Physikalisch-Technische Bundesanstalt
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National Metrology Institute

Good Practice Guide for the recalibration of ECUs

Sixth European ANAMET Seminar and Workshop

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Outline

- Introduction
- Recalibration guideline
- Conclusion

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Introduction

Task: Stability in electronic calibration units (METAS, NPL, PTB, SP)

1. Common methodology developed for stability and temperature sensitivity tests
2. Workshop to disseminate stability study methodology to interested collaborators
3. First data set on ECU stability on timescales of minutes and hours collected
4. First data set on ECU stability on timescales of months and years collected
5. Final data set on ECU stability on timescales of minutes and hours collected
6. Paper on ECU stability on timescales of minutes and hours
7. Second data set on ECU stability on timescales of months and years collected
8. Final data set on ECU stability on timescales of months and years collected
9. Report on the stability of and temperature effects on ECUs
10. Good Practice Guide for the recalibration of ECUs

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Recalibration guideline

Investigations (e.g. D2.3.9) have clearly revealed:

- ECUs show, dependent on manufacturer and model, different behavior.
- Recommendation for recalibration cannot be generalized for all kinds of ECU.
- First step: determine the important characteristics of an ECU.
- Second step: define the recalibration.

Always: Follow the instruction of the ECU manufacturer (e.g. heat up time)

Recalibration guideline

Thermal stability:

- ECUs usually utilize semiconductor components.
- Semiconductors are highly sensitive to heat changes.
- ECU circuits are thermally stabilized (e.g. active heating).

Testing or calibration laboratories:

- Fixed environmental conditions (e.g. 23°C).
- Heat may flows from the ECU towards the reference plane.
- Reduction of heat influence with adapters may be possible.

Recalibration guideline

Determine the temperature influence (test procedures from D2.3.1):

- **Test TS1a** investigates the change of VNA error terms after connecting the ECU to the VNA test port cable until the thermal equilibrium is reached
- **Test TS2** investigates the change of DUT S-parameters immediately after completing a VNA calibration using an ECU.

Outcome may be classified into two cases:

- Temperature influence on the measurement results can be neglected (much smaller than measurement uncertainty).
- Temperature influence on the measurement results can not be neglected (similar scale as or larger than measurement uncertainty).

Recalibration guideline

Long-term stability - Investigations (D2.3.9) have revealed:

- An ECU can be stable on timescales of month and years.
- Even if the majority of ECU states is stable on timescales of month and years, one or more states of the same unit may show instable behavior.

Individual ECU properties:

- Measuring of all ECU states on a monthly basis for a 6-12 month period.
- Stable behavior: recalibration interval of **12 month**
- Instable behavior: recalibration interval of less 12 month
  (increase of measurement uncertainty)

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Conclusion

- ECUs have been investigated in HFCircuits

- Main results are summarized here:

1. Common methodology for stability and temperature sensitivity tests of ECU
9. Report on the stability of and temperature effects on ECUs
10. Good Practice Guide for the recalibration of ECUs

- ECU for VNA measurements in testing or calibration laboratories
- Investigation of the individual unit is generally required.
- Manufacturer support is desirable to provide thermal and long-term stability data and recommend recalibration intervals.

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