

Introduction to EMPIR 15RPT04 TracePQM Project Outputs

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Overall goal:

To develop and validate a **modular** and well documented **metrology grade** system for sampled power and PQ parameter measurements, which can be easily established at all partner NMIs and other interested parties.

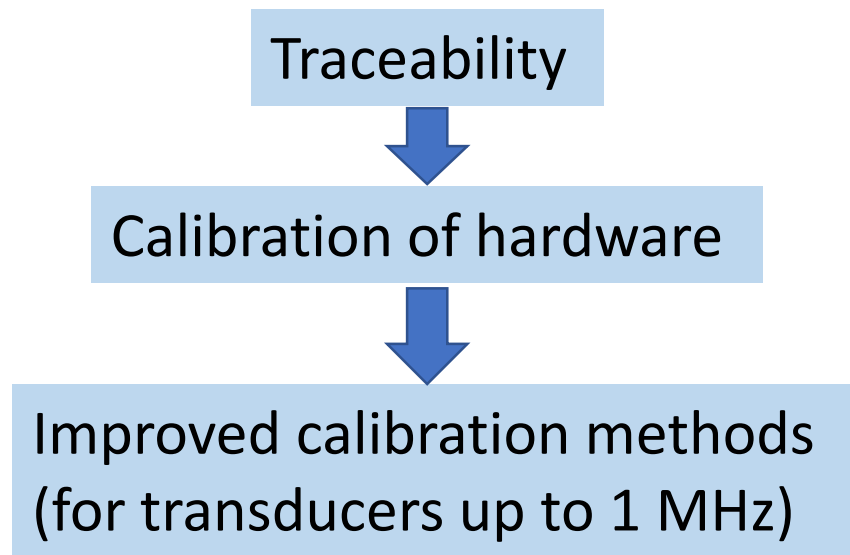
Particular objectives:

- ☐ To develop and validate a modular, metrology grade measurement setup.
- ☐ To develop and make available an open SW tool.
- ☐ To develop and make available a good practice guide.
- ☐ For each participant to develop an individual strategy for long-term operation of the developed research capacity.

