Sherwood Engineering HF Test Results

Model FTdx-101D Serial # 9F010008 Starting test date: 05/10/2019

IF BW 2400 –6 / -60, 2443/3231 Hz	Ultimate	105	dB
IF BW 500 –6 /-60, 491/708 Hz	Ultimate	110	dB
Front End Selectivity (A – F)	tracking preselector		A
First IF rejection 9 MHz		88	dB
Dynamic Range with radio, no preamp			
Dynamic Range 20 kHz		110	dB
Dynamic Range 10 kHz		110	dB
Dynamic Range 5 kHz		110	dB
Dynamic Range 2 kHz		110	dB
Dynamic Range with radio, Preamp 1			
Dynamic Range 20 kHz		110	dB
Dynamic Range 10 kHz		110	dB
Dynamic Range 5 kHz		110	dB
Dynamic Range 2 kHz		110	dB
Dynamic Range with radio, 2nd radio			
Dynamic Range 20 kHz			dB
Dynamic Range 2 kHz			dB
Dynamic Range with radio, alternate conversion scheme			
Dynamic Range 20 kHz			dB
Dynamic Range 2 kHz			dB
Blocking above noise floor, 1uV signal @ 100 kHz, AGC On, (Or ADC overload for DS SDR radios)		147	dB

Reciprocal Mixing Dynamic Range (RMDR)

Spacing kHz	dB	
2.5	124	dB
5	126	dB
10	127	dB
15		
20	128	dB
25		
30		
40		
50	128	dB
75		
100	128	dB
200	128	dB
300		
400		
500		

Phase noise (normalized) at 2.5 kHz spacing:	151	dBc
Phase noise (normalized) at 5 kHz spacing:	153	dBc
Phase noise (normalized) at 10 kHz spacing:	154	dBc
Phase noise (normalized) at 20 kHz spacing:	155	dBc
Phase noise (normalized) at 30 kHz spacing:		dBc
Phase noise (normalized) at 40 kHz spacing:		dBc
Phase noise (normalized) at 50 kHz spacing:	155	dBc
Phase noise (normalized) at 80 kHz spacing:		dBc
Phase noise (normalized) at 100 kHz spacing:	155	dBc
Phase noise (normalized) at 200 kHz spacing:	155	dBc
Phase noise (normalized) at 300 kHz spacing:		dBc
Phase noise (normalized) at 400 kHz spacing:		dBc
Phase noise (normalized) at 500 kHz spacing:		dBc

Noise floor, SSB bandwidth 14 MHz, no preamp	-121	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 1 On	-130	dBm
Noise floor, SSB bandwidth 14 MHz, Preamp 2 On	-135	dBm

Sensitivity SSB at 14 MHz, no preamp	0.6	uV
Sensitivity SSB at 14 MHz, Preamp 1 On	0.2	uV
Sensitivity SSB at 14 MHz, Preamp 2 On	0.12	uV

Noise floor, 500 Hz, 14.2 MHz, no preamp	-127	dBm
Noise floor, 500 Hz, 14.2 MHz, Preamp 1 On	-136	dBm
Noise floor, 500 Hz, 14.2 MHz, Preamp 2 On	-140	dBm

Noise floor, SSB, 50.125 MHz, no preamp	-125	dBm
Noise floor, SSB, 50.125 MHz, Preamp 1	-134	dBm
Noise floor, SSB, 50.125 MHz, Preamp 2	-135	dBm
Sensitivity, SSB, 50.125 MHz, no preamp	0.4	uV
Sensitivity, SSB, 50.125 MHz, Preamp 1	0.14	uV
Sensitivity, SSB, 50.125 MHz, Preamp 2	0.12	uV
Noise floor, 500 Hz, 50.125 MHz, no preamp	-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
Signal for S9, no preamp	100	uV
Signal for S9, Preamp 1	32	uV
Signal for S9, Preamp 2	13	uV

Each S unit is approximately 3 dB, similar to Icom and Kenwood.
Apache, Elecraft and Flex S units are 6 dB.

