Amplifier Measurement Guidelines

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Amplifier Measurements

• S-parameter measurements of amplifiers are critical:
  – Verification of amplifier performance
  – Data for system design

• Additional considerations weigh in designing the measurement setup.
Considerations in Measurement Setup

• The amplifier must remain in its linear range of operation.
• The measurement system must remain in its linear (and safe!) region of operation.
• The measurement system must be protected against potential oscillation.
Linear Amplifier Operation

- Power limitations to keep the amplifier in its linear range, or “small-signal behavior” vary from amplifier to amplifier.
- Linear range can be determined by a 50-ohm power sweep.
- Make sure you are well below the 1-dB compression point of the amplifier for “small-signal” measurements.
Linear Measurement Region

• The VNA has listed RF power limits at its port for “safe” operation.

• The linear region of the VNA is often much lower than these listed “safe” limits.

• Tradeoff
  – Keep power as low as possible.
  – Make sure your measurement is above the “noise floor.”
Oscillation Protection

• The measurement system must be protected against potential oscillations.

• The potential oscillations are at the upper power limit of the amplifier (determined by DC bias and loading).

• Only external attenuation can adequately protect against oscillation!
Power Level Adjustments

• Signal Power (Ports 1 and 2)
  – Adjust to fit in linear region of device.

• Internal Attenuation
  – Keep the measurement instrument in its linear measurement range.

• External Attenuation
  – Protect the instrument from damage.
  – Did I mention it is the only way to protect against an oscillating device?
Biasing Your Device Under Test

• NEVER bias a device until it is properly loaded (i.e. your output cables are connected).
  – An open circuit could produce instability in a device designed to see 50 ohms.
• BJT: Increase the base voltage, then increase the collector.
• FET: ALWAYS decrease the gate voltage below threshold BEFORE increasing the drain voltage.
• Avoid “turning on” the bias voltages. Instead you should slowly increase them.
Conclusions

• Always think about how much power is seen by both the device under test (your amplifier) and the measurement equipment.
• Protect your equipment against oscillation of the DUT.
• The order in which device ports are biased can be very important.