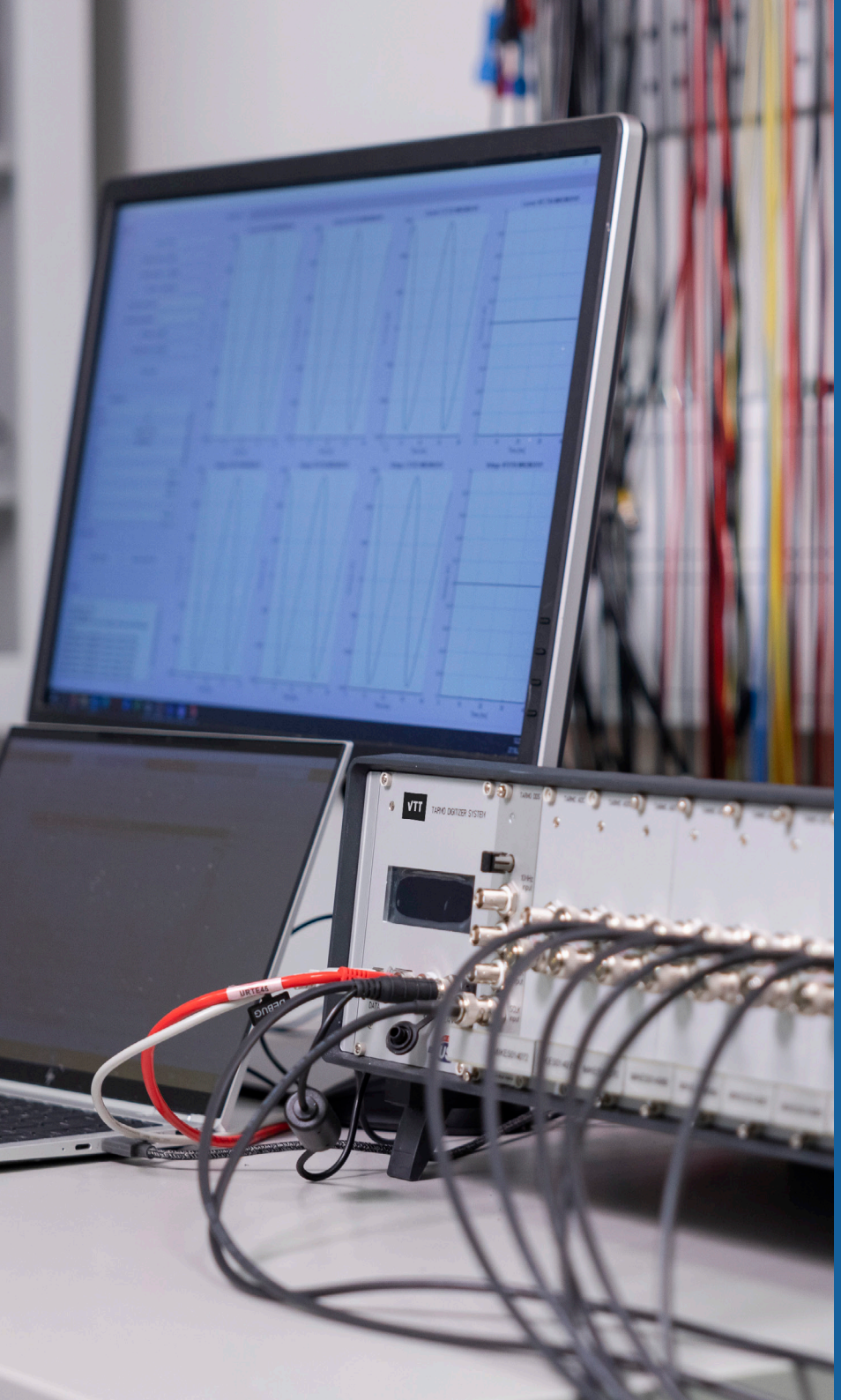


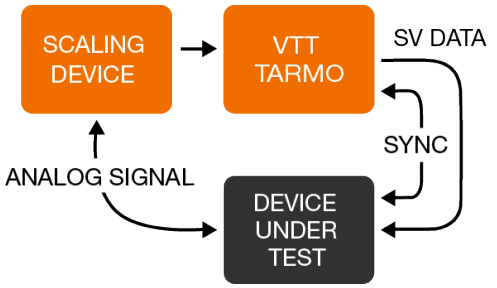
VTT Tarmo – Enabling NMI level traceability for IEC 61850 compliant measurement devices

IEC 61850 substation measurement technology in a nutshell

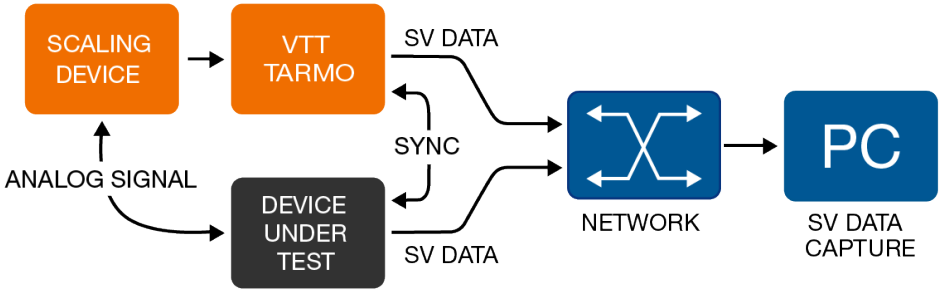
Digital substations in accordance with the IEC 61850 constitute a large paradigm shift in grid measurement technology. Most notably, the response of an instrument transformer is no longer determined as a ratio of input and output phasors of two analog signals. The output is now transmitted as a stream of digital data, better known as Sampled Values (SV) output, where the grid signal phase is referenced to a common time source and magnitude is encoded using common rules in the IEC 61850 and IEC 61869 family of standards.

