Sherwood Engineering HF Test Results

Model IC-7760 Serial # 12001144 Test Date: 02/20/2025 - 03/05/2025

IF BW 2400 Hz -6 / -60	2524/3458	SF 1.37	Ultimate	108 dB
IF BW 500 Hz -6 / -60	515/663	SF 1.28	Ultimate	108 dB ^
IF BW 250 Hz -6 / -60	255/343	SF 1.34	Ultimate	108 dB
IF BW 150 Hz -6/ -60	163/243	SF 1.49	Ultimate	108 dB

^ See notes

Front End Selectivity with Digi-Select tracking preselector (A – F) A

Dynamic Range Main Receiver, no preamp, IP+ ON

Dynamic Range 20 kHz	98	dB
Dynamic Range 10 kHz	98	dB
Dynamic Range 5 kHz	98	dB
Dynamic Range 2 kHz	98	dB

Dynamic Range Sub Receiver, no preamp, IP+ ON

Dynamic Range 20 kHz	99	dB
Dynamic Range 10 kHz	99	dB
Dynamic Range 5 kHz	99	dB
Dynamic Range 2 kHz	99	dB

Blocking above noise floor, 1uV signal @ 100 kHz, AGC On, 122 dB
(Or ADC overload for direct sampling radios)

Reciprocal Mixing Dynamic Range (RMDR)

Spacing kHz	dB
1	112 dB
2	112 dB
3	112 dB
4	115 dB
5	119 dB
6	120 dB
7	121 dB
10	OVF #

See notes

Phase noise (normalized) at 2 kHz spacing:	-139	dBc/Hz
Phase noise (normalized) at 5 kHz spacing:	-146	dBc/Hz
Phase noise (normalized) at 7 kHz spacing:	-148	dBc/Hz
Phase noise (normalized) at 10 kHz spacing:		OVF #

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		-142	dBm
* See notes			
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/Hz	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

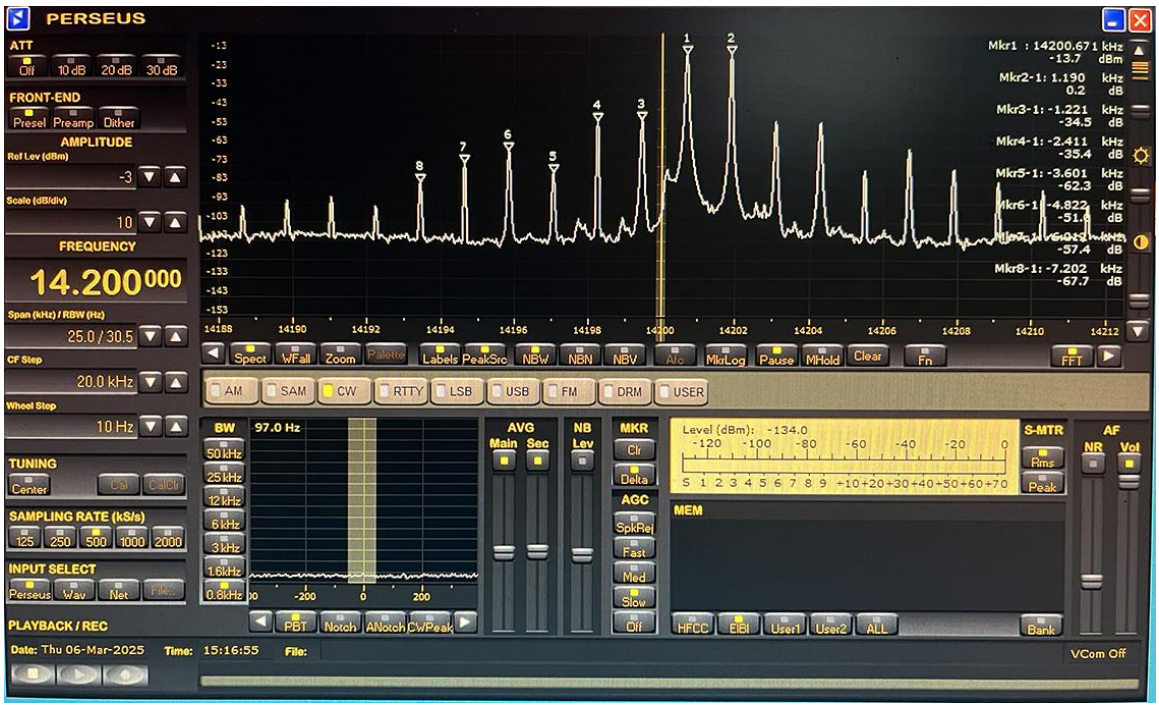
Odd-order distortion SSB 20m (Easily passes CSI with DPD enabled)

