

AN120
Measuring Amplifier Gain
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Abstract:

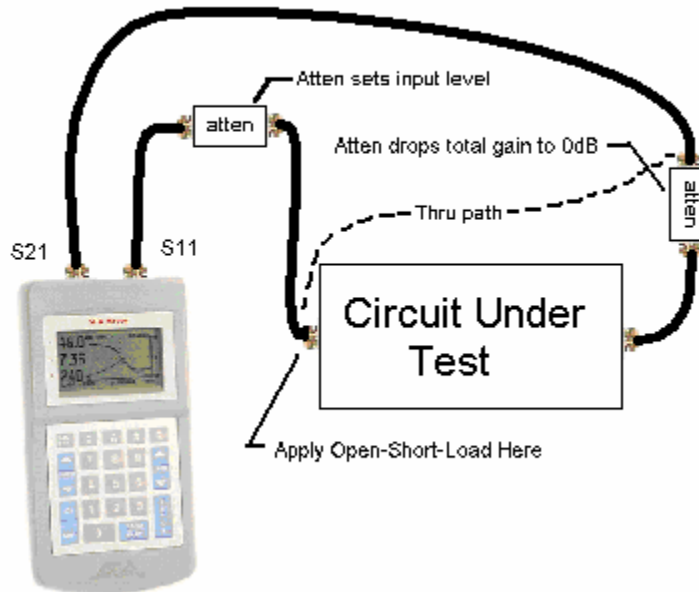
This paper outlines how to measure amplifier gain with the AEA Technology two port network analyzers. This technique applies to measuring passive loss as well.

Introduction:

Amplifier gain may be measured using any 2 port network analyzer. To protect the front end of the analyzer, always use an attenuator between the amplifier output and the analyzer S21 input. The AEA technology network analyzers were designed for isolation measurements (i.e. gain < 0 dB), so the attenuator should be slightly greater than the expected amplifier gain. The amplifier input connects to the S11 port. Quality connections to the analyzer, attenuator, and amplifier are required to get accurate readings. Use coaxial connectors for each connection. Connectors at the amplifier end of the cables allow a convenient way to perform cable null.

Test setup:

Amplifier circuits require one or two attenuators, where the total attenuation offsets the expected amplifier gain to 0 dB (or a few dB of loss). The attenuator may need to be split to provide the proper input level to the amplifier. If you use an output attenuator, consider it as part of the test fixture when cable nulling. If you use an input attenuator, include it when performing the cable null (apply Open-Short-Load to fixture side of the attenuator).



Test fixture quality is a key factor in measuring the circuit under test. Use good PCB mount coaxial connectors for the input and output ports. A ground plane usually improves performance by reducing stray inductance in the power distribution. Beware that many RF circuits, especially active ones, operate differently if the I/O ports use coaxial pigtailed instead of good connectors. Using coaxial connectors for the I/O ports allows you to replace the test fixture with a barrel connector when cable nulling the “thru” path. Any power supply or control inputs should be well bypassed with capacitors to the fixture ground plane. Once you have created your fixture, measurements can begin.

Steps to Measure Amplifier Gain:

1. Set the network analyzer center frequency and sweep range to cover the frequencies of interest. If you have a multiple band situation, you should prestore multiple sweeps to cover the various bands.
2. Set at least one of the plots to an S21 reading (linear gain, log gain, or gain phase). You may view two plots at once on the analyzer. If you also want to measure and save the S11 data, then the second plot *must* be one of the S11 plots. You may view more than two plots simultaneously by operating the network analyzer via the PC Vision software. PC Vision Hint: read one plot, take the effort to save all the plot settings the way you like it (axes formats, colors, labels, etc) then select Chart Window|Save Settings. Future readings will be presented in a similar manner.
3. Cable null the network analyzer, including cables, input attenuator, and adaptors, consider the output attenuator as part of the test fixture, so it does not appear in the thru path nulling.
4. Connect the cables to the test fixture input and outputs.
5. Apply power to the test fixture.
6. Take readings, save plots as desired. See how circuit alterations affect the amplifier characteristics.
7. Use saved data to document your design.

Conclusion:

AEA Technology two port network analyzers may be used to measure your amplifier's characteristics, and will provide useful displays to guide you in the design of the amplifier.

References:

- AN101 When to Use Cable Null, AEA Technology
- AN121 Measuring Group Delay, AEA Technology
- AN122 Measuring Gain Compression, AEA Technology
- AN124 Measuring Differential Amplifiers, AEA Technology
- AN125 Measuring AM to PM Distortion, AEA Technology