Gain of preamp(s)		
Preamp 1	9	dB
Preamp 2	18	dB
AGC threshold at 3 dB, no preamp	4.5	uV
AGC threshold at 3 dB, Preamp 1 On	1.6	uV
AGC threshold at 3 dB, Preamp 2 On	0.58	uV

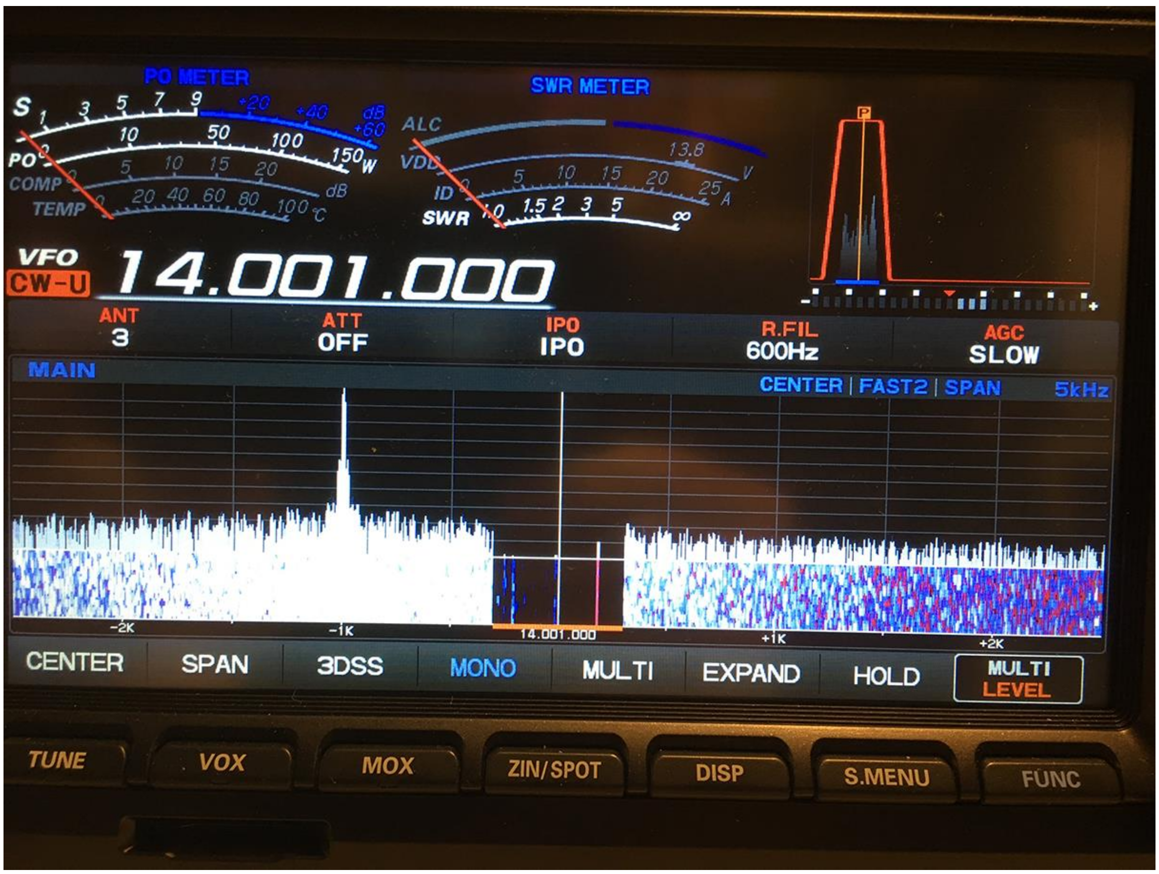
Notes:

The waterfall is rather granular (chunky).

IMD on the spectrum display is significantly higher than the down-conversion radio itself. (Less dynamic range on the bandscope than the radio itself)

