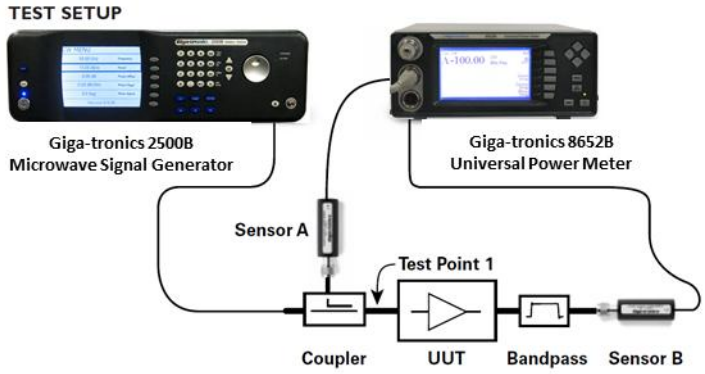
Technical Brief

Characterizing Amplifier Gain Compression

OVERVIEW

When an RF or microwave application requires cascading several amplifiers in a system, gain compression performance of the individual amplifiers must be characterized. Cascading amplifiers improperly will result in poor gain performance (for a desired RF input power level), poor output power performance, and the generation of harmonics created by the cascaded amplifier operating in its non-linear power range.

One cost-effective method to determine the gain compression performance is to use a dual channel Giga-tronics 8652B Universal Power Meter. This method determines gain compression by referencing the change in input power level to the change in output power level.



REQUIRED EQUIPMENT

- A signal generator capable of providing enough power to drive an amplifier into gain compression (or gain saturation), such as the high output power of the Giga-tronics 2500B series Microwave Signal Generators (with frequency ranges up to 50 GHz).
- Giga-tronics 8652B Universal Power Meter
- 80301A Power Sensors (2) or other high dynamic range power sensors with the desired frequency range (up to 50 GHz)
- 10 or 16 dB directional coupler with the desired frequency range (up to 50 GHz)
- Band pass filter(s) for the desired frequency range (up to 50 GHz)
- Miscellaneous cables, connectors and adapters

TEST PROCEDURE

1. Connect Sensor B to the through-line port of the coupler, test point 1.

2. Configure the top line of the power meter display for B/A (channel B referenced to A).

3. Configure the bottom line of the power meter display for channel A.

4. Apply a signal from the signal generator and record the B/A value. Input this value to offset channel A. Use the measurement setup menu/offset and enter the channel A offset value. After this is done, the B/A display should read 0.00 dB.

5. Remove sensor B from test point 1 and connect the UUT (unit under test), the band pass filter, and sensor B as shown, and bias/power the UUT (as required).

Note: The input RF power level should be low enough to ensure that the UUT will not be in gain compression — ideally, 10 dB below the expected gain compression level. The band pass filter is essential to the test setup because it ensures that harmonics generated by the UUT in compression do not introduce measurement errors.

6. Apply bias/power and RF to the amplifier. The B/A display (top line) will indicate gain of the amplifier and the A display (bottom line) will indicate the input RF power level. Record the B/A and A channel values.

7. Press the "REL" button located on the front panel of the power meter. Both lines of the display will read 0.00 dBr.

8. Slowly increase the RF power level of the signal generator. The bottom line of the display (channel A) will begin to show a positive dBr value. Continue increasing the RF power until the top line of the display (relative B/A display) begins to show a negative value. This negative value is the indication that the amplifier is entering gain compression. Add the value of the lower display to the original channel A value. The new value is the RF input level (in dBm) where gain compression begins.

9. Repeat step 8, stopping at desired increments to characterize gain compression.

The Giga-tronics 8652B Universal Power Meter can be fully automated using this method to identify various levels of gain compression. This is especially useful when 0.25 dB or 0.1 dB compression values are needed to cascade several amplifiers into one amplifier chain.