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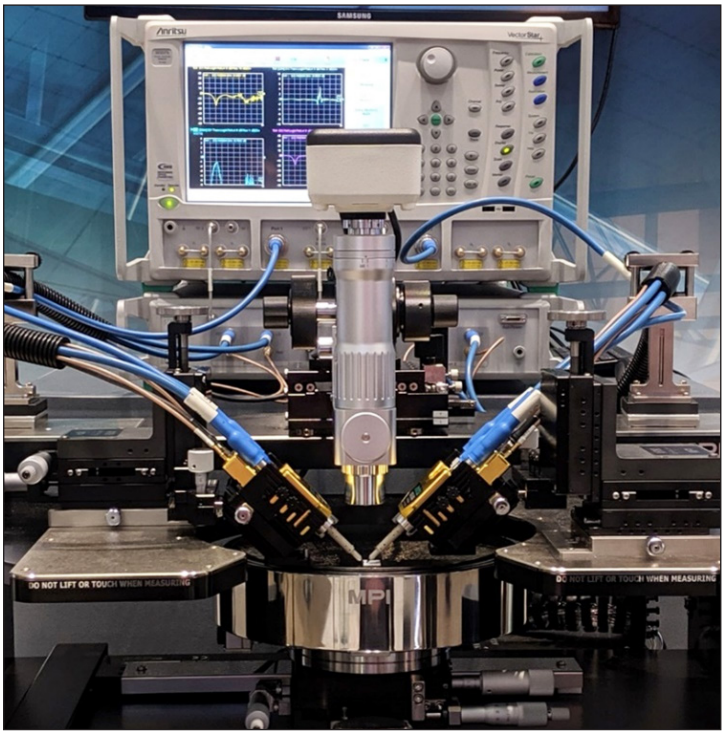
Generating an .s2p File for a 220 GHz Probe with the VectorStar™ ME7838G Vector Network Analyzer



VectorStar ME7838G 70 kHz to 220 GHz Broadband VNA

While an S-parameter description of the probe is not used for ordinary S-parameter calibrations, it can be useful for transferring power calibrations (which will initially be referenced to a coaxial or waveguide interface) to the probe tip. Power calibrations of a VNA typically have one or two goals: establish a flat power level across a wide frequency range and/or establish an absolute power reference at the input plane of the device under test (DUT). A broadband VNA is often defined as an analyzer that spans across the microwave spectrum (up to 70 GHz) using coaxial connectors combined with mmWave bands above 70 GHz and supported by narrow-band waveguide modules. Broadband VNAs require small geometry test port connectors to support high-frequency measurements without moding. Power sensors, such as the Anritsu Power Master™ MA24510A, are available with coaxial connectors operating up to 110 GHz. A common alternative is to use power sensors with V connectors (1.85 mm) and WR10 waveguide connectors to span the frequency range up to 110 GHz. The process of performing broadband power calibrations therefore includes the ability to perform power calibrations using coaxial power sensors combined with waveguide power sensors.

The VectorStar ME7838G broadband VNA sweeps from 70 kHz to 220 GHz through a single 0.6 mm geometry output port. Although this extreme broadband VNA achieves the ability to combine three waveguide bands above 70 GHz, the process of calibrating power at the output port of the mmWave modules is the same.

The Anritsu application note, *User Power Calibration with the VectorStar ME7838G VNA Application Note* (P/N: 11410-01156), describes the process of calibrating the VectorStar ME7838G 220 GHz broadband VNA. The process includes embedding the on-wafer probe (Figure 1) to transfer the power calibration to the tip of the probe. This process may include a provided generic .s2p file for probe embedding. The generic .s2p file offers an immediate path for probe embedding, but there could be a concern that those S-parameters may change over time so a re-characterization process would be useful. This application note describes such a process.

