Recommendations for common VNA configurations for channel characterization

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“Are there some preferred VNA configurations that should be used by all participants contributing channel data to the group?

Start with some VNA basics

The phase change between two frequency points needs to stay below 360 degrees and for a reflection measurement is given by:

$$Phase\ change\ (deg) = \frac{2 * length * \Delta F * 360}{Velocity}$$

In other words, the range that the VNA can observe is set by the frequency step size. Example, for a 1 meter channel with a propagation velocity of 0.6 C, the phase will change 40 degrees from point to point in a roundtrip measurement (20 degrees for a transmission measurement)

If we use a step size of 10 MHz (convenient for a 10 MHz to 40 GHz span), the maximum *round trip* phase change (in degrees) point to point for the following channel lengths will be:

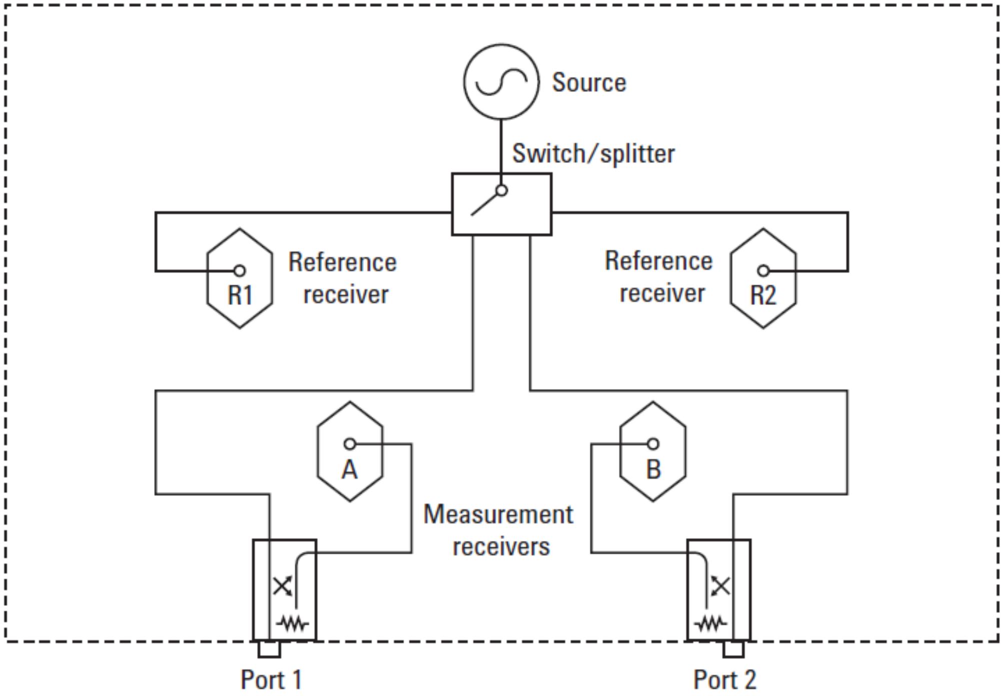
1 meter:	40
2 meters:	80
3 meters:	120
4 meters	160
5 meters:	200
6 meters:	240
7 meters:	280

Assumes a propagation velocity of 0.6 C. For slower propagation velocities, phase changes for a given length are proportionally longer (Example: 1 meter channel with 0.5 C velocity has a 48 degree phase change between two points for a 10 MHz step). Faster propagation velocities yield proportionally smaller phase changes

Getting good low frequency results

The VNA uses a broadband directional coupler behind the front panel to measure transmitted and reflected signals from the DUT. Coupler loss is high at low frequencies

Reduced signal levels can lead to susceptibility to noise and degraded low frequency data, which may be yield poor estimates of the DC value



Good measurement practice for low frequencies

Reducing the IF BW will reduce noise (but increases measurement times)

Your VNA probably can be configured to use a low IF BW over the low frequencies and switch to a wider BW over the remainder of the span

Use available source power to maximize SNR

Averaging decreases impact of noise (at the expense of measurement time)

How good are those projections back from 10 MHz?

There are some modeling techniques available that use simple DC Ohmmeter tests combined with the VNA data to generate estimates of the response between lowest VNA point and DC

Some recommendations

Use 10 MHz to 40 GHz span with 10 MHz spacing for channels up to 4 meters

Decrease frequency spacing to 5 MHz for channels longer than 4 meters (doubles file sizes)

(Advanced analysis is available if channels can be loaned for a short time to better validate low frequency data)