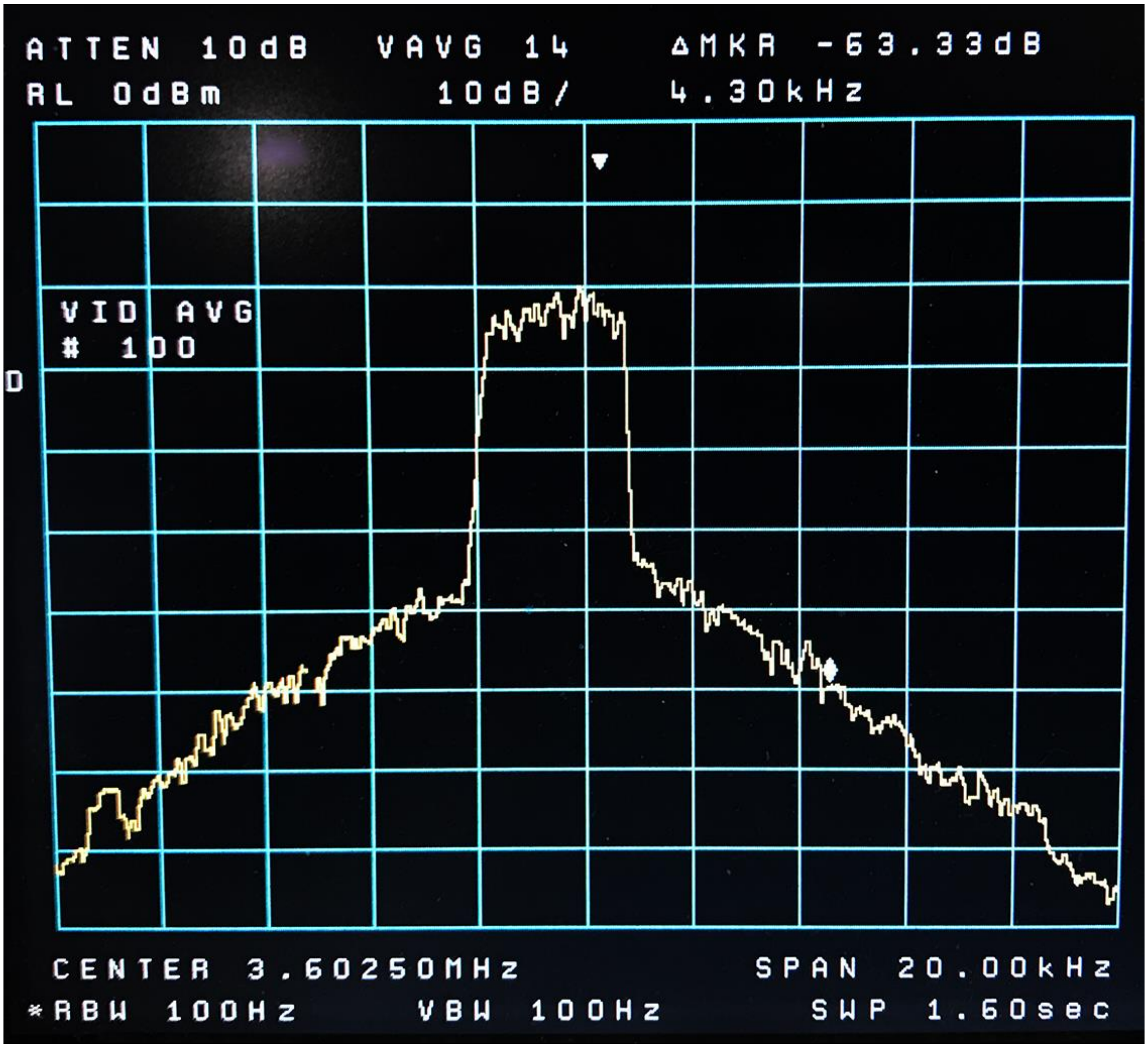
At strong test signal levels required to test the radio for dynamic range (DR3), the spectrum display / waterfall has a notch (dead zone) equal to the roofing filter bandwidth at levels around S9+40 dB. The third-order distortion product that is about 30 dB (3 divisions) above bandscope noise disappears when the signal is in the roofing filter passband .

With a single test signal, such as making a Reciprocal Mixing Dynamic Range (RMDR) measurement, the level for this anomaly is around S9+53 dB.



There is no dedicated power output knob, which is inconvenient when adjusting drive to a linear amplifier. This requires a button push, a push on the multi-function knob, then selecting the power output function on a very busy menu, and finally adjusting output power with the multi-function knob. This can be assigned to the C. S. button, but takes 3 functions: Push C.S. button, adjust with sub-RX VFO dial, push C.S. button again.

