Sherwood Engineering HF Test Results

Model IC-7600 Serial # 0201456 Test Date: 09/02/2009

IF BW 6000 –6 / -60, kHz	Ultimate		dB
IF BW 2400 –6 / -60, kHz	Ultimate		dB
IF BW 1800 –6 /-60, kHz	Ultimate		dB
IF BW 500 –6 /-60, Hz 540 / 800	Ultimate	78	dB*

* Phase noise degrades noise floor by 3 dB, signal 2 kHz away.

Front End Selectivity (A – F)		B
First IF Rejection @ 64.455 MHz	102	dB

Dynamic Range 100 kHz	dB	IP3		dBm	
Dynamic Range 20 kHz Noise limited 100	dB	IP3	+20	dBm	*
Dynamic Range 5 kHz	dB	IP3		dBm	
Dynamic Range 2 kHz Noise limited 78	dB	IP3	-13	dBm	*
Dynamic Range 1 kHz	dB	IP3		dBm	

* Since the radio is phase noise limited, IP3 is rather meaningless.

Blocking above noise floor,100 kHz, AGC On, 1 uV signal: Noise limited	126	dB
Phase noise (normalized) at 10 kHz spacing:	121	dBc
Noise floor, SSB bandwidth 14 MHz, Preamp Off	-123	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 1 On	-132	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 2 On	-134	dBm
Sensitivity at 14 MHz, Preamp Off	0.43	uV
Sensitivity at 14 MHz, Preamp 1 On	0.16	uV
Sensitivity at 14 MHz, Preamp 2 On	0.11	uV
Noise floor, 500 Hz, 14.2 MHz, Preamp Off	-130	dBm
Noise floor, 500 Hz, 14.2 MHz, Preamp 1 On	-138	dBm
Noise floor, 500 Hz, 14.2 MHz, Preamp 2 On	-141	dBm
Noise floor, SSB, 1.9 MHz, Preamp Off	-125	dBm
Noise floor, CW, 1.9 MHz, Preamp Off	-130	dBm
Sensitivity, 1.9 MHz, Preamp Off	0.39	uV
Noise floor, 500 Hz, 50.125 MHz, Preamp Off	-130	dBm
Noise floor, 500 Hz, 50.125 MHz, Preamp 1 On	-139	dBm
Noise floor, 500 Hz, 50.125 MHz, Preamp 2 On	-141	dBm
Noise floor, SSB, 50.125 MHz, Preamp Off	-124	dBm
Noise floor, SSB, 50.125 MHz, Preamp 1 On	-133	dBm
Noise floor, SSB, 50.125 MHz, Preamp 2 On	-136	dBm

Sensitivity, 50.125 MHz, Preamp Off	0.41	uV
Sensitivity, 50.125 MHz, Preamp 1 On	0.14	uV
Sensitivity, 50.125 MHz, Preamp 2 On	0.11	uV

Signal for S9, Preamp Off, with roofing filter 15 / 6 / 3 kHz	58 / 63 / 104	uV
Signal for S9, 3-kHz roofing, Preamp Off, Preamp 1, Preamp 2	-66 / -73 / -80	dBm
Insertion loss of roofing filters: 15 kHz = reference, 6 & 3 kHz	0.8 / 5.0	dB
Preamp(s), dB gain,	7 / 14	dB

Spectrum scope, minimum discernable signal, span +/- 25 kHz	2.5	uV

AGC threshold vs. roofing filter	15 kHz	6 kHz	3 kHz	
AGC threshold at 3 dB, Preamp Off	2.98	3.24	5.3	uV
AGC threshold at 3 dB, Preamp 1 On	1.32	1.43	2.35	uV
AGC threshold at 3 dB, Preamp 2 On	0.64	0.69	1.13	uV

S meter linearity:	S9 to S9 + 60 dB	Perfect
Below S9, it averages 2.5 dB per S unit		
S9 - 5 dB		S 7.5
S9 - 10 dB		S6
S9 - 15 dB		S4
S9 - 20 dB		S2
S9 - 25 dB		S0

Noise pedestal, 500 Hz filter, vs. broadband noise to 10 kHz	45	dB
(IF noise in CW passband with no signal vs. broadband noise)		
(A larger number is better, 30 dB is adequate)		

Notes:

The preamp exhibited unusual characteristics. Usually when a preamp is turned on with no signal, the noise from the receiver goes up a few dB. In this case with Preamp 1 enabled, the noise went down 2 dB. Preamp 1 gain is only 7 dB, but the noise went down 2 dB, so it acts more like 9 dB. With Preamp 2 vs. no preamp, the noise went up 2 dB.

From a dynamic range or blocking standpoint, the radio is completely phase noise limited. One cannot see or hear any 3rd order products at all, even with a 3 Hz spectrum analyzer (SA) bandwidth at the point where the noise floor is degraded 3 dB.

With the phase noise dominating, it is difficult to see how the 6 or 3 kHz roofing filters provide any actual improvement over the 15 kHz filter. The 3 kHz roofing filter measured 7.6 kHz wide at -6 dB. The 6 kHz filter is greater than 9.15 kHz. These were measured by putting the radio into AM mode, and selecting the widest AM filter bandwidth of 9 kHz, and then measuring the total bandwidth, DSP plus roofing.

In comparison to the 756 Pro III, the radios are very similar in most respects, except the phase noise is worse by 5 dB in the 7600.

When measuring blocking, a signal 130 dB above the CW noise floor (500 Hz BW) does not actually block the signal, but the noise floor is raised 8 dB and the tone is barely audible by ear. The 1 uV tone is visible on the audio spectrum analyzer (SA). The S meter is starting to wiggle from the phase noise, and the AGC is keeping the noise at the speaker from raising more than 8 dB. At 135 dB above the noise floor, the tone is inaudible by ear, and can barely be discerned on the SA. The S meter now reads S 0.7 S units. At 140 dB above the noise floor, the phase noise reads S1, and there is no hint of the 1 uV signal, even on the SA.

When measuring 3rd order dynamic range at 2 kHz, it is possible to feed in a strong enough signal to see the IMD above the phase noise, but the noise floor has been raised by 7.5 dB. The tone on the SA with a 3 Hz IF filter and a 3 Hz video filter averages 10 dB above the phase noise. The IMD does follow a 3:1 ratio down to the point that the IMD disappears into the noise.

Since the nominal 3-kHz roofing filter has 5 dB loss over the 15 kHz filter, it is likely most people will run Preamp 1 all the time. With this setting, S9 = 50 uV = -73 dBm. So in other words, the S meter is properly calibrated with the 3-kHz roofing filter and Preamp 1 enabled.

A comment on Noise Pedestal: A Yaesu Mk V has a pedestal of about 33 dB. An Elecraft K3 has a pedestal of about 40 dB. The highest value yet observed is 75 dB for the Flex 3000. This is a rather new measurement, so there is not much data available yet. Any value 30 dB or higher is likely adequate, though 50 dB would be desirable so that hiss way outside the IF passband is not obvious and fatiguing.

The 7600 continues the tradition set by the IC-7800 of having a significantly inferior spectrum display, assuming one wants to see weak (1 uV or weaker) signals to pounce on. A 2.5 uV signal can be observed above the band scope “grass”. (Reference a +/- 25 kHz total span on the display) The Pro III is much better than the 7600, and nothing rivals the IC-781 in respect to zero “grass” in the display. Some 7800 owners argue that if one sets the display to +/- 2.5 kHz (total span of 5 kHz) one can see a 1 uV signal. What good is a spectrum display for S&P that only covers 5 kHz?

Revision B