Stability of R&S ZVA24 in the Lab

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Loads considered:
- open port
- attenuator
- 50 ohm termination

Settings of the VNA:
- SOL calibration using Maury 8050B kit
- Power level: 0 dBm
- Frequency range: 50 - 200 MHz
- Frequency resolution: 1.5 MHz
- Measurement bandwidth: 100 Hz
- Trace averaging: 10 times
- Number of traces: 1180
- Trace recording period: 1 per minute
- Room temperature: ~ 23 C
OPEN PORT
Temperature of VNA Exhaust Vent During Experiment
Correlation of S11 and Temperature, for Selected Frequencies
Correlation of S11 and Temperature, for Selected Frequencies

Frequency: 110 [MHz]

Frequency: 140 [MHz]
Correlation of S11 and Temperature, for Selected Frequencies
Result of Correction (traces in red)

- All data, no corrections: STD=0.0041 [dB]
- 1.7 [hr] of data, no correction: STD=0.0023 [dB]
- 1.7 [hr] of data, projected to 32.5 C: STD=0.0012 [dB]
- 1 trace at 32.5 C: STD=0.00085 [dB]
ATTENUATOR
Temperature of VNA Exhaust Vent During Experiment
Correlation of S11 and Temperature, for Selected Frequencies
Correlation of S11 and Temperature, for Selected Frequencies
Correlation of S11 and Temperature, for Selected Frequencies
Result of Correction (traces in red)

- All data, no corrections: STD=0.0038 [dB]
- 1.7 [hr] of data, no correction: STD=0.0031 [dB]
- 1.7 [hr] of data, projected to 30 C: STD=0.0021 [dB]
- 1 trace at 30 C: STD=0.0022 [dB]
50 OHM LOAD
ZVL3 (for comparison)

50 ohm terminator: 1 trace

MEAN: $-46.43$ [dB]
STD : $0.12$ [dB]

50 ohm terminator: ~150 traces (2.5 hours)

MEAN: $-46.44$ [dB]
STD : $0.17$ [dB]
ZVA24

50 ohm terminator: 1 trace

MEAN: -45.98 [dB]
STD : 0.087 [dB]

50 ohm terminator: ~1200 traces (20 hours)

MEAN: -46.45 [dB]
STD : 0.25 [dB]
Temperature of VNA Exhaust Vent During Experiment
Correlation of S11 and Temperature, for Selected Frequencies
Correlation of S11 and Temperature, for Selected Frequencies
Correlation of S11 and Temperature, for Selected Frequencies
Result of Correction (traces in red)

- All data, no corrections: STD=0.25 [dB]
- 1.7 [hr] of data, no correction: STD=0.16 [dB]
- 1.7 [hr] of data, projected to 30 C: STD=0.12 [dB]
- 1 trace at 30 C: STD=0.092 [dB]
CONCLUSIONS
1) The measurements of the 4-port R&S ZVA24 VNA seem to correlate with temperature (for a temperature change of ~ 1 C), especially within 1.7 hours since calibration.

2) Approx. 1.7 hours after calibration, S11 shows jumps (sometimes sudden) after which its behavior is uncertain. On top of the jumps, the scatter is larger after 1.7 hours, in general.

3) The drift due to temperature during the first 1.7 hour can be modeled linearly and corrected.

4) The temperature affects S11 evenly across the frequency domain.

5) The main resulting figures are:

<table>
<thead>
<tr>
<th></th>
<th>1 Trace ZVL3 [dB]</th>
<th>1 Trace ZVA24 [dB]</th>
<th>1.7 Hr Raw [dB]</th>
<th>1.7 Hr Corrected [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open port</td>
<td>0.0018</td>
<td>0.00081</td>
<td>0.0023</td>
<td>0.0012</td>
</tr>
<tr>
<td>Attenuator</td>
<td>0.0076</td>
<td>0.0014</td>
<td>0.0031</td>
<td>0.0021</td>
</tr>
<tr>
<td>Termination</td>
<td>0.12</td>
<td>0.087</td>
<td>0.16</td>
<td>0.12</td>
</tr>
</tbody>
</table>

6) The R&S ZVA24 is better than the portable R&S ZVL3. Its measurements are smoother and less noisy.

7) Accurate measurements with the ZVA24 are recommended to be done within 1.7 Hr from calibration. If temperature correction is implemented, the scatter decreases between 25 and 50% in this period of time.