Low-Noise Block Downconverter-Feedhorn Testing

Using the N9000A CXA Signal Analyzer Makes Testing Easier

Application Note

Abstract

This application note provides an example of a LNBF test configuration using a CXA X-Series signal analyzer and illustrates how easy it is to perform tests and make measurements.

Overview

A low-noise block downconverter (LNB) is the receiving device of a parabolic satellite antenna; the antenna type commonly used for satellite TV reception. A LNB uses the superheterodyne principle to take a wide block (or band) of relatively high frequencies, such as C-band (3.4 to 4.2 GHz) or Ku-band (11.7 to 12.2 GHz), and amplifies and converts it to a low, intermediate frequency (IF) ranging from 950 to 2150 MHz.

The unit consisting of the feedhorn plus the converter is called the LNB-feedhorn (LNBF). LNBFs are used for a wide variety of applications, such as television and internet access. LNBFs are advantageous because they are cost-effective.

During the mass production of LNBF devices, a spectrum analyzer verifies the LNBF's RF performance to ensure that the LNBF devices achieve customer requirements and work properly.

The Agilent N9000A CXA signal analyzer is ideal for this application, providing a well-balanced choice between high throughput and low cost of ownership. Its excellent RF performance and robust measurement capabilities make it ideal for testing:

- **Local oscillator's frequency and power**
- **Channel gain flatness**
- **Noise figure**

Typical LNBF Measurement Configuration

Figure 1 is a typical automatic test system configuration for LNBF RF performance testing.

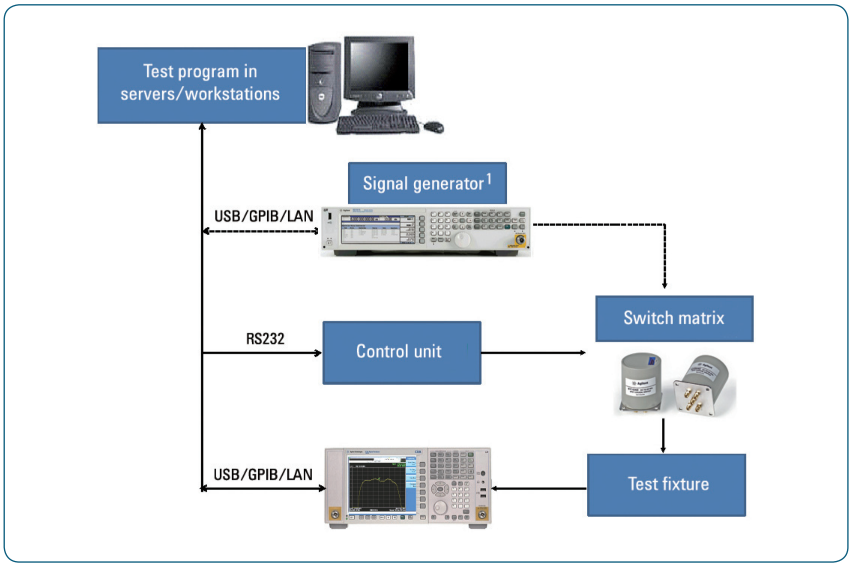

Figure 1. Typical LNBF test system block diagram

1. *An RF signal generator is used for RF-TO-IF isolation.*

Table 1. Summarizes the equipment's role in the automated system and suggests suitable Agilent products

Device	Purpose	Agilent solution
RF spectrum analyzer with: • GPIB interface • USB • LAN	Measures the DUT's RF specifications	N9000A CXA signal analyzer: • **Option 503 or 507:** Frequency range, 9 kHz to 3 or 7.5 GHz • **Option P03 or P07:** Preamplifier, 3 or 7.5 GHz • **W9069A-1FP:** Noise figure measurement application
Switch matrix	Provides switch signal pathway	Agilent multiport coaxial switch
Computer	Runs software	N/A
Main control unit	Controls test fixture, signal pathway, and other parameters	N/A
Test fixture	Makes testing easier	N/A

The CXA signal analyzer plays a pivotal role in maximizing throughput for LNBF products because of its fast measurement speed, rich measurement capabilities, and flexible programmability. Some of its key attributes include:

- 9 kHz to 3.0 or 7.5 GHz frequency range covers LNB IF range
- ± 0.5 dB amplitude accuracy ensures accurate measurement results
- W9069A noise figure measurement application makes measurement easy
- Fast measurement speed maximizes productivity
- LAN/USB/GPIB connections provide adequate remote control interfaces and optimum flexibility to expand an automated test system
- SCPI command compatibility with the Agilent ESA Series spectrum analyzers offers an easy migration path to a new generation test platform

Local Oscillator Frequency and Power Measurement

In order to receive and demodulate the satellite's signal, the LNBF's local oscillator (LO) must work at the correct frequency and appropriate power.

