INTRODUCTION TO RNVNA, A MULTIPORT VNA SYSTEM

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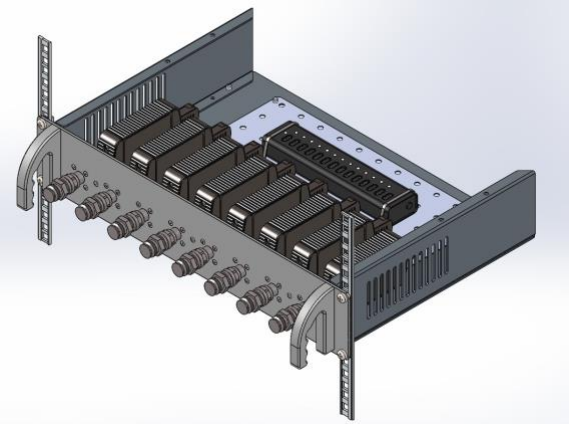
Background

In many applications it is necessary to make multiport measurements. The RNVNA is capable of performing these up to 16 ports. Each of the 16 ports will make individual vector reflection measurements and scalar measurements from port to port. In other words, S_{11}, S_{22}, S_{33} and so on will be complex measurements and S_{21}, S_{31}, S_{41} and so on will be scalar only measurements.

Description



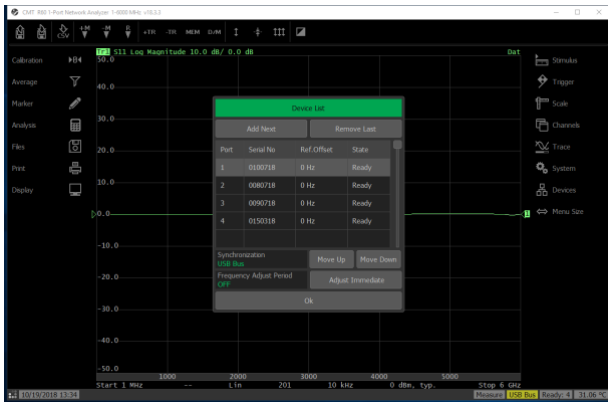
Each 2RU rack shelf can house up to eight reflectometers. Reflectometer models are available with frequency ranges of 85 MHz to 5.4 GHz (R54), 1 MHz to 6 GHz (R60), 85 MHz to 14 GHz (R140) and 1 MHz to 18 GHz (R180). The shelves can only be populated with one model of VNA. It isn't possible to mix them at this time. A powered hub is used to aggregate all of the separate units to a single USB connection to the host computer and to supply the needed power to the VNAs.

The software assigns each VNA to a port number. In a first-time setup, the VNAs will be plugged into the hub one at a time from left to right to assign ports 1 through 8. Ports 9 through 16 on the second shelf are processed in the same way. The software will remember these VNA designations.

Remember to assign a frequency correction period. The first VNA is assigned as the standard and each of the rest of the VNAs are adjusted to precisely match its frequency. This is necessary to assure that measurements between VNAs are properly centered in the middle of the receiver's IF bandwidth.

Calibration

To simplify the calibration process, it is highly recommended that an Automatic Calibration Module (ACM) is used. This will greatly reduce the time to perform the calibration process. The calibration process will be described using this device but if a mechanical kit is used the process is much the same, just more tedious.



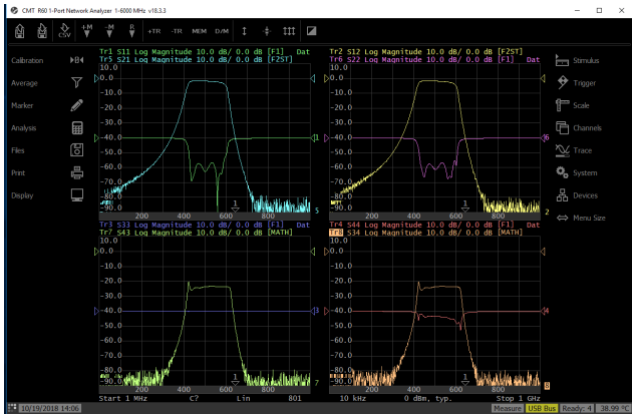
Under “Calibration”, choose “Autocalibration” and set the source port to 1 and the receiver port to 2. Attach the ACM between ports 1 and 2 of the RNVNA shelf. Select “Perform Auto-Orientation” to allow the ACM to determine which ports are connected to which side of its body. Press the “Calibrate” button and wait for the process to finish. Now remove the connection to port 2 and connect port 3 to the ACM. Choose Receiver Port 3 and Perform Auto-Orientation and then press “Calibrate” once again. Repeat this procedure attaching ports 4 and up, changing the receiver port designation each time and pressing the calibration button. For N ports you will have performed N-1 connections and calibrations. At this point the system is calibrated. Each Sii measurement will be designated with [F1] to indicate full 1-port calibration. Each S1i measurement will show [F2ST] to indicate Full 2-Port Scalar Thru and each Sij where i is not equal to 1 will show “MATH” which means the VNA has calculated those terns based on the previous measurements. The performance of this calculation is quite good.

The following chart shows a 10 dB attenuator measured with both “MATH” for ports 2 and 3 followed by a measurement with explicit calibration performed on those two ports.

Figure 3: The agreement is within 0.1 dB across the entire band.

Measurement

With the ports calibrated, one can now make vector 1-Port measurements and scalar measurements between ports. The next chart shows simultaneous measurement of two bandpass filters. Since the two filters were so similar, the connection from port 3 to the filter was loosened until the response degraded enough to be completely different from the measurement of the filter on ports 1 and 2.



Similarly, one could make measurements of multiband packaged antennas and be able quickly evaluate the VSWR of each antenna and its isolation to all other antennas in the system. Limit lines and limit tests could be added for fast production test.

A Truly Scalable Solution

Each RNVNA shelf can be populated with any number of VNAs up to 8 units but the system can be ordered with as few as two VNAs and then scaled up as production requirements change.