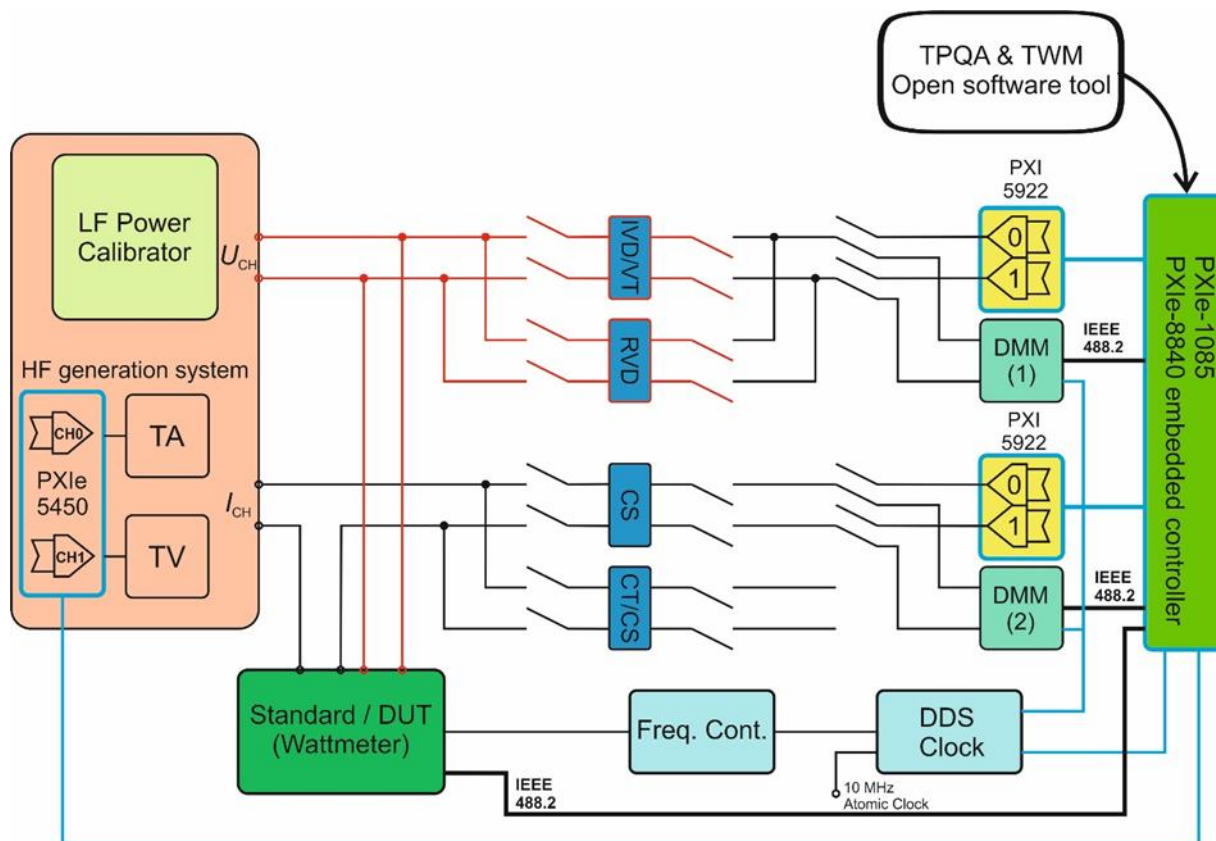
Summary of Project Outputs

- ☐ “Best-in-class” hardware design
- ☐ Calibration methods (transducers & digitizers)
- ☐ Sampling Tool (TWM, TPQA)
- ☐ Publications, Training, Impact
- ☐ Good Practice Guide

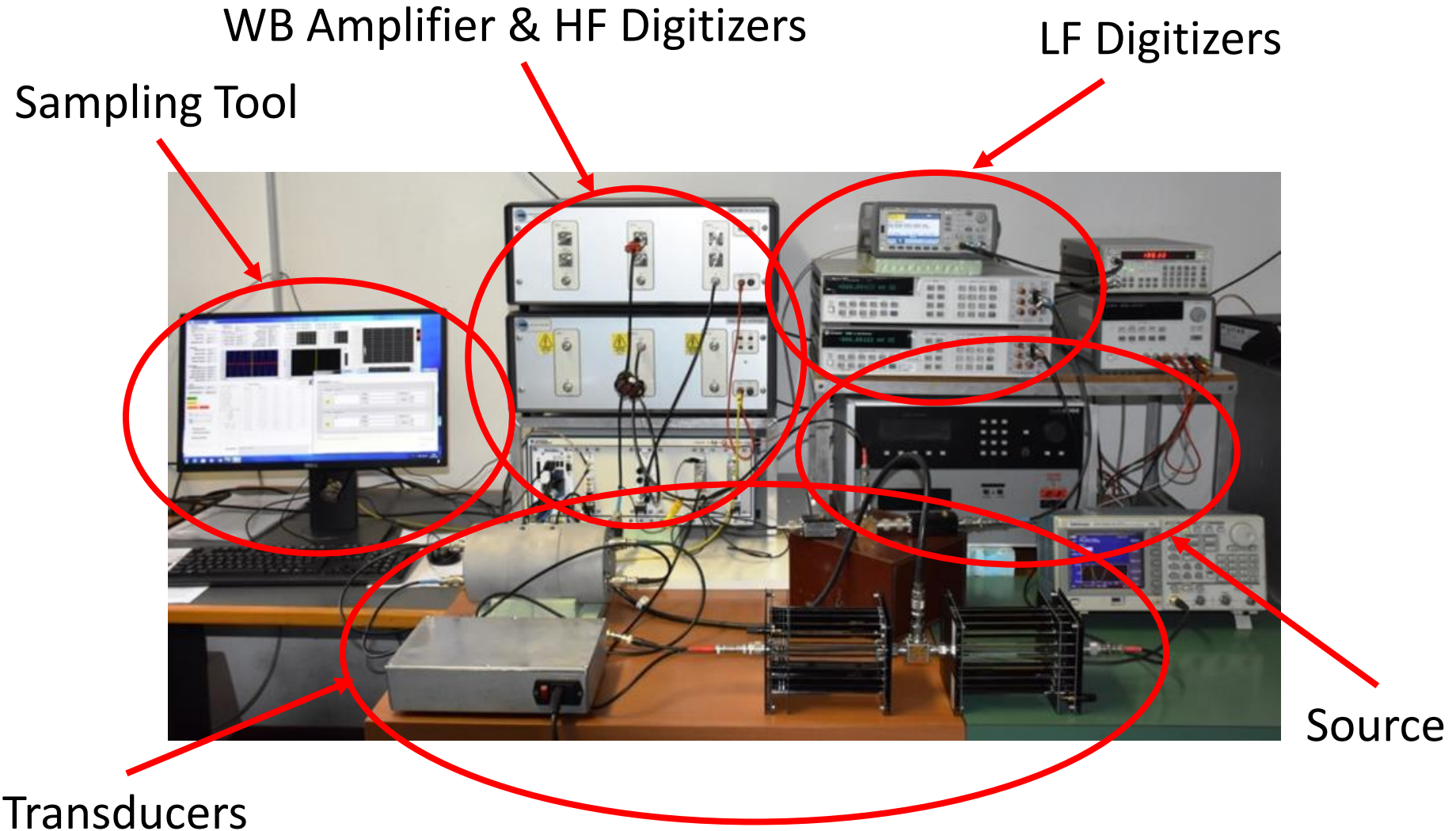
- ☐ Two macro-setups
- ☐ High accuracy – limited bandwidth
- ☐ Wide Bandwidth (1 MHz) – reduced accuracy

