

NPR Test on HPSDR Transceiver (Gar Fisher VA7GRR).

Adam Farson VA7OJ/AB4OJ. 5 February 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 \approx 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. Thus, the HPSDR receiver exhibits a significant deviation from the theoretical maximum value (much more so than the Perseus, whose highest NPR value in my August 2011 test was 75 dB at 5340 kHz.)

The RF preamplifier in the Mercury receiver is in the RF signal path at all times. A 20 dB pad is switched in at the preamp input for the "Preamp out" function. Apparently, the noise loading provokes sufficient IMD in the preamp to degrade the NPR as much as 12 dB below the theoretical maximum value. (The optimum noise loading value decreases by 19 dB with the attenuator out, which reflects the inserted 20 dB attenuation pretty closely.)

Links:

[Noise Power Ratio \(NPR\) Testing of HF Receivers](#)

Adam Farson VA7OJ/AB4OJ, North Vancouver, BC, Canada

5 February 2012

HPSDR built by: Gar Fisher VA7GRR, Vancouver, BC, Canada