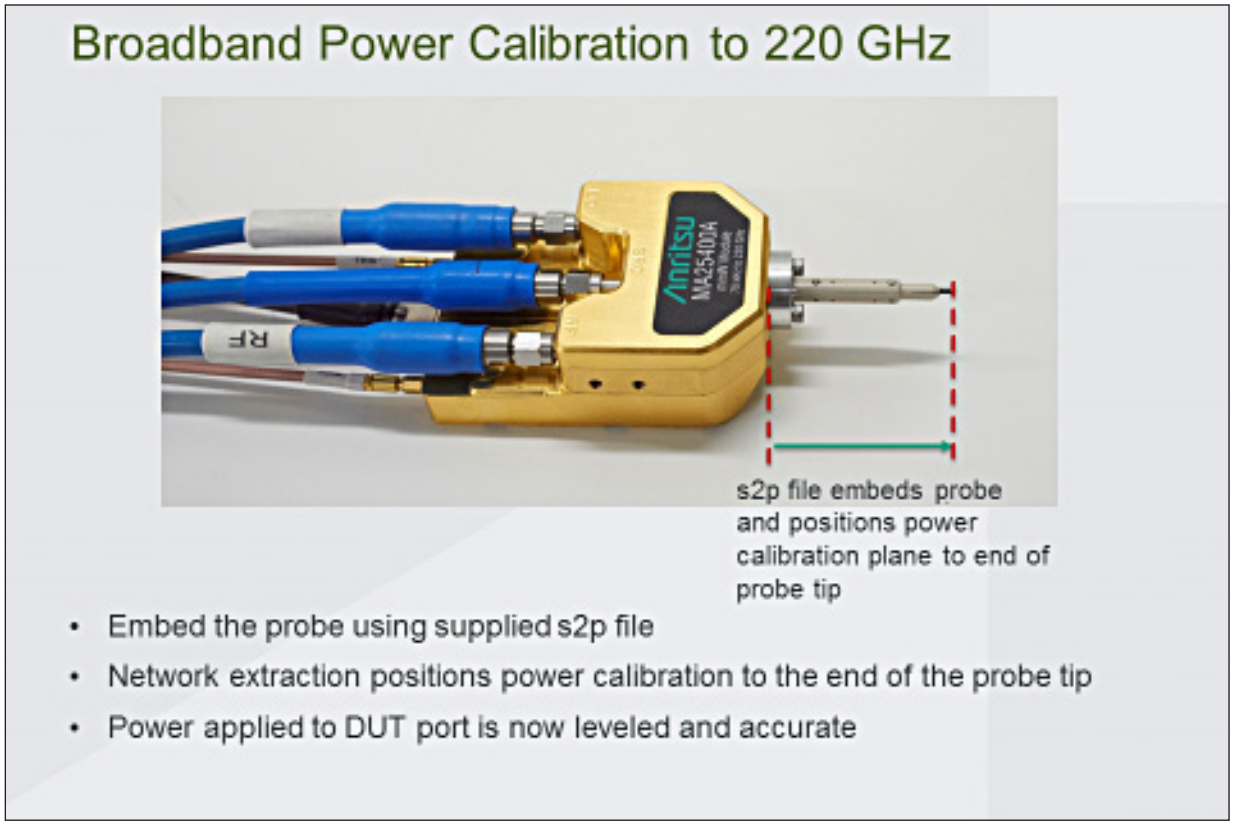


Figure 1. Embedding the probe for power calibration transfer

There are two related methods that are both conceptually similar and involve the steps of:

1. Performing a calibration using an adapter set or a “golden” probe at some convenient reference plane(s).
2. De-embed the adapters or golden probe to bring the reference plane back to the flange interface.
3. Perform a calibration on-wafer with the target probe (or use phase localized network extraction [Option 21-UFX fixture extraction] if a full calibration is not possible for some reason).
4. Use the calibration error coefficients in Steps 2 and 3 to compute the S-parameters of the target probe.

Method 1: Adapter Approach

1. 0.8 and WR-5 to flange adapters are used in this method. Coaxial and waveguide cals are performed sequentially for Step 1 above and Cal Merge is used to create a combined calibration relative to a remote and disjoint reference plane. Generally, these will be 1-port calibrations (and a broadband one in the case of the 0.8 connector to 145 GHz; the WR-5 calibration can be SSS or SSL and should cover 145-220 GHz). Refer to the *User Power Calibrations with the VectorStar ME7838G VNA Application Note* for more details.

