Sherwood Engineering HF Test Results

Model IC-7760 Serial # 12001144			Test Date: 02/20/2025 - 03/20/2025				
IF BW 2 IF BW 5 IF BW 2 IF BW 1 ^ See no	2400 Hz -6 / -6 500 Hz -6 / -60 250 Hz -6 / -60 50 Hz -6/ -60 tes	60 0 0)	2524/3458 515/663 255/343 163/243	SF 1.37 SF 1.28 SF 1.34 SF 1.49	Ultimate Ultimate Ultimate Ultimate	108 d 108 d 108 d 108 d	B A B B B
Front Er	d Selectivity	with Di	gi-Select tracl	king preselecto	or (A – F)	А	
Dynamie Dynamie Dynamie Dynamie Dynamie	c Range Main c Range 20 kH c Range 10 kH c Range 5 kH c Range 2 kH	i Receiv Hz Hz z z	er, no preamp	9, IP+ ON		98 98 98 98	dB dB dB dB
Dynamie Dynamie Dynamie Dynamie Dynamie	c Range Sub I c Range 20 kH c Range 10 kH c Range 5 kH c Range 2 kH	Receive Hz Hz z z	r, no preamp,	IP+ ON		99 99 99 99	dB dB dB dB
Blocking (Or ADO	g above noise C overload for	floor, 1 r direct	uV signal @ sampling radio	100 kHz, AGC os)	COn,	122	dB
Reciproc	cal Mixing Dy	ynamic	Range (RMD)	R)			
Spacing	kHz dB						
1 1 2 1 3 1 4 1 5 1 6 1 7 1 10 0 # See no	12 dB 12 dB 12 dB 15 dB 19 dB 20 dB 21 dB DVF # ttes						
Phase no Phase no Phase no Phase no	oise (normaliz oise (normaliz oise (normaliz oise (normaliz	xed) at 2 xed) at 5 xed) at 7 xed) at 1	kHz spacing: kHz spacing: kHz spacing: 0 kHz spacing	<i>z</i> :	-139 -146 -148	dBc/H dBc/H dBc/H OVF	Iz Iz Iz #

See notes

Noise floor, SSB bandwidth 14 MHz, no preamp		-127	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 1 On		-134	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 2 On		-136	dBm
Sensitivity SSB at 14 MHz, no preamp		0.32	uV
Sensitivity SSB at 14 MHz, Preamp 1 On		0.12	uV
Sensitivity SSB at 14 MHz, Preamp 2 On		0.10	uV
Noise floor, 500 Hz, 14.2 MHz, no preamp		-133	dBm
Noise floor, 500 Hz, 14.2 MHz, no preamp, IP+ ON		-128	dBm *
Noise floor, 500 Hz, 14.2 MHz, Preamp 1 On		-141	dBm
Noise floor, 500 Hz, 14.2 MHz, Preamp 2 On * See notes		-142	dBm
Noise floor, SSB, 50.125 MHz, no preamp		-126	dBm
Noise floor, SSB, 50.125 MHz, Preamp 1		-134	dBm
Noise floor, SSB, 50.125 MHz, Preamp 2		-137	dBm
Sensitivity, SSB, 50.125 MHz, no preamp		0.33	uV
Sensitivity, SSB, 50.125 MHz, Preamp 1		0.14	uV
Sensitivity, SSB, 50.125 MHz, Preamp 2		0.10	uV
Noise floor, 500 Hz, 50.125 MHz, no preamp		-132	dBm
Noise floor, 500 Hz, 50.125 MHz, Preamp 1 On		-140	dBm
Noise floor, 500 Hz, 50.125 MHz, Preamp 2 On		-142	dBm
Signal for S9, no preamp 20 meters	-73 dBm	50	uV
Signal for S9, Preamp 1	-78 dBm	28	uV
Signal for S9, Preamp 2	-79 dBm	25	uV
Signal for S9, no preamp 6 meters	-73 dBm	50	uV
Signal for S9, Preamp 1	-80 dBm	22	uV
Signal for S9, Preamp 2	-83 dBm	16	uV
Gain of preamp(s)			
Preamp 1		12	dB
Preamp 2		20	dB
AGC threshold at 3 dB, no preamp		2.65	uV
AGC threshold at 3 dB, Preamp 1 On		1.40	uV
AGC threshold at 3 dB, Preamp 2 On		1.30	uV

Notes:

^ Ultimate rejection at 5 kHz offset 500 Hz filter

Phase noise & RMDR measurement limited at wider offsets due to ADC limit. These values are excellent.

* Noise floor degradation due to IP+ being enabled is reduced with preamp 1 and negligible with preamp 2.

