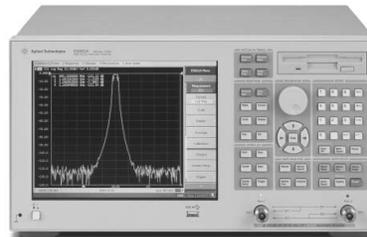
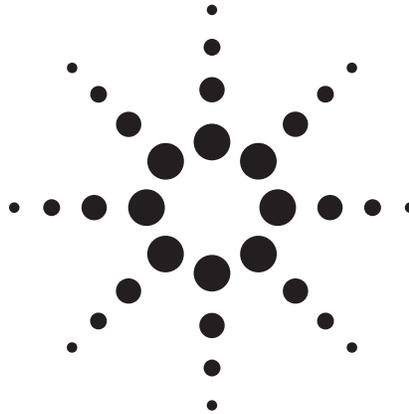


Agilent Replace 8508A Vector Voltmeter with ENA-L RF Network Analyzers

Application Note



ENA-L



8508A VVM

- **Broader dynamic range for S_{11} and S_{21} measurements**
- **No external Signal Generator needed for stimulating DUT**
- **Emulate VVM operation with ENA-L built-in Visual Basic for Applications**



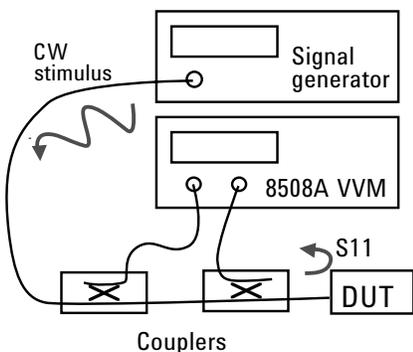
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The 8508A Vector Voltmeter (VVM) has been used for various kinds of applications. Most of these can be covered by network analyzers. This document introduces some VVM application examples that can be covered by the E5061A/62A ENA-L RF network analyzer (1.5 GHz/3 GHz).

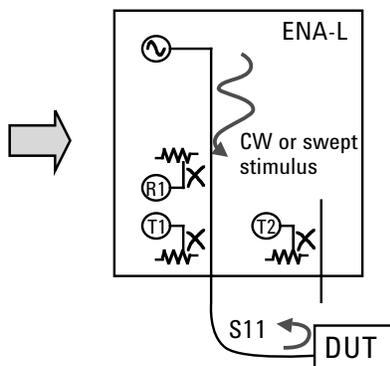
S_{11} and S_{21} measurements

The VVM has been widely used for simple CW transmission (S_{21}) and reflection (S_{11}) measurements in combination with an external signal generator (SG) that stimulates the DUT (See Figure 1a). Typical application examples are:

- Equalizing a RF cable's electrical length to a reference "golden" RF cable by measuring its relative S_{11} phase value in the open-ended condition and physically trimming the cable length;



a) Traditional test config. with VVM & SG

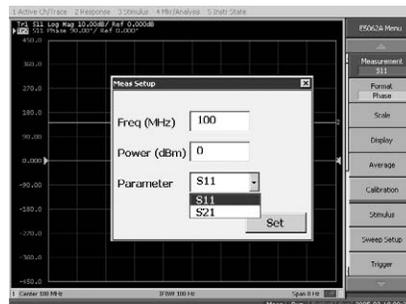


b) New test config. with ENA-L

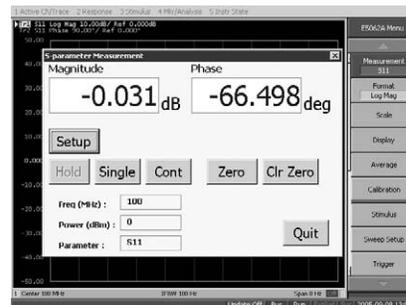
Figure 1. S_{11} measurement simplification with ENA-L.