2. The combined .s2p file for the adapters is used with an embedding process to move the reference planes back to the flange interface for Step 2 above. Save this resulting calibration.
3. The target probe is now connected to the module and an on-wafer calibration is performed using a standard calibration substrate. This can be a 1- or 2-port calibration. Save this resulting calibration.
4. Use the two calibration files in the previous two steps to conduct type B network extraction, which will automatically generate the .s2p file for the target probe (Figure 2).

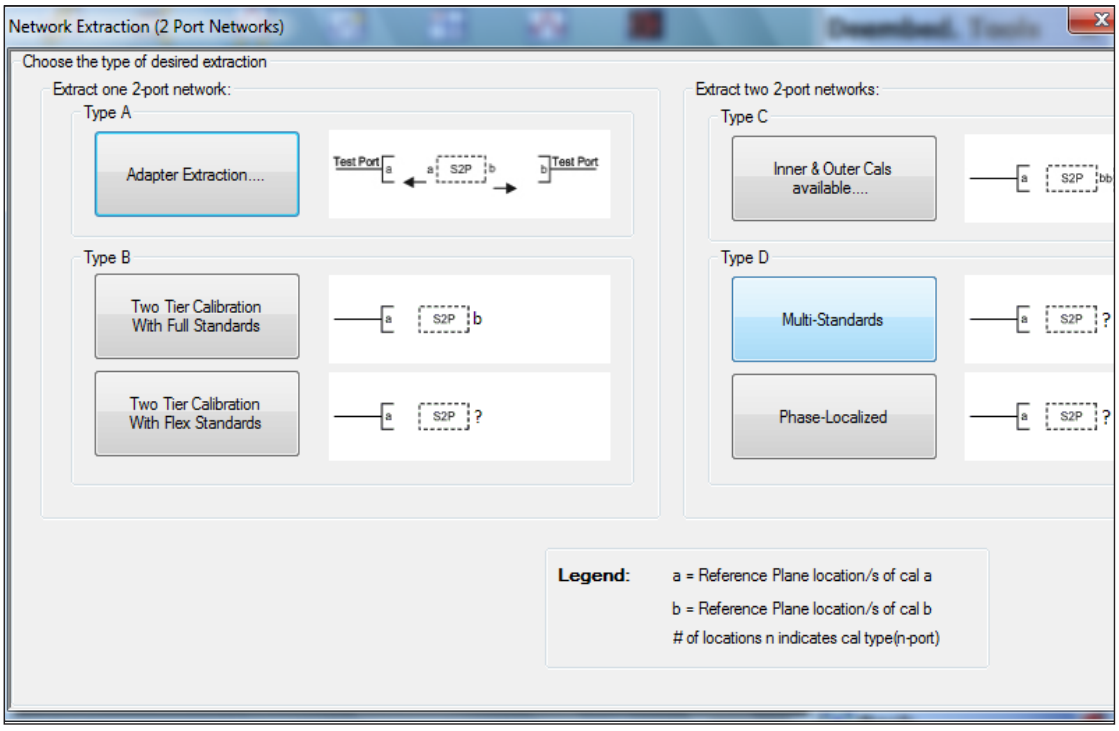


Figure 2. Network Extraction options using Option 21, UFX.

Method 2: "Golden" Probe

1. If a relatively un-worn probe is available, the knowledge of its S-parameters can be used to refresh the S-parameters of the target probe.
2. Connect the golden probe to the module and perform an on-wafer calibration over the full frequency range. This can be a 1- or 2-port calibration.
3. Use the golden probe .s2p file and an embedding process to move the reference plane back to the flange interface. Save this resulting calibration.
4. The target probe is now connected to the module and an on-wafer calibration is performed using a standard calibration substrate. This can be a 1- or 2-port calibration. Save this resulting calibration.
5. Use the two calibration files in the previous two steps to conduct type B network extraction which will automatically generate the .s2p file for the target probe.

Summary

The VectorStar ME7838G is a broadband system providing coverage to 220 GHz. Performing power calibrations across the entire sweep range will require multiple sensors and multiple adapters. After the power calibration and de-embedding of the adapters, the reference plane needs to be positioned at the tip of the probe for optimum performance. Relocation of the reference plane requires embedding of the probe using the .s2p file. This application note describes how to update the .s2p file of the probe as wear of the probe becomes a concern.

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Specifications are subject to change without notice.

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