During initially testing the 7760, I noted an AC ripple (not hum) on a signal generator carrier, plus odd sounding receiver noise. The audio just wasn't clean. It also made it impossible to measure audio distortion with an HP 8903E analyzer. When looking at an audio sine wave on a Tektronix scope, 60 Hz was superimposed on the audio signal, causing the signal to jump around.

The issue was caused by the RF unit being on a different AC circuit than the "wall wart" that powers the Ethernet-connected control head. Eliminating the AC ground loop by plugging the two Icom units into the same power strip solved the ripple problem. I also plugged the HP distortion analyzer into the same power strip, though that may not have been necessary. I did not plug the oscilloscope into the common power strip.

Problem solved.

The practical problem:

Since the RF unit and the control unit may be up to 100m apart, an AC ground loop may be difficult to eliminate. Two different locations in a house would often be on different circuit breakers.

Differences between the IC-7760 and the IC-7610:

The 7760 with an internal AC only power supply is rated at 200 watts vs. 100 watts and an external power supply for the 7610.

The 7760 preamps can be activated ahead of the Digi-Select tracking preselector. With a 7610 if a preamp is enabled, turning ON Digi-Sel disables any preamp.

The 7760 has a small secondary LCD scope that makes it easy to center a CW signal in the DSP filter. On the other hand, individual band buttons are gone, and selecting a band is done on the main LCD screen as it is with an IC-7300.

There are four transmit antenna ports vs. two.

The CW 1/4-tuning speed option is a soft button on the lower left main LCD screen, not in a menu. This is a convenient use of an otherwise blank soft button.

The major laboratory numbers for the 7760 and the 7610 are virtually identical. From an on-air standpoint, it would be impossible to observe these minor differences in lab data. This includes the 500-Hz noise floor, SSB sensitivity, Blocking (ADC OVF), 2-tone dynamic range at any test spacing and the absolute OVF level that is dependent on preamp and attenuation selections.

Attenuation is optionally in 3 dB steps up to 45 dB beyond 6, 12 & 18 dB as is the 7610.

S meter calibration at S9 is 50 uV / -73 dBm with no preamp, and 3 dB per S unit as is the 7610. Above S9 both transceivers are very accurate.

RC-28 secondary tuning knob recommended for the sub receiver as with the 7610.

Audio distortion Icom SP-20 8-ohm speaker output with an S9+10 dB signal:

Voltage RMS	Power Watts	THD Distortion %
1.0	0.125	0.15
0.5	0.031	0.33
0.25	0.008	0.50
4.0	2.0	0.95
4.75	2.8	10% (clipping)

The IC-7760 has two identical direct sampling receivers. No two ADC chips are exactly the same thus the minor difference in dynamic range between Main and Sub. Another random sample 7760 would likely be slightly different. In general rig to rig variation in 2-tone dynamic range for direct sampling radios is often a few dB.

A mouse still is only functional within the band scope & waterfall.

The accessory pedestal needs much more tilt on the order of 2 inches for a better viewing angle. There is no tilt-bail per se, a silly oversight.

Transmit composite noise 20m (Does not pass CSI mask)					
Power Level	200 W dBc/H	z 100 W dBc/Hz	30 W dBc/Hz		
Offset kHz					
5 kHz	-122	-121	-118		
10 kHz	-119	-118	-116		
20 kHz	-123	-122	-120		
50 kHz	-133	-133	-129		
75 kHz	-141	-138	-133		
100 kHz	-143	-140	-134		

Key Click Bandwidth Hz, Semi-Break-in, rise time 8ms (Does not pass CSI mask)

-20 dB	166
-40 dB	364
-60 dB	999

Odd-order distortion SSB 20m (Easily passes CSI with DPD enabled on any band)

Watts PEP	3 rd DPD OFF	5 th DPD OFF	3 rd DPD ON	5 th DPD ON
50 W	-32 dBc	-51 dBc	-67 dBc	-70 dBc
100 W	-35 dBc	-36 dBc	-67 dBc	-68 dBc
150 W	-32 dBc	-36 dBc	-65 dBc	-67 dBc
200 W	-28 dBc	-40 dBc	-61 dBc	-68 dBc

With DPD OFF, higher order distortion products improve, however 9th order is higher than 7th order. See screen captures for both OFF and ON at 100 watts PEP.

With DPD ON, higher order distortion products improve to a lesser extent.

Two-tone test signals were fed into the Line In port. Generators were an HP 3325A and HP 3336C. Line IN port gain was at default 50%. At a nominal 100 mV RMS input level the ALC reading was S7. At 50 mV RMS input level the ALC reading was S3. Distortion products did not change more than 2 dB with the audio drive level. Multiple distortion runs showed a variation of around 2 dB.



