application note 112

CALIBRATING SPECTRUM ANALYZERS WITH A NOISE SOURCE

A simple way to calibrate a spectrum analyzer is to use a broadband white noise source to monitor the analyzer's frequency response. Noise sources are available with spectral flatness that far exceeds typical spectrum analyzer response, which makes them ideal references.

A noise source is characterized by its frequency response and its amplitude content. The frequency response of the noise source is represented by displaying the distribution of power contained at specific frequencies. White noise has constant spectral density over the bandwidth of the device.

The amplitude content of the noise is described by its voltage probability density function. In most noise sources, this function is approximately Gaussian. It is the flat frequency content that makes the noise source ideal for analyzer calibration.

Spectrum analyzers have well-documented deviations with time, temperature, frequency, and power level that mandate at least yearly calibration to maintain reasonable levels of error. In some applications, frequency response of the spectrum analyzer is an important performance parameter. The analyzer's flatness is corrupted by the effects of its internal RF attenuator, preselector, and mixing mode gain variations. Spectrum analyzers can have specified amplitude responses of ±5 dB up to 18 GHz after calibration. Noise sources can be designed with typical flatness, as shown in Table 1.

TABLE 1

FREQUENCY	FLATNESS
0 to 1.5 GHz	±0.5 dB
1 to 2 GHz	±0.5 dB
2 to 18 GHz	±1.5 dB

Table 1. Typical noise source performance.

Injecting noise into a spectrum analyzer can therefore provide an accurate measurement of the amplitude variations versus frequency of the analyzer. Figure 1 shows the basic test set-up.

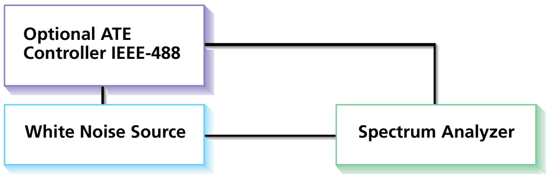

Figure 1. Basic Block Diagram.

A common way to normalize the errors associated with analyzer measurement is to employ a signal generator that sweeps the required frequency while the analyzer stores the response. A noise source has several advantages over this approach:

Cost: The cost of a noise source is insignificant compared to the cost of a broadband signal generator with similar output-versus-frequency characteristics.

Size: A noise source can be made much smaller than a signal generator.

Speed: When performing broadband measurements, the oscillator must be swept and responses stored, which can take several minutes. The noise source can generate all the frequencies simultaneously, so its response can be rapidly stored and subtracted from that of the DUT. This yields the actual DUT response to within the accuracy of the noise source. The procedure requires less time, which dramatically reduces cost.

Accuracy: Noise sources can be accurately measured to within tenths of a dB by NIST-traceable methods. Calibration data are provided to precisely characterize the noise source, enabling further error correction capabilities in a computer-controlled test application.

If there is concern about variation in the analyzer's frequency response in relation to input power level, the noise source can be integrated into an instrument with precision step attenuators. This allows the user to vary the output noise power while constantly viewing an on-screen reference as the input power level changes. Noise Com's UFX7000 Series is such an instrument. It can be programmed locally and over the IEEE-488 bus, which makes it well suited to incorporation in an automated test set-up.

For more information on the NC346, see pages 2-3; on the NC500/500SM, see pages 28-29; and on the UFX7000 Series, see pages 8-9.