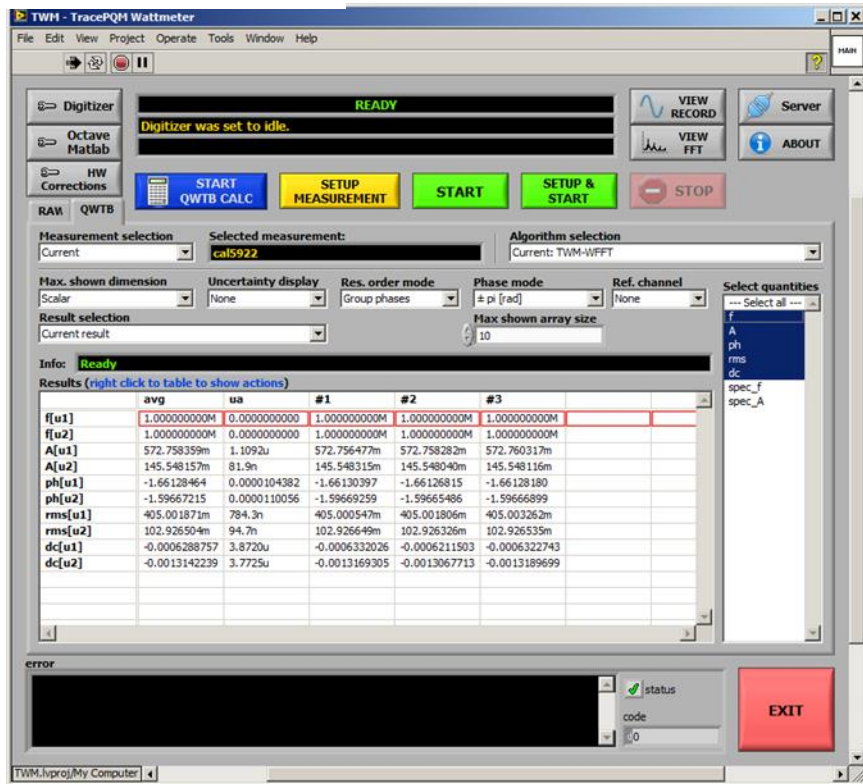


Design of Modular Measurement set-up

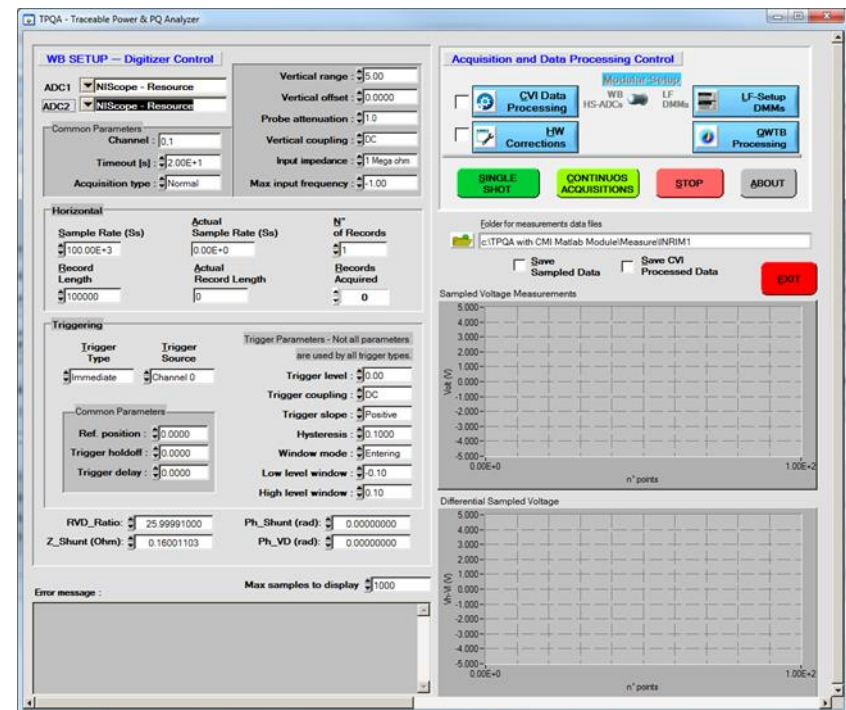


Implementation of measurement set-up at INRIM





TWM
Traceable **W**attmeter



TPQA
Traceable **P**ower & Power **Q**uality **A**nalyzer

Data Acquisition

Data Processing

PQ Parameters

Uncertainty Evaluation

- ☐ TWM-PSFE – Phase Sensitive Frequency Estimator
- ☐ TWM-FPNLSF – Four Parameter Non-linear Sine Fit
- ☐ TWM-MFSF – Multifrequency Sine Fit
- ☐ TWM-WRMS – RMS value by Windowed Time Domain Integration
- ☐ TWM-WFFT – Windowed FFT spectrum analysis
- ☐ TWM-THDWFFT – THD from Windowed FFT
- ☐ TWM-PWRTDI – Power by Time Domain Integration
- ☐ TWM-PWRFFT – Power by FFT
- ☐ TWM-Flicker – Flicker Algorithm
- ☐ TWM-MODTDPS – Modulation analyzer in Time Domain by quad. Phase Shifting
- ☐ TWM-HCRMS – Half Cycle RMS algorithm
- ☐ TWM-InDiSwell – Interruption, Dip, Swell event detector
- ☐ TWM-InpZ – Estimator of Digitizer Input Impedance

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Four-Terminal Pair Digital Sampling Impedance Bridge up to 1 MHz

Stanislav Mašlán¹, Martin Šíra, Tereza Skalická, and Tobias BergstenOPEN ACCESS
IOP Publishing

Measurement Science and Technology

Meas. Sci. Technol. 30 (2019) 035006 (10pp)

<https://doi.org/10.1088/1361-6501/aafb27>

Characterization of an analog-to-digital converter frequency response by a Josephson arbitrary waveform synthesizer

