AM Noise Measurements with the R&S FSUP 8 Signal Analyzer

Based on the R&S FSUP 8 Operating Manual – by A. M. Farson VA7OJ/AB4OJ 2023-11-08

Introduction.

The R&S FSUP Signal Source Analyzer can be used in conjunction with a zero-bias (zero-offset) microwave Schottky diode detector for amplitude (AM) noise measurement on test signals within its frequency range. The DUT output signal is fed to Input 2 on the FSUP front panel via the detector.

In this example, an R&S SMBV100A serves as the Normalization Signal Generator *and* the DUT.

The FSUP Operating Manual (FW 4.67.3) describes two basic AM noise measurement methods: Calibration File and Normalization. This short paper will describe the Normalization method, in which the detector is normalized against an AM test signal with 1% modulation at 1 kHz.

Please refer to the AM Noise section of the FSUP Operating Manual (starting on p. 4-51) and also to the FSUP Quick Start Guide. See also HP33330B-003 Data Sheet.

Recommended test signal level: +10 to +15 dBm. (**Note:** The Signal Generator and DUT *must* be set to the same output level.) To avoid overload, do not exceed ±1V DC at FSUP RF IN 2.

Procedure for AM Noise Measurements.

1. Press green PRESET key (important!)
2. SSA Home > AM Noise Measurement.
3. Settings > Detector Settings.
4. DISABLE AM MODULATION on Signal Generator. Connect Signal Generator output directly to FSUP RF IN 1 (diode detector not required yet).
5. Perform PREMEAS procedure:
   a. Press Freq & Level. Verify that Signal Generator output frequency & level are correctly displayed in Detector Settings field.
6. ENABLE AM MODULATION on Signal Generator and connect Signal Generator to RF IN 2 via diode detector. Set Modulation Index m = 0.01 (1% modulation) at 1 kHz sinewave.
7. Press NORMALIZE TO AM MOD, then NORMALIZE. In Marker 1 field, set Freq. Offset = 1 kHz.
8. Press STOP after one or two sweeps.
9. DISABLE AM MOD on Signal Generator.
   a. If DUT is separate from Signal Generator, connect DUT output to RF IN 2 via diode detector.
10. QUICKSET > [Next] > Change LNA GAIN to +40 dB.
11. Settings > Detector Settings > AM detector gain = -6 dB.
    a. For m = 0.01, modulation marker = -46 dBc. For 40 dB LNA gain, set det. gain = -6 dB.
12. SETTINGS > GENERAL SETTINGS > Start 1 Hz, Stop 1 MHz, Smoothing 20%.
13. TRACE > AVERAGE.
14. SWEEP > SINGLE SWEEP.
    a. SWEEP COUNT > 5 or 10.
15. Press CONTINUE. Wait for "Measurement Completed".
16. TRACE > SELECT TRACE > 2 > BLANK
17. QUICKSET > SPOT LIST to display Marker values. Also, spurs can be suppressed by selecting/deselecting HIGHLIGHT SPURS or SUPPRESS SPURS in the softkey list.
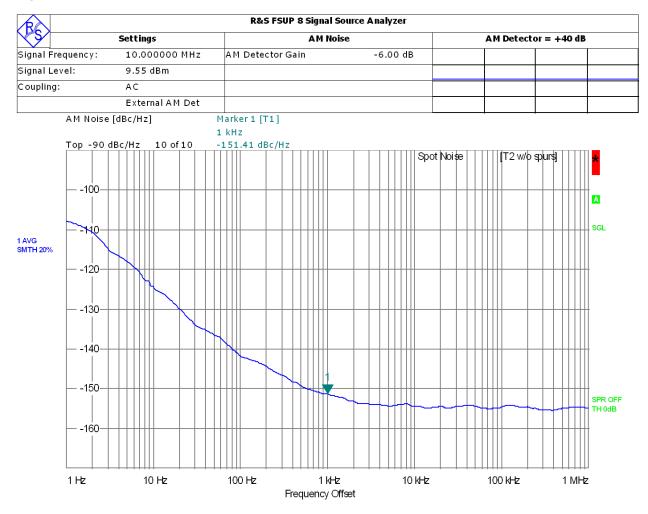18. Press HCOPY to print or save screen or trace.
    END

Figure 1. Typical FSUP AM Noise Chart.

R&S FSUP 8 Signal Source Analyzer							
Settings		**AM Noise**		**AM Detector = +40 dB**			
Signal Frequency:	10.000000 MHz	AM Detector Gain	-6.00 dB				
Signal Level:	9.55 dBm						
Coupling:	AC						
	External AM Det						

AM Noise [dBc/Hz]   Marker 1 [T1]
                                 1 kHz
Top -90 dBc/Hz   10 of 10   -151.41 dBc/Hz

Measurement Complete

AM Noise SMBV100A 10 MHz +10 dBm Det. HP33330A-003
Date: 9.NOV.2023   01:55:49

Figure 2. FSWP AM Noise Chart (taken on R&S FSWP Signal Analyzer).

Note on FSUP vs. FSWP AM Noise Measurements.

The limited sensitivity of the diode detector in the AM noise measurement mode on the FSUP limits the noise floor to -150...-160 dBc/Hz. As only one diode is used with the FSUP, cross-correlation provides no benefit. By contrast, both measurement channels are used for AM noise measurement in the FSUP; this reduces the dynamic-range averaging time. Thus, the FSWP can "see" AM noise down to -185 dBc/Hz.

It can be seen from Figures 1 and 2 that the FSUP tracks the FSWP reasonably well at offsets ≤ 1 kHz. Above 1 kHz offset, the FSUP AM noise curve levels off at ≈ -153 dBc/Hz, whereas the FSWP curve (blue) continues rolling off, finally levelling at -185 dBc/Hz (200 kHz offset).

Acknowledgements.