NPR Test on HPSDR Transceiver (Gar Fisher VA7GRR).

Adam Farson VA7OJ/AB4OJ. Iss.2, 7 June 2012.

Test Equipment:

W&G RS-50 White Noise Generator. Filters selected for Tests 1 & 2 as follows:

1. 60…5600 kHz Band Limiting (RSB-5600) and 5340 kHz Bandstop (RSB-5340 BN 728/60).
2. 60…4100 kHz Band Limiting (RSB-4100) and 3886 kHz Bandstop (RSB-3886 BN 726/60).

Mini-Circuits FT-1.5-1-B 75/50Ω matching transformer at output (insertion loss 0.35 dB). 50Ω port connected to DUT RF input.

HP 339A Distortion Measuring Set. Connected to DUT LINE audio output.

Marconi 2018A RF Signal Generator. Initially connected to DUT RF input to measure MDS.

Test Conditions:

HPSDR with "Mercury" receiver and "Alex" preselector. HPSDR tuned to bandstop filter centre frequency (5338.5 USB or 3887.285 MHz LSB). NR/NB/ATT off, default AGC. Preselector, Preamp, Dither & Random off/on as required by test case.

Test Procedure:

1. Using signal generator and distortion measuring set, measure MDS.
2. Disconnect signal generator and connect noise generator.
3. Increase noise generator output until LINE audio output increases by 3 dB.
4. Read P_{TOT} off attenuator of noise generator.
5. Calculate NPR as follows:

P_{TOT} = noise loading required to raise DUT audio output by 3 dB.

NPR = P_{TOT} - BWR - 0.35 - MDS, where BWR = 10 log (B_{RF}/B_{IF})

- B_{RF} = total noise bandwidth = (band-limiting filter BW – bandstop BW)
  - *where bandstop BW ≈ 3 kHz*
- B_{IF} = bandwidth of DUT IF channel = 2.4 kHz for this test case.

Thus, for Test 1: BWR = 10 log (5537/2.4) = 33.6 dB

Test 2: BWR = 10 log (4037/2.4) = 32.3 dB

6. Read NPR off HPSDR spectral display,
   where NPR in dB = (amplitude at top of notch) – (amplitude at bottom of notch)

The readings in steps 5 and 6 should agree to within 1 dB. ***Note:*** If the ADC starts to clip before the P_{TOT} value specified in Step 4 can be achieved, back off noise generator output until ADC does not clip within a 10 sec. (minimum) interval, omit step 5 and read NPR as per Step 6.

Test Results:

Test 1: f_0 = 5338.5 kHz (USB).							
MDS dBm	**Presel**	**Preamp**	**Dither**	**Random**	**P_{TOT} dBm**	**NPR dB**	**Notes**
-109	1	0	1	1	-4	71	
-126	1	1	1	1	-23	73	1,2
-107	0	0	1	1	-4	69	
-108	1	0	0	1	-4	70	
-106	1	0	1	0	-3	69	
-108	1	0	0	0	-4	70	
Test 2: f_0 = 3887.285 MHz (LSB).							
-110	1	0	0	0	-5	72	1,2,3
-111	0	0	0	0	-5	74	1,2,4

Notes:

1. Amplitude jitter observed on spectral display with preamp on.
2. NPR value read directly off spectral display per Step 6.
3. 71 dB NPR read off spectral display.
4. NPR degraded by 2 dB with preselector **on**. This suggests passive IMD in 80m preselector filter.

Remarks:

The **theoretical maximum NPR** for a 16-bit ADC is **85.4** dB, as compared to 74.01 dB for a 14-bit ADC. These values apply only for $B_{RF} = f_S/2$, where f_S is the sampling frequency. When BRF is limited by the band-limiting filter, we must subtract the process gain from the theoretical maximum NPR:

$G_P = 10 \log (fs/2B_{RF})$

Thus, assuming f_S = 122.8 Ms/s, G_P = 10.5 dB for Test 1, and 12 dB for Test 2. This yields maximum theoretical NPR values of **74.9** and **73.4** dB respectively. The test results obtained above appear reasonably close to these ideal values (with process gain factored in).

Links:

Noise Power Ratio (NPR) Testing of HF Receivers

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