Baofeng UV-5R receiver sensitivity measurements

PA3FYM, April 2012

Introduction
Many people consider the Baofeng UV-5R the successor of the suprisingly popular UV-3R/UV-100 models. As far as I could ascertain at this moment of writing, Hans PD0AC [1] was the first who published some results of actual measurements on his Baofeng UV-5R.
In a private communication with Hans I promised him to measure my Baofeng UV-5R.
In this contribution my results are presented.

Measurement conditions and procedure
The Baofeng UV-5R was put into 'dual watch mode', i.e. menu item 7 (TDR) was set to 'ON'.
Menu item 5 (W/N) was set to 'WIDE'. Selected VHF and UHF frequencies were 145.000 MHz, and 432.000 MHz respectively. A Rohde & Schwarz SMS2 (old, but still going strong ;-) signal generator was used as RF-source. Calibrated output level accuracy of the R&S SMS2 is ± 1.5 dB, minimum signal level is -137 dBm (0.03 μV). The Baofeng UV-5R was connected to the signal generator, and the injected signal was varied with 1 dB steps.

The SMS2 has a tone generator, but I always to use the 'quieting' method to measure sensitivities of FM-receivers. Quieting makes it very easy to tune FM-receivers because e.g. frontend coils can be tweaked to *minimum* audio meter reading, assuming that the IF and discriminator are 'on frequency'. Although being a topic of debate, in practice it appears that 20 dB quieting equals 12 dB SINAD [e.g. 2].

With an 'open receiver', i.e. squelch level was set to '0', I defined three states:

a) when I could hear a difference between 'no signal' and 'signal'
b) 10 dB quieting (meter reading is ~3/10th of the noise level)
c) 20 dB quieting (meter reading is 1/10th of the noise level)

For squelch levels 1 – 9 (menu item 0) the injected signal was increased with 1 dB steps until the squelch opened *within one second*, and subsequently decreased until the squelch closed.

In table 1 (next page) the results of my measurements are presented.

@145 MHz 20 dB quieting was measured at -125 dBm (0.13 μV), while @432 MHz this value amounts -131 dBm (0.06 μV). @432 MHz I reached the limits of my RF-generator.

The performance of squelch levels 1 – 7 @145 MHz measured equal, while @432 MHz squelch levels increase with ~1dB steps.

Although I don't want to draw conclusions, I consider my Baofeng UV-5R receiver very sensitive.

I did not measure other parameters (like strong signal behaviour etc.), so how the UV-5R behaves with an external antenna is perhaps for somebody else to find out?

	145.000 MHz		432.000 MHz		note
SQuelch level	SQ open (dBm)	SQ close (dBm)	SQ open (dBm)	SQ close (dBm)	
0	-132	----	-136	----	± 1 dB
0	-129	----	-133	----	~10 dB quieting
0	-125	----	-131	----	~20 dB quieting
1	-130	-133	-135	-137	
2	-130	-133	-134	-136	
3	-130	-133	-134	-135	
4	-130	-133	-133	-134	
5	-130	-133	-132	-133	
6	-130	-133	-131	-132	
7	-130	-133	-130	-131	
8	-129	-132	-129	-130	
9	-129	-130	-128	-129	

Table 1. Baofeng UV-5R receiver sensitivity measurements by PA3FYM

Addendum:
The RF-output of my UV-5R was measured with a HP-432A power meter in conjunction with calibrated attenuators. Battery status: 'fully charged' (i.e. green led on the charger).

Menu item 2 (TXP)	'HIGH'	'LOW'
145 MHz:	3.4W ± 50mW	0.85W ± 50mW
432 MHz:	3.6W ± 50mW	0.90W ± 50mW

Hans [1] asked me to measure the frequency accurary of my Baofeng UV-5R too, because some people claim the UV-5R being 'off frequency'. I assumed that the transmit frequency is an indicator for the PLL accuracy for both RX and TX, as I did not open the UV-5R to measure the local oscillator frequency itself. Measurements with a HP-5326A (yes, nixie tubes! ;-) and a homebrew prescaler, in conjunction with a calibrated rubidium standard as time base, revealed the following results
(sample time: 10 sec, accuracy 10 Hz):

UV-5R display	frequency	
145.000 (MHz)	145.000.040 MHz	(+ 40 Hz)
432.000 (MHz)	431.999.930 MHz	(- 70 Hz)

My UV-5R frequency accurary @145 and 432 MHz is (far) better than 0.5 ppm, which is very good.

References
[1] http://hamgear.wordpress.com
[2] http://www.repeater-builder.com/measuring-sensitivity/measuring-sensitivity.html