IMPROVING NOISE FIGURE MEASUREMENT

Noise Com's NC346 and NC5000 Series are designed to be used with an HP8970 or similar Noise Figure Meter. The preferred setup for RF frequencies within the range of the meter is shown below in Figure 1. The isolator and LNA are added to reduce measurement uncertainty. The isolator reduces reflected power between the DUT and the test setup. The LNA reduces the noise figure of the test setup. For the wideband case, the isolator may be replaced with a low VSWR attenuator of approximately 6 to 10 dB.

The test setup is first calibrated without the DUT (device under test) at the frequencies to be tested. The DUT is then connected after the noise source for a noise figure measurement.

For the HP8970:

1. Turn on the HP8970 and wait a few seconds for power-up checks. Then press the "PRESET" button. The HP8970 should measure and display its own noise figure at 30 MHz.

2. Press the "ENR" button. The meter will display a frequency for which the ENR is to be entered. Enter the ENR from the back of the noise source and press "ENTER". Continue in this fashion until the entire table is entered. Press "FREQUENCY" to exit this mode.

3. To calibrate the setup, connect the calibrate path as shown in Figure 1. Press "PRESET" to put the meter in a known state. Then enter the start frequency by pressing "START FREQ", frequency in MHz, "ENTER". Then enter the stop frequency by pressing "STOP FREQ", frequency in MHz, "ENTER". Then enter the step size by pressing "STEP SIZE", step size in MHz, "ENTER". Then press "CALIBRATE". Press "NOISE FIGURE AND GAIN" to measure the corrected gain and noise figure of the setup. This should be close to 0.

4. To make a corrected measurement of the DUT, connect the output of the noise source to the input of the DUT, and the output of the DUT to the input of the test setup as shown in Figure 1. Press "FREQUENCY", enter the frequency in MHz, and press "ENTER". The meter will display corrected noise figure and gain.

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5. For further details about test procedure, consult your Noise Figure Meter Owner's Manual.

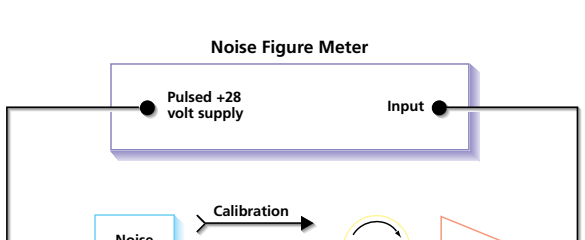

Figure 1. RF Measurements

For NF measurement of devices that have output microwave frequencies above the range of the meter, a down-conversion is necessary. The preferred setup is detailed below in Figure 2. The steps to calibrate the setup and measure noise figure are nearly the same as for the RF case. If the LO can be remotely controlled using GPIB or HP-IB, then for the swept LO, Double Side Band measurement, the microwave frequencies can be entered directly into the Noise Figure Meter. Consult your meter's manual. An optional Band Pass or Low Pass filter can be added to the LO signal path to suppress spurious and harmonic outputs. Another optional BPF is shown before the meter. Because further frequency conversion takes place inside the meter, this filter improves accuracy by suppressing out-of-band spurious and harmonic signals that could otherwise end up in the measurement bandwidth.

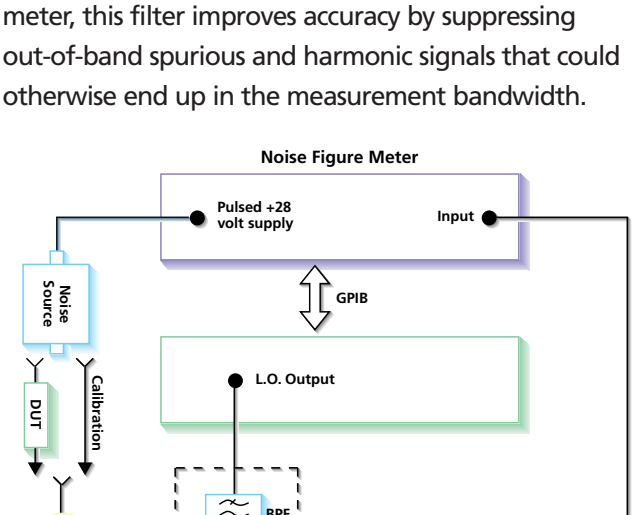

Figure 2. Downconversion for microwave measurements

How A Good Noise Source Improves Noise Figure Measurements

One of the most important contributions to measurement accuracy is a good match (low VSWR) between the noise source output and the device connected to it (DUT or test setup). During measurement, a small amount of noise power is reflected at the DUT input (or test setup) (see Figure 3). Some of this reflected power is reflected again at the noise source output with unpredictable phase, thus changing the measured power of the signal in an uncertain way. The same holds true for the difference in mismatch between calibration setup and measurement setup.

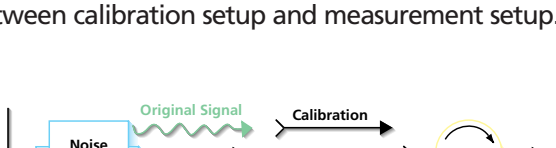

Figure 3. Reflected power during noise figure measurements

Minimum mismatch change from the "ON" state to the "OFF" state of the noise source is another key to measurement accuracy. The ENR for the noise source is calibrated relative to a 50 Ω termination at room temperature. If the noise source changes impedance when turned on, the DUT sees a different excess noise than is calibrated for the noise source. This causes the same reflected and re-reflected power situation as above.

The meter uses the noise source ENR calibration, along with measured data, to calculate noise figure. The accuracy of the noise figure value is therefore dependent on the accuracy of the noise source calibration.

For more information on the NC346 Series, see pages 2-3; on the NC5000 Series, see pages 4-5.