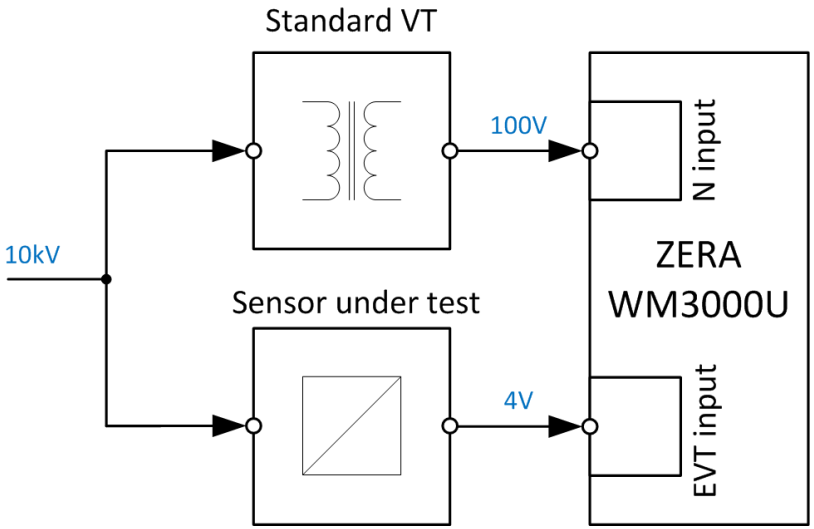
1. Calibration of analogue non-conventional sensors

c) commercial test set ZERA WM3000U / WM3000I:

consits of: two comercial test sets (voltage / current)

one standard transformer

PC system with readout and control software



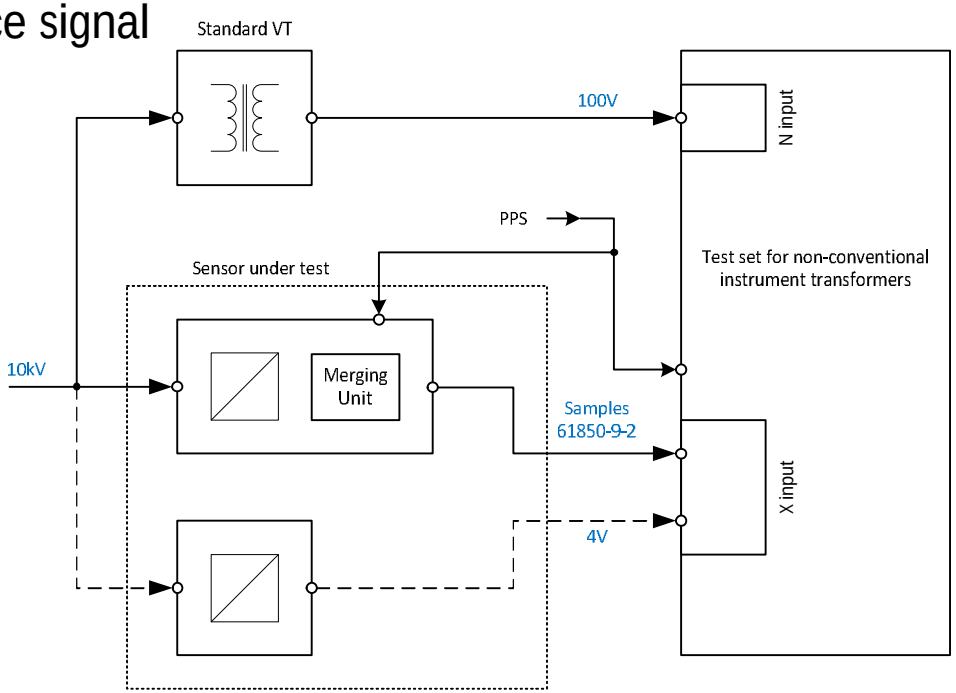
1. Calibration of analogue non-conventional sensors

summary

step-up	step-down	commercial test set
< 100 ppm / µrad	< 30 ppm / µrad	< 130 ppm / µrad
old hardware can be used	complex hardware setup	easy to use
for testing labours, if conventional bridge is available	for NMIs	for testing labours

2. Calibration of digital non-conventional sensors

- the calibration system consists of a commercial test set for digital instrument transformers and a standard transformer (ZERA WM3000)
- the accuracy of the X input can be checked with a SV-generator (Schniewindt)
- the phase accuracy depends on the PPS synchronisation of the digital sensor and the alignment to the analogue reference signal



3. Conclusion

analogue sensors:

- 3 calibration systems for analogue sensors were presented
- a change of PTBs CMC entries for calibrating analogue sensors was submitted

digital sensors:

- digital input can be checked for rms and absolute phase
- actual uncertainty of the phase of the “analogue” reference signal corresponds to 1 µs

➔ more research is needed for testing bridges for digital sensors

➔ further information in the next presentation (Marco Agustoni)

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Bundesallee 100
38116 Braunschweig

Enrico Mohns
Arbeitsgruppe 2.31 – Messwandler und Sensoren

Telefon: 0531 592-2310
E-Mail: enrico.mohns@ptb.de
www.ptb.de

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