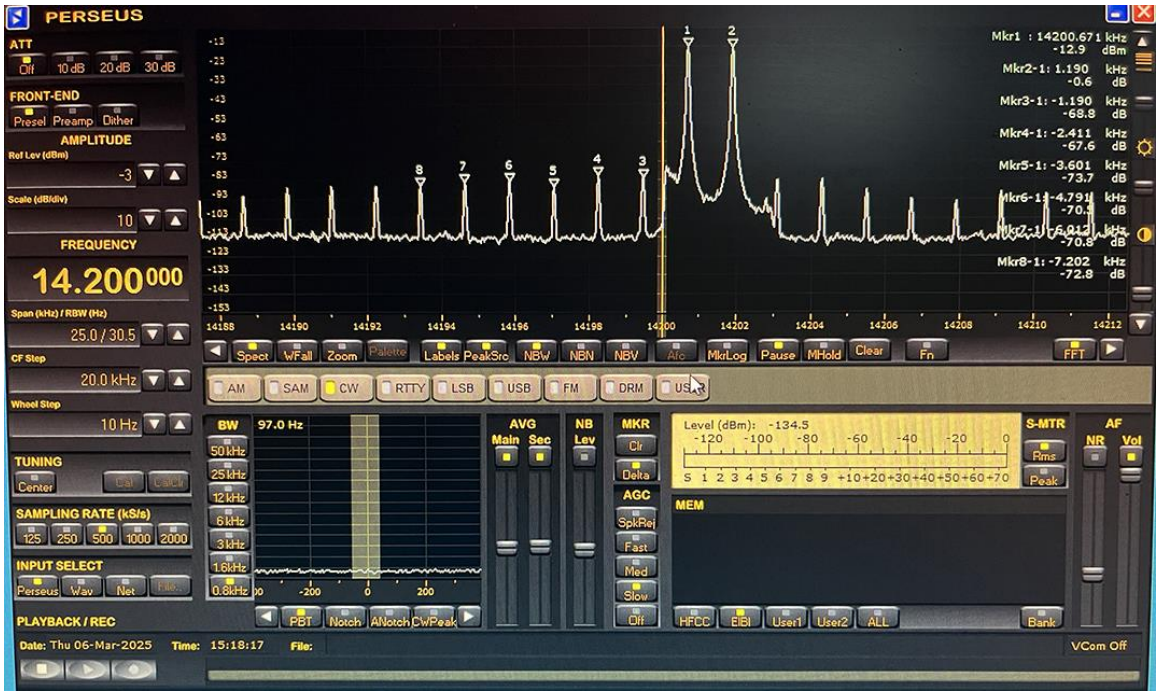
Watts PEP	3^{rd} DPD OFF	5^{th} DPD OFF	3^{rd} DPD ON	5^{th} DPD ON
50 W	-32 dBc	-51 dBc	-67 dBc	-70 dBc
100 W	-35 dBc	-36 dBc	-67 dBc	-68 dBc
150 W	-32 dBc	-36 dBc	-65 dBc	-67 dBc
200 W	-28 dBc	-40 dBc	-61 dBc	-68 dBc

With DPD OFF, higher order distortion products improve, however 9^{th} order is higher than 7^{th} 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 1 dB. Multiple distortion runs showed a variation of around 1 dB.




PERSEUS
ATT
Off
10 dB
20 dB
30 dB
FRONT-END
Presel
Preamp
Dither
AMPLITUDE
Ref Lev (dBm)
-3
Scale (dB/div)
10
FREQUENCY
14.200000
Span (kHz) / RBW (Hz)
25.0 / 30.5
CF Step
20.0 kHz
Wheel Step
10 Hz
TUNING
Center
SAMPLING RATE (kS/s)
125
250
500
1000
2000
INPUT SELECT
Perseus
Wav
Net
File
PLAYBACK / REC
Date: Thu 06-Mar-2025
Time: 15:18:17
File:
Mkr1 : 14200.671 kHz
-12.9 dBm
Mkr2-1: 1.190 kHz
-0.6 dB
Mkr3-1: -1.190 kHz
-68.8 dB
Mkr4-1: -2.411 kHz
-67.6 dB
Mkr5-1: -3.601 kHz
-73.7 dB
Mkr8-1: -7.202 kHz
-72.8 dB
Spect
WFall
Zoom
Palette
Labels
PeakSrc
NBW
NBN
NBV
Afc
MkrLog
Pause
MHold
Clear
Fn
FFT
AM
SAM
CW
RTTY
LSB
USB
FM
DRM
USER
BW
97.0 Hz
50 kHz
25 kHz
12 kHz
6 kHz
3 kHz
1.8kHz
0.8kHz
PBT
Notch
ANotch
CWPeak
AVG
Main
Sec
NB
Lev
MKR
Clr
Delta
AGC
SpkRej
Fast
Med
Slow
Off
Level (dBm): -134.5
S-MTR
Rms
Peak
MEM
HFCC
EIBI
User1
User2
ALL
Bank
AF
NR
Vol
VCom Off

Rev 1e