To implement the manual LO frequency and power measurements, set up the CXA signal analyzer as follows:

Note: Key names surrounded by [ ] indicate hardkeys located on the front panel, while key names surrounded by { } indicate softkeys located on the right of the display

1) Set center frequency: Press [FREQ Channel] > [1.7905] > {GHz}
2) Set span: Press [SPAN] > [10] > {MHz}
3) Set reference level: Press [AMPTD Y Scale] > [10] > {–dBm}
4) Set RBW: Press [BW] > [100] > {kHz}
5) Set peak marker and read the result: Press [Peak Search]. The result appears on the upper right of the display screen, as shown as Figure 2.

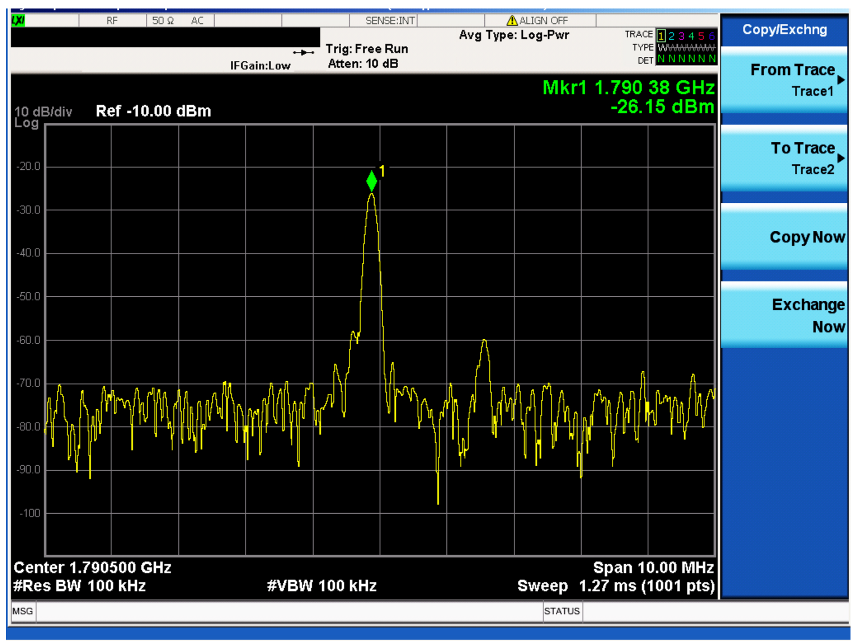

Figure 2. Figure 2. LO's frequency and power

If a manual test system is being used, there are two alternatives for making LO frequency and power measurements.

1. Using the Auto Tune function press [Frequency] > {Auto Tune}. The CXA will automatically find the signal and make the measurement.
2. Using the User State Register, perform Steps 1 through 5 mentioned previously

   a. Press [Save] > {State}
   b. Choose one of the six registers to save the setup
   c. To repeat the measurement, press [Recall] > {State} to recall the previously saved states.

The User State Register function can be used for most manual measurements.

Channel Gain Flatness Measurement

The signal received by the LNBF is typically a wide band signal so the LNBF's channel gain flatness is very important. If the channel gain flatness of the LNBF does not meet the requirement, it will impair the signal and degrade the signal quality, making demodulation more difficult.

To measure channel gain flatness, use the CXA signal analyzer as follows:

1) Set center frequency: Press [FREQ Channel] > [1.79] > {GHz}
2) Set span: Press [SPAN] > [60] > {MHz}
3) Set reference level and scale/div:
   Press [AMPTD Y Scale] > [33] > {–dBm} > {Scale/Div} > [2] > {dB}
4) Set RBW and VBW: Press [BW] > [2] > {MHz} > {Video BW} > [510] > {Hz}
5) Use peak-to-peak search to achieve the maximum delta power in the band:
   Press [Peak Search] > {More ½} > {Pk-Pk Search}

