



Why Warm Up a VNA before Use?

Introduction

Engineers regularly face difficult deadlines. In a rush to complete a series of measurements, it is tempting to take a piece of test gear off the shelf, plug it in, and begin the process. Resist the urge! Here, we'll look at how a typical Vector Network Analyzer (VNA) measurement can change from initial power-up to thermal equilibrium. Note, we are only examining warm-up characteristics, not ambient temperature changes, which can not only affect the VNA but the coaxial test cables as well.

Measuring a Short on Port 1

In the first experiment, a calibration short was applied to Port 1 of a compact VNA such that there would be a large reflection seen by the A receiver. A calibration Short provides a good, stable high reflection to the VNA port, so it is a good choice to evaluate the drift of a high reflection measurement from cold start to equilibrium. The experimental results are shown below in Figure 1.

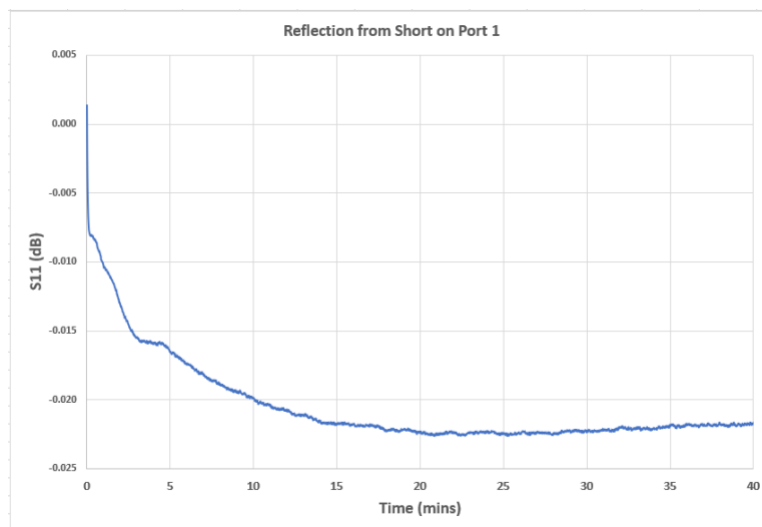


Figure 1 – Power-up Drift of Short Measurement

The drift is quite small, about 0.022 dBs, and settles in 20 minutes.





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Measuring a 12 dB Return Loss

Next, a 6 dB pad was attached to Port 1 with the other end shorted to provide an approximate 12 dB return loss. The VNA was allowed to cool and then powered up to evaluate the drift at this lower reflection value. The result is seen in Figure 2.

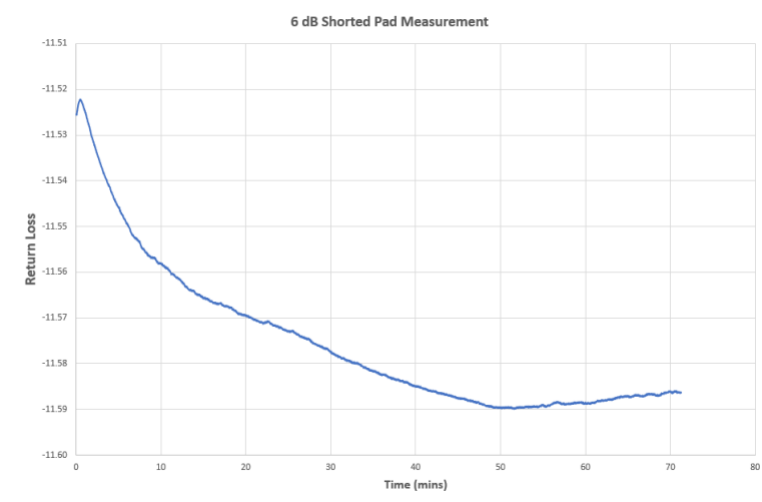


Figure 2 – Power-up Drift of 12 dB Return Loss

Stabilization took somewhat longer than the high reflection case, about 45 minutes, however the measurement is within 0.01 dB after thirty minutes.

It was not necessary to perform a warm-up test on an S_{21} measurement. The VNA receivers are identical in design, so a reflection measurement is equivalent to a transmission measurement for this purpose.



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VNA Internal Temperature

Lastly, we can look at the time it takes for a typical compact VNA to stabilize in temperature. The internal temperature rise of an [M5090 9 GHz Compact VNA](#) and a [TR1300/1 1.3 GHz Compact VNA](#) from cold start is shown in Figure 3.

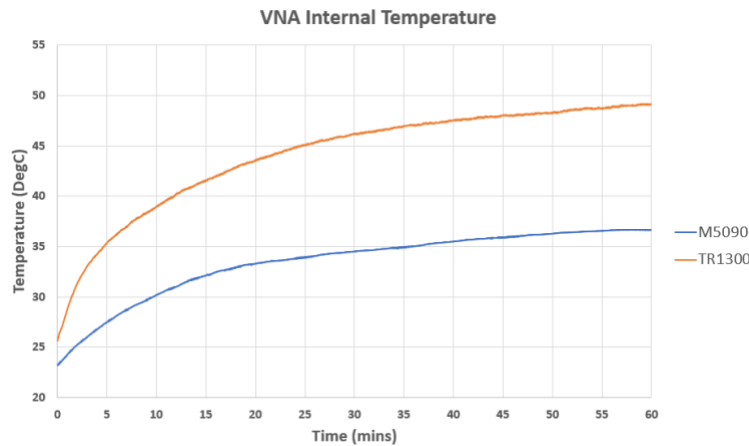


Figure 3 - VNA Temperature Rise

Reasonable temperature stability is reached within 45 minutes. The TR1300/1 has a higher temperature rise because it has no fan.

Conclusion:

To achieve the best measurement precision, allow the VNA to warm up. A thirty-to-forty-minute warm-up period is acceptable.