Calibrating configurable ports for the Agilent E8364B PNA

This procedure is for calibrating the configurable ports to display a ratioed measurement (i.e. \( P_r/P_t \)) as well as phase information. A total of four calibrations will need to be performed: \( P_{r1}/P_{t1} \), \( P_{r1}/P_{t2} \), \( P_{r2}/P_{t1} \), and \( P_{r2}/P_{t2} \). This will also calibrate out any external attachments (e.g. cabling) for both attenuation losses and phase instability.

To begin, connect the cabling /attachments that are to be calibrated out. Be sure to lay cables in a pattern close to how they will actually be used. Moving and bending cables affects phase and can change the attenuation by several dBi! Tighten all connections with a torque wrench. Be sure that the following parameters are set to the desired values:

- Frequency Range
- IF Bandwidth
- Number of Data Points
- Smoothing or Averaging (If necessary)

The calibration will only be valid for the range specified, and will need to be performed every time the frequency range is changed.

**Configuring Port 1:**

Remove the jumpers from **Source Out** and **Receiver A**. Leave **Reference** jumper attached and attach cabling.

In the menu, select `Trace->Measure->Measure`

Select the **Receivers** tab.

On the first line, check **Activate**

Set Numerator to **A**

Set Denominator to **1.0**

Set Source Port to **Port 1**

Select **Apply**, then **OK**

In the menu, select `Trace->Math/Memory`

Click **Data->Memory** and select ‘Data/Memory’ in the drop down menu. Hit **OK**
You have now normalized the power levels and cable losses against themselves, so the line should be completely zeroed out.

To see the phase information, right click the trace tab and select phase (unwrapped). The phase line should be zero across the frequency range, and the PNA will now only measure changes in phase compare to this point.

For The Rest of the Ports:

As needed, you can calibrate the other ports. The procedure is the same, except that in the Change Measurement box, select the appropriate line for the port you are calibrating, as below:

Power level Calibration:
Important notes about using the PNA in this fashion:

What are we measuring?

While it is convenient to refer to these as S parameters, they are in fact not. The receiver is using different transmission lines to carry the transmit and receive signal. Also, there is no ‘Open, Short, Load’ calibration. This is acceptable as long as it is assumed that only well-matched antennas are used (luckily for our application, this is an okay assumption). Some of the power that gets sent down the transmission line will be reflected instead of being transmitted out the antenna. This is compensated for by characterizing each antenna with an Effective Gain, which lumps both the reflection losses, dissipative losses inside the antenna, and directivity of the antenna into a single value, greatly simplifying the equations without lessening the accuracy of the measurements.

Using Time-Domain Filtering:

Another key to using the PNA properly is to understand the function and uses of Time-Domain filtering to improve measurement sensitivity. A thorough explanation of the capabilities and properties of Time-domain measurements using an Agilent PNA is explained at


The most important thing to realize is that the PNA performs the following basic steps:

1. Collect Frequency-Domain data
2. Mathematically transform into the time domain
3. Mathematically apply a windowing filter
4. Mathematically transform windowed data back into the Frequency Domain

Thus, you can end up looking at highly processed data when you used this function. The resolution and quality of the filtering depends on the frequency band, the number of points, the choice of windowing function, and the nature of the interference. Unless you understand the nature of the filtering, there are serious limitations to the kind of filtering one can do and still get usable data. This most common use for time-domain filtering in this lab is for discrete sources of interference which are separable from the target data, such as T/R cross talk from two antennas in a quasi-monostatic arrangement.