- Testing a phased array antenna by measuring each of its elements' relative S_{21} phase to a reference element; and so on. A vector network analyzer is designed for making these kinds of measurements (See Figure 1b). By replacing your old VVM-based test system with the ENA-L RF network analyzer, you will have the following advantages:
- The ENA-L features an internal source for stimulating DUTs. No external SG is needed.
- The ENA-L provides a much broader dynamic range (max. 120 dB).
- It is possible to make not only CW measurements but also swept measurements very easily.
- The ENA-L's built-in vector error correction functions can improve measurement accuracy.

In addition, the ENA-L's built-in VBA programming capability enables you to emulate the VVM user interface by making a customized control panel on the ENA-L (Figure 2a). This allows you to minimize switching barriers for test operators who are familiar with the traditional VVM operations (Figure 2b).



a) Setup menu for internal source and test parameter



b) VVM emulation control panel

Figure 2. Example of VVM emulation VBA program (for S_{11} and S_{21} measurements).

Measuring phase difference of external source devices

Measuring phase difference between two CW signals coming from external source devices is also a typical VVM application (Figure 3). The ENA-L can perform this phase difference measurement as follows:

- Set the ENA-L's center frequency to the DUT's frequency, and set the ENA-L's span to zero. These operations are for setting the ENA-L's receiver frequency to the DUT's frequency.
- Set the ENA-L to RF Out OFF mode to turn off its internal source output.
- Measure $S_{11} = T1/R1$ and $S_{21} = T2/R1$.

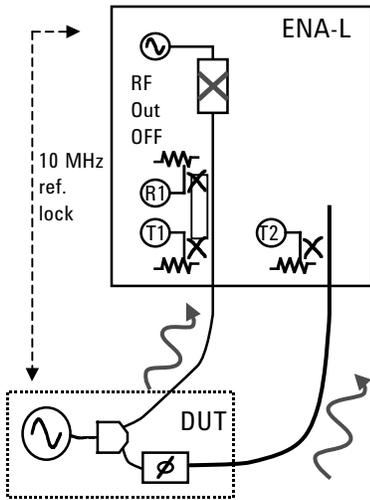


Figure 3. Measure phase difference with ENA-L.

Perform a complex calculation to derive the phase angle of $S_{21}/S_{11} = T2/T1$. (See Figure 4)

For GPIB controlled automated system environments, the above operation sequence and complex calculation should be performed on an external PC. For manual test applications, the sequence and calculation can be automated with the ENA-L's built-in VBA programming function.

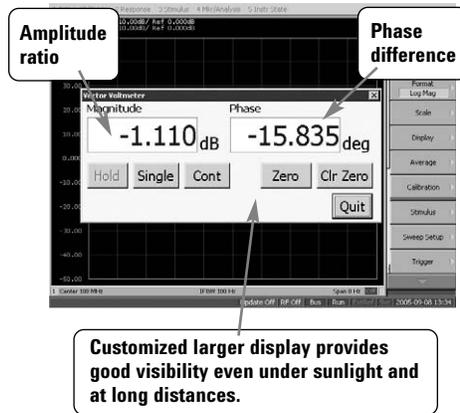


Figure 4. Example of VVM emulation VBA program (for external source measurement).

Notes

- The ENA-L has no capability to phase-lock the measured CW signal. It is recommended that you lock the 10 MHz reference signal between the ENA-L and the DUT. If the 10 MHz reference lock is not possible, carefully adjust the ENA-L's center frequency to the DUT. If necessary, adjust the receiver IFBW to a broader value.
- To precisely measure the ratio $T2/T1$ with 50 ohm input ports, it is important to minimize impedance mismatches between the analyzer and the DUT. Ensure that a good impedance match is maintained in each of the ratio measurement paths. If possible, it is also recommended that you perform the Zero compensation by inputting equal-phase CW signals, prior to conducting the measurements.
- The ENA-L has no built-in high-impedance input function. If high-impedance input is needed, use external high-impedance probes and external probe powers.
- It is recommended that you add Option 016 Touchscreen for easy operation of the VBA panel in environments where the mouse can not be used.

Web Resources

Visit our Web sites for additional product information and literature.

ENA RF network analyzers:
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