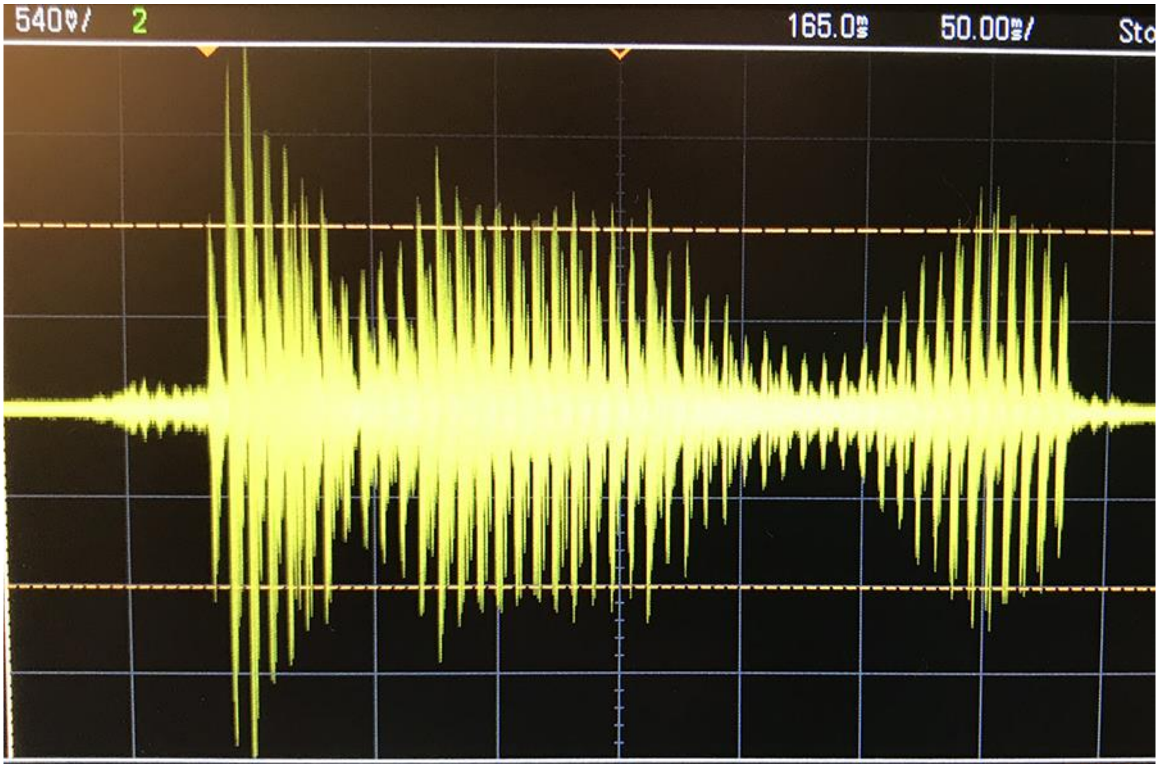
Transmit intermodulation, band limited white noise to approximate speech



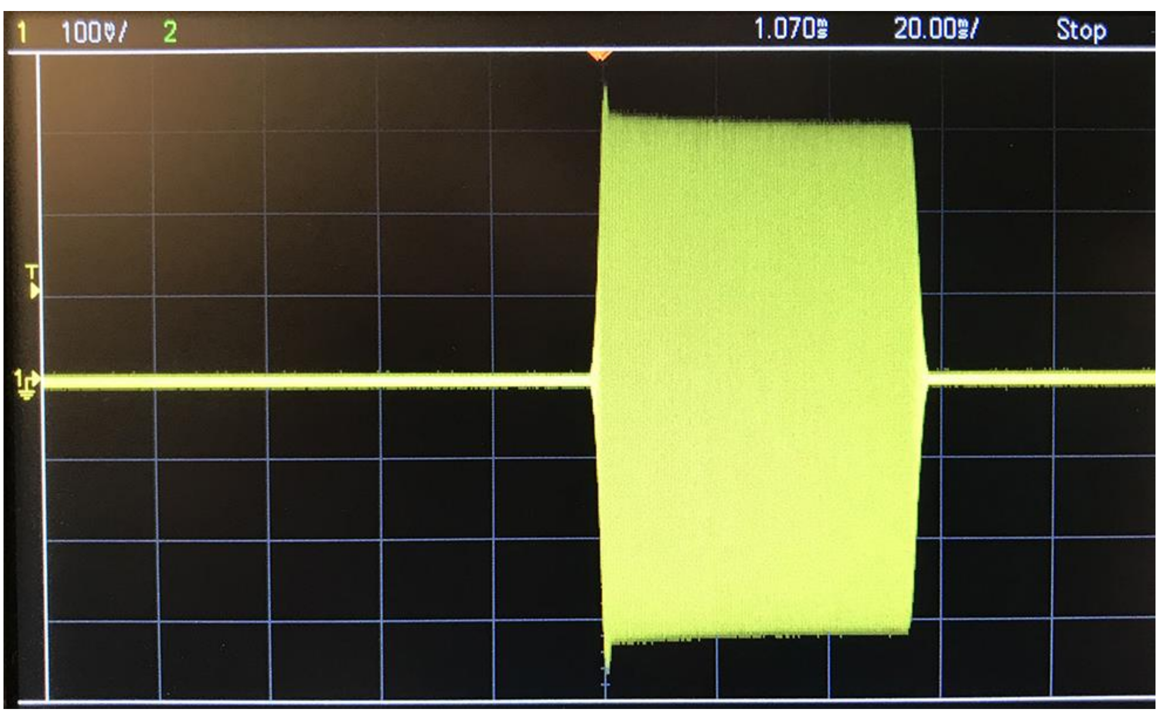
Output power overshoot occurs on CW, and even more so on SSB. When output power is set for 30 watts, typical of a low drive linear amplifier, peak power can exceed 120 watts, four times the desired power setting. When set for 30 watts output, a peak reading wattmeter has captured peaks in excess of 190 watts.

