VNA Tools training course

Subject	VNA Tools workshop
Document version	v.01
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Organisation	METAS
Date	3 day VNA Tools training course (09:00 – 17:00) plus a 1 day VNA expert seminar (optional free event)
Location	METAS, Switzerland

Agenda

VNA Tools – theory parts

- Introduction (Project, Motivation, License)
- VNA Tools concept – the multistep measurement process
- VNA Tools uncertainty calculation overview (the core library: Metas.UncLib)
- VNA Tools measurement model, error terms and uncertainty calculation
- VNA Tools demonstration
- VNA Tools data formats
- VNA Tools optimization calibration

VNA Tools – practical parts

- Installation, data taking with a real VNA, Measurement Journal
- Calibration (available methods, error term calculations and analysis)
- Error correction
- Visualization, data analysis, data export and evaluation of the uncertainty budget
- Working with the available Tool functionalities including data post-processing with uncertainties.
- Good measurement practice (custom cables, statistical experiments, measurement set-up, …)
- VNA Tools Database (definitions and management)
- Evaluation of the VNA box (noise, drift, linearity, raw performance, measurement wizard)
- New cal kit standard definitions (systematic connector effects and the near field coupling issue)
- Future developments, Questions & Answers, Feedback

Additional VNA metrology topics (if time and interest)

- The new S-parameter traceability chain developed at METAS
- Best measurement practice hints used during a primary experiment
- The Electronic calibration Unit (ECU): temperature effects and characterisation
- The virtual VNA implemented in VNA Tools
- Is there still any need for beadless airlines in a calibration lab?
- And many more

IMPORTANT: Please do not forget to bring your own laptops with you.
Minimal system requirements: Windows 7 or Windows 10, at least 512 MB (better 1024 MB) of RAM

1 day: (Introduction, theory, installation, demo, VNA hands-on)
- Introduction
- VNA Tools overview
- Uncertainty calculation according GUM
- Metas.UncLib (the generic uncertainty calculator, concept and demo, www.metas.ch/unclib)
- Implemented VNA measurement model
- Software Installation
- 1-port and 2-port VNA error models
- VNA Tools demo (general software overview)
- Data taking and the Measurement Journal
- Hands-on example with a real VNA (to demonstrate the VNA Tools measurement process)

2 day: (using the software, S-parameter traceability)
- 2-port error model (switched versus generic model)
- Supported calibration concepts
- 2.4 mm example with measurement data collected at METAS:
-- SOLT_01 example (generic cal standard definitions from the cal kit manufacturer)
-- UThru_01 example (generic cal standard definitions from the cal kit manufacturer)
-- QSOLT_01 example (generic cal standard definitions from the cal kit manufacturer)
- Presentation about the systematic connector effects (based on the new research collaboration outcomes with Keysight, Huber+Suhner and METAS)
-- SOLT_02 example (data base standard definitions; including the systematic connector effects)
-- UThru_02 example (data base standard definitions; including the systematic connector effects)
-- QSOLT_02 example (data base standard definitions; including the systematic connector effects)
- Discussions on how to improve the measurement set-up (goal: to reduce uncertainties)
-- SOLT_03 example (data base standard definitions and better set-up)
-- UThru_03 example (data base standard definitions and better set-up)
-- QSOLT_03 example (data base standard definitions and better set-up)
- Optimization calibration (theory and example)

3 day: (additional topics - just a few typical examples)
- Data formats supported by VNA Tools
- VNA Tools data base (VNA device, cable, connector, calibration standard, CMC entry, data logger)
- How to evaluate the entries needed by the data base (new measurement wizard to determine noise effects)
- Post processing of the data including the uncertainties
- Add measurement series (DUT, sliding load, ECU, step attenuators, VNA drift, VNA settings)
- Measurement uncertainty capabilities and scope: CMC Entry calculations and CMC checker
- The VNA Tools Real Time Interface (RTI)
- Verification methods according the new VNA EURAMET guide cg-12
- Additional verification concepts supported by VNA Tools
- Scripting functionality (automatization of measurements, calculations and data analysis)
- Interfacing with Matlab or other software
- How to deal with an instable DUT (Type-A analysis: statistical data analysis using VNA Tools)
- Custom cable or custom connector definitions
- Unc analysis (how to improve your system; where are the weakest links?)
- Driver development (VNA, step attenuator, switch box, ECU)
- Splitter characterizations (Juroshek method, 2-port method, 3-port method)
- Good measurement practice (hints and tips)
- Time Domain Analysis with uncertainties
- Wave parameter measurements implemented in VNA Tools

If time and interest:
- How VNA Tools can be used in the modeling process of airlines, offset shorts and flush shorts The ‘PrimaryOffsetShortStandard’ and ‘PrimaryLineStandard’
- VNA Tools – software validation and verification
- Adapter characterization up to 1.0 mm (ANAMET presentation plus movie from the setup)
- On wafer measurement uncertainty calculations using VNA Tools
- …

Note: We do offer lab visits and time for individual discussions after each training day.