Traceability for IEC 61850 devices using VTT Tarmo

The basis for establishing traceability for equipment with SV output or input is to generate a reference quality SV stream. This implies that both the magnitude and the phase of an input signal encoded into the stream have a known, SI traceable value. VTT's reference device has been designed from the ground up to provide this functionality with ease. Magnitude calibration is performed in a traditional manner, for example by comparing to an AC standard. Calibrating the phase encoded into the output stream requires the determination of the absolute delay of the analog input path. VTT has developed a simple and accurate method for delay calibration, which will be performed to all inputs prior to delivery. Guidance for doing the calibration will be provided. Expanded uncertainty of the calibration is well below 30 ns.



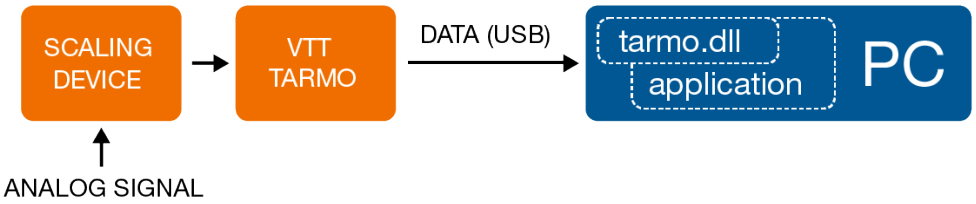
VTT Tarmo used as a reference device for calibrating measurement devices with Sampled Values input (e.g. digital transformer test bridges)



VTT Tarmo used as a reference device for calibrating measurement devices with Sampled Values output (e.g. merging units and digital instrument transformers)

The device provides more than just IEC 61850 support

While primarily intended as a reference device for the IEC 61850 environment, Tarmo can be used as a general digitizer, with accuracy surpassing most commercially available digitizers. The device constitutes of up to eight floating input channels, each with 18- or 24-bit SAR type analog-to-digital converters and linear, low-drift electronics. Two modes of operation are supported: a buffer mode and a stream mode. In buffer mode the device stores data in the internal 1M sample deep buffers for a later transfer to a host PC via USB 2.0. In stream mode the data is transferred to the PC continuously, leaving no gaps in the input signals. Sample clock can be provided from an external source, or the internal direct digital synthesis (DDS) based sample clock can be used.



VTT Tarmo used as a sampling AC measurement standard. A separate scaling device can be used for extending the input range.

Easy to integrate in your software environment

The device is controlled through a C-type library (.h and .dll files) for easy integration into Lab-view, C/C++, or Python among others. A python wrapper is included for further convenience. The library enables all functionality, including device control and data transfer between the device and a PC. Support for implementing the library will be provided by VTT.

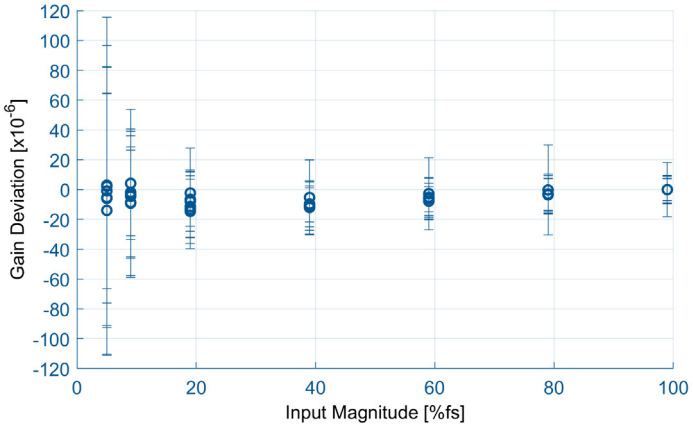
Technical specifications

VTT's Tarmo reference device is intended for various AC measurement applications. The design emphasises short- and long-term stability and linearity to reduce the impact a digitizer usually has in an uncertainty budget.

Parameter	Value
AC gain temperature coefficient	< 2 x10^{-6}/K
AC gain linearity[1]	within 20 x10^{-6}
Max sampling rate	100 kHz
Internal DDS sample clock resolution[2]	2.3 mHz

1 for input above 5% of full-scale value, see plot
2 using a 10-MHz reference clock

The reference device can output Sampled Values data in accordance with all profiles specified in IEC 61869-9. This includes data streams used for protection, metering, and power quality measurement applications.



Measured AC gain linearity of six representative input channels

VTT

VTT is a visionary research, development and innovation partner for companies and the society, and one of the leading technical research organisations in Europe. We have over 80 years of experience in cutting-edge research and science-based results. Our more than 2,000 professionals work to develop systemic and technological solutions that can bring about fundamental transformation. We promise to always think beyond the obvious.

VTT MIKES is a metrology facility for SI unit realisations, high-accuracy measurements, measurement innovations and calibration technologies. It provides high-end measurement innovations, capabilities and tools for demonstrating quality of measurements, and worldwide recognised measurements and calibrations.

Get in touch with us:

Tapio Lehtonen
Research Scientist
+358 50 511 0037
tapio.lehtonen@vtt.fi

Kaj Nummila
Solution Sales Lead
+358 40 758 7461
kaj.nummila@vtt.fi

VTT MIKES
Tekniikantie 1, FI-02150 Espoo
Finland

www.vttresearch.com

beyond the obvious