DPD OFF 20 meters 100 watts

DPD ON see below

PERSEUS		١×
ATT	-13 $\gamma = \gamma$ Mkr1 : 14200.671 kHz	-
Off 10 dB 20 dB 30 dB	-23 Mkr2-1: 1.190 kHz	
FRONT-END	-0.6 dB	-
Presel Preamp Dither	-69.8 dB	
AMPLITUDE	-63 Mkr4-11-2-411 kHz -67.6 dB	Ø
-3 V A	-73 -53 <u>8</u> 7 6 5 7 3 Mkr5-1:-3.601 kHz -73.7 dB	
Scale (dB/div)	-93 / / / / / / / / / / / / / //////////	
10 🔽 🔺		
FREQUENCY	-123	0
14 200000	-133 Mkr8-1: -7.202 kHz -72.8 dB	
14.200	10	
Span (kHz) / RBW (Hz)	1995 19188 19190 19192 19194 19196 19198 19100 19702 19304 19306 19308 1910 19212	T
25.0 / 30.5 V	Sand WEall Zoon Paletic Lande Paulon NEV NEN NEW Arc Middon Pause Midde Clear En	
20 0 kHz T		
Wheel Step	AM SAM CW RTTY LSB USB FM DRM USA	
10 Hz 🔽 🔼	BW 97.0 Hz AVG NB MKR Level (dBm): -134.5 S-MTR AF	
700000	Sokhz Main See Lev Ck -120 -100 -80 -60 -40 -720 0 Rms NR V	
	25kHz 5 i 2 3 4 5 6 7 8 9 +10+20+30+40+50+60+70	
Center		
SAMPLING RATE (KS/s)		
INPUT SELECT		
Perseus Way Net		
PLAYBACK / REC	PBT Norch ANorch CWPeak Off HFCC EBI User1 User2 ALL Bank	
Date: Thu 06-Mar-2025 Time:	: 15:18:17 File: VCom Off	

DPD ON 20m 100 watts

Tests on 80m and 10m were similar but with less 3rd order compression than on 20m. Typical -3rd order IMD product was -57 dBc for both 80 & 10m. All test at 100 watts.

Spectrum screen captures for 160m 3rd order -56 dBc and 6 meters -57 dBc.

PERSEUS			- 🛛
ATT	·3 1 2	Mkr1 : 1828.108 -12.4	kHz 🔺
Off 10 dB 20 dB 30 dB		Mkr2-1: 1.190	kHz 🗏
FRONT-END		0.2 Mkr3-1: -1.221	ав kHz —
Presel Preamp Dither	-43	-55.9	dB
AMPLITUDE Bof Ley (dBm)	-53	Mkr4-1: 2.380 -61.8	dB 🚫
7 🔽 👗	-73 5 7 / 1 4	Mkr5-1: -2.411	kHz
Scale (dBldiv)	-83 7 7 / / 6 8	Mkr6-1: 3.601	kHz =
10 🔽 🛣		-76.4	dB
FREQUENCY	mile a love to a free to a	Mkr7-1:-3.601	
1 920000	-123	Mkr8-1: 4.791	kHz
1.030000	-133	70.0	=
Span (kHz) / RBW (Hz)	-243 1818 1820 1822 1824 1826 1828 1800 1832 1824 1826 1876		
25.0 / 30.5 🔻 🔺		1840 18	54Z
CF Step	Spect What Zoom Control Labels PeakSrc NBW NBN NBV Arc MkrLog Pause MHold Clear Fn	FFT	
	AM SAM CW CRTTY LSB USB FM CORM CUSER		
10 Hz T			
	Main Sec Lov 120 -100 -80 -60 -40 -20	0 S-MTR	AF Vol
TUNING		H Rms E	
Center CalCk	Deka 5 1 2 3 4 5 6 7 8 9 +10+20+30+40+50+60	-70 Reak	
SAMPLING RATE (kS/s)			
125 250 500 1000 2000			
INPUT SELECT	16kHz		
Perseus Way Net File			
PLAVBACK / DEC			
Date: Thu 20-Mar-2025 Time:	19:19:22 min	Bank	
		VCon	n Off
			COCCUPACION OF



⁶m IMD DPD ON 100 watts

Note: All IMD measurements are dBc reference the two test tones. Add 6 dB for PEP.

Additional Transmit IMD with DPD (digital pre-distortion) OFF 160m and 6m 100 watts.

On 160m 3rd order IMD is -30 dBc, and on 6m IMD is -27 dBc.

In general Icom DPD reduces 3rd order IMD by about 30 dB.

Testing of the companion PW2 is on-going.



160m IMD DPD OFF 100 watts

(6m see below)



6m DPD OFF 100 watts

Rev 1g