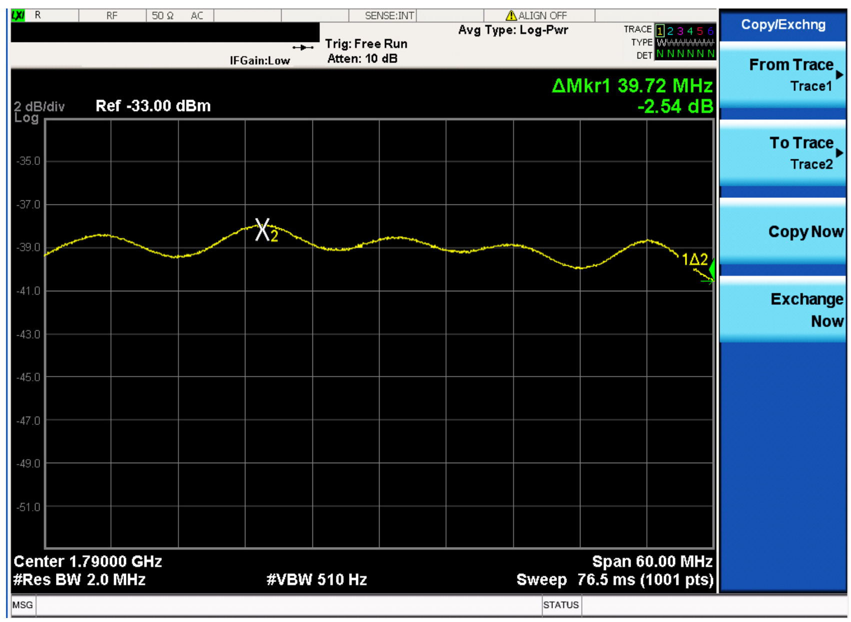

Figure 3. Channel gain flatness

Noise Figure Measurement

The CXA signal analyzer is the most affordable member of the Agilent X-Series signal analyzers and is a perfect replacement for the Agilent ESA spectrum analyzer. With more powerful performance, sophisticated analysis capabilities, and faster measurement speeds, the CXA brings you a versatile and essential signal characterization toolset available at a lower price point than ever before.

For more information about the CXA, visit **www.agilent.com/find/CXA**

For more information about migrating your ESA spectrum analyzers to CXA signal analyzers, visit **www.agilent.com/find/esa2cxa**

Noise figure and gain are key specifications because they define the LNBF's sensitivity. The CXA signal analyzer equipped with the W9069A noise figure measurement application provides noise figure and gain measurement capabilities. Because the noise source's excess noise ratio (ENR) determines the noise figure's range, using a low ENR noise source such as the Agilent N4000A smart noise source (4.6 to 6.5 dB) or 346A traditional noise source (5 to 7 dB) is recommended.

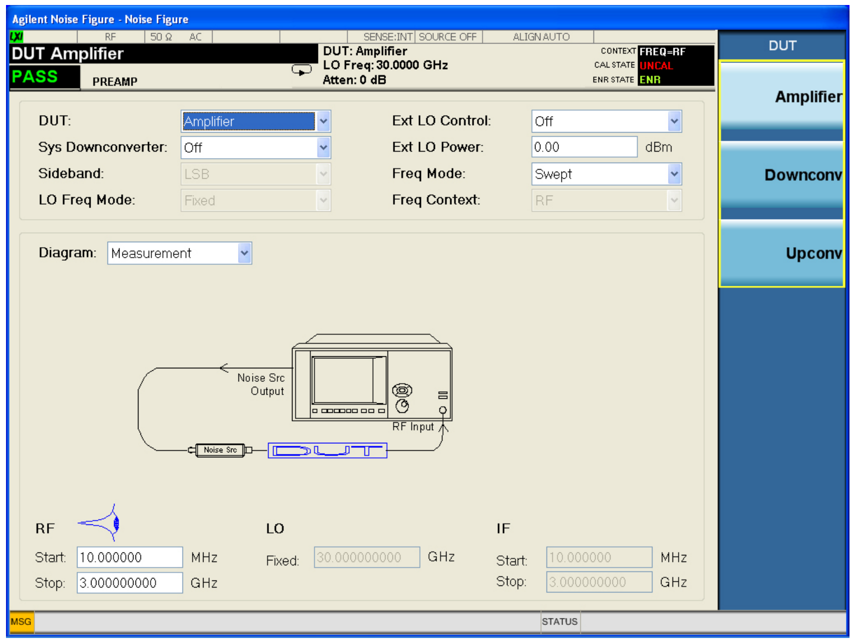

Figure 4. W9069A noise figure measurement application setup

For detailed manual measurement procedures, refer to the Agilent N9069A and W9069A Noise Figure X-Series Measurement Application Self-Guided Demonstration, literature number 5990-9835EN.

To learn more about noise figure measurements, visit **www.agilent.com/find/w9069a.**

Conclusion

A test configuration for LNBF using the CXA signal analyzer with other Agilent products provides the measurement capabilities necessary to ensure product quality. The affordably-priced, easy-to-use test equipment provides accurate, repeatable results with the speed and performance required in your manual or automated test environment.

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