There have been some email reflector reports of the FTdx-101D causing linear amplifiers to fault on SSB due to the excessive overshoot.

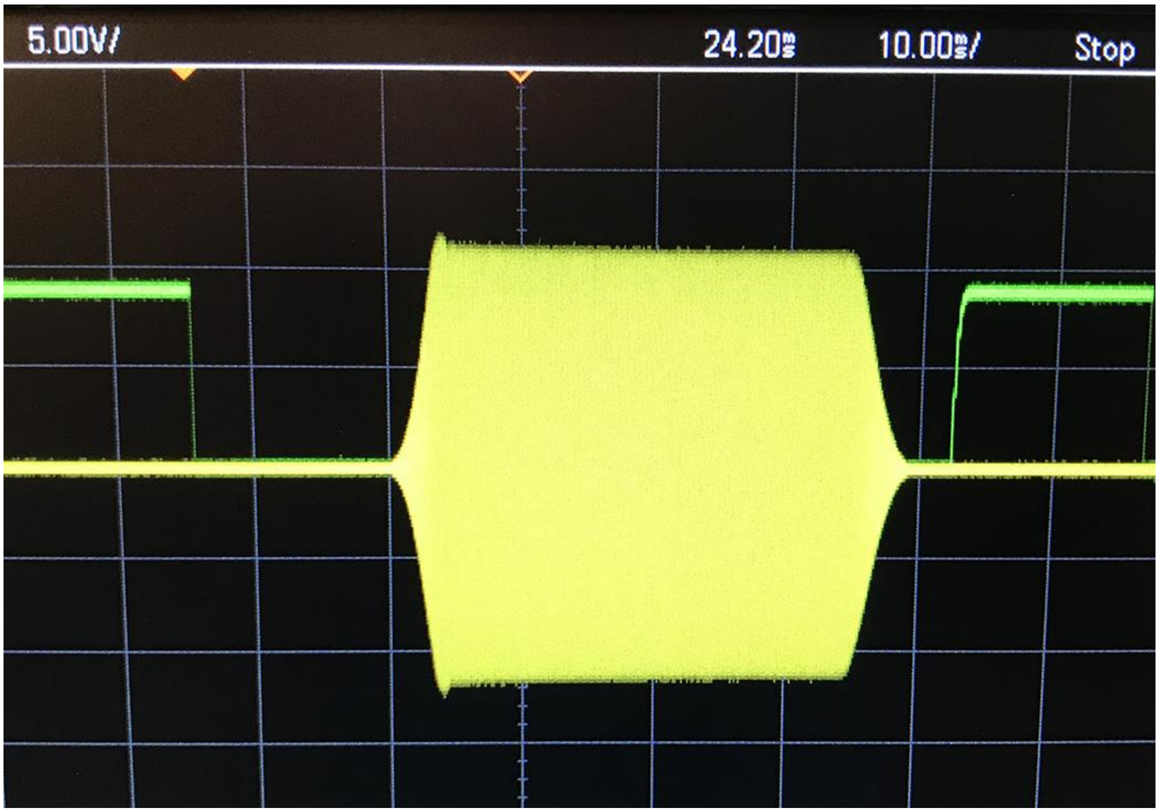
SSB overshoot set for 30 watts output.
Horizontal cursor lines are set at 30 watts.



CW overshoot at 30 watts key down.   30 watts was at the right edge of the “dit”.



The key line timing is acceptable for a QSK capable linear amplifier. Unless there is a menu setting to adjust for slower T/R relays in non-QSK amps, hot switching may occur on CW and SSB on the initial power output. The “key-up” delay is adequate. Key down delay is about 14ms, and key up is about 3ms.