Javier Díaz de Aguilar¹, J R Salinas², Oliver Kieler³, Raúl Caballero¹, Ralf Behr³, Yolanda A Sanmamed¹ and Ángel Méndez⁴¹ Centro Español de Metrología, CEM, Madrid, Spain² Universidad de Málaga, UMA Málaga, Spain³ Physikalisch-Technische Bundesanstalt, PTB, Braunschweig, Germany⁴ E.T.S.I. Aeronáutica y del Espacio. Universidad Politécnica de Madrid, Madrid, Spain

IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 68, NO. 6, JUNE 2019

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Realization of Absolute Phase and AC Resistance of Current Shunts by Ratio Measurements

TracePQM Workshop, 27-28 May 2019, Brno
Tobias Bergsten¹ and Karl-Erik Rydler, *Member, IEEE*

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15RPT04 TracePQM

GUIDE FOR SAMPLING POWER AND POWER QUALITY MEASUREMENTS

Radoslava Hadzhistoykova¹⁾, Yolanda Álvarez Sanmamed²⁾, Javier Díaz de Aguilar²⁾, Stanislav Mašláň³⁾, Damir Ilić⁴⁾, Bruno Trinchera⁶⁾, Kristian Ellingsberg⁷⁾, Soureche Soccalingame⁸⁾, Aristo Philominraj⁸⁾, Andrei Pokatilov⁹⁾, Oliver Power¹⁰⁾, Marko Berginc¹¹⁾, Tobias Bergsten¹²⁾, Stefan Svensson¹²⁾, Hüseyin Çaycı¹³⁾, Özlem Yilmaz¹³⁾, Tansu Kefeli¹³⁾,

May 24, 2019



- ☐ 236 pages!!
- ☐ Description of modular set-ups
- ☐ Calibration methods
 - Current shunts
 - Voltage dividers
 - Digitizers
- ☐ Sampling Tool
 - Installation
 - Configuration
 - Operation
 - Algorithms

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