Transmit odd-order IMD

Power 100 watts		odd-order product dBc		Add 6 dB for PEP method
Band	3^{rd}	5^{th}	7^{th}	9^{th}
6m	-25	-29	-37	-48
20m	-33	-32	-41	-53
80m	-37	-38	-41	-44

Power 50 watts		odd-order product dBc		Add 6 dB for PEP method
Band	3^{rd}	5^{th}	7^{th}	9^{th}
6m	-26	-37	-51	-61
20m	-26	-35	-49	-55
80m	-34	-35	-40	-48

Broadband transmit composite noise (total noise)

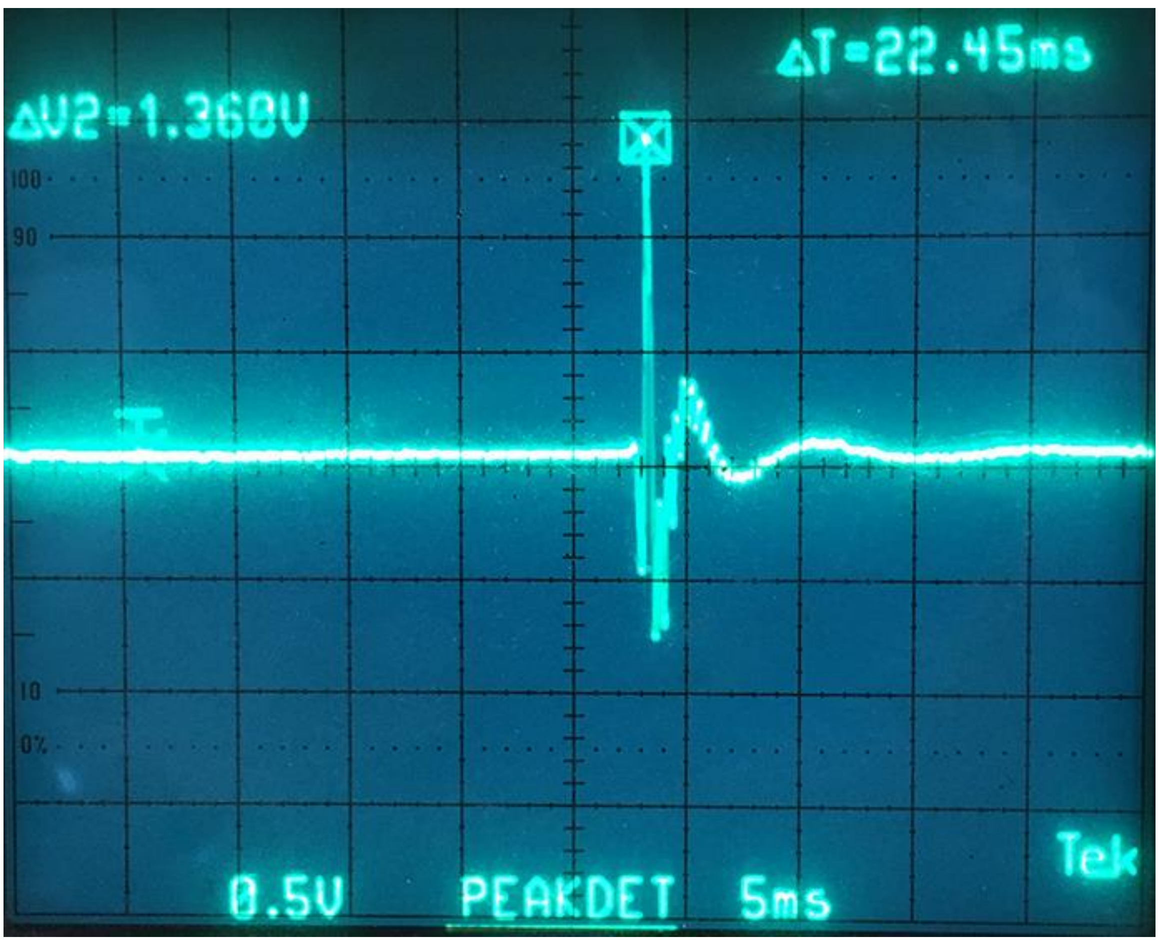
Composite noise is a combination of phase noise and AM noise. Noise interference, particularly with strong signals on the same band, is caused by composite noise (total noise), not just phase noise. Most data in magazines currently only publish phase noise data, which may be much less than composite noise. The ARRL is working on correcting this oversight.

Composite Noise, 20 meters at 100 and 30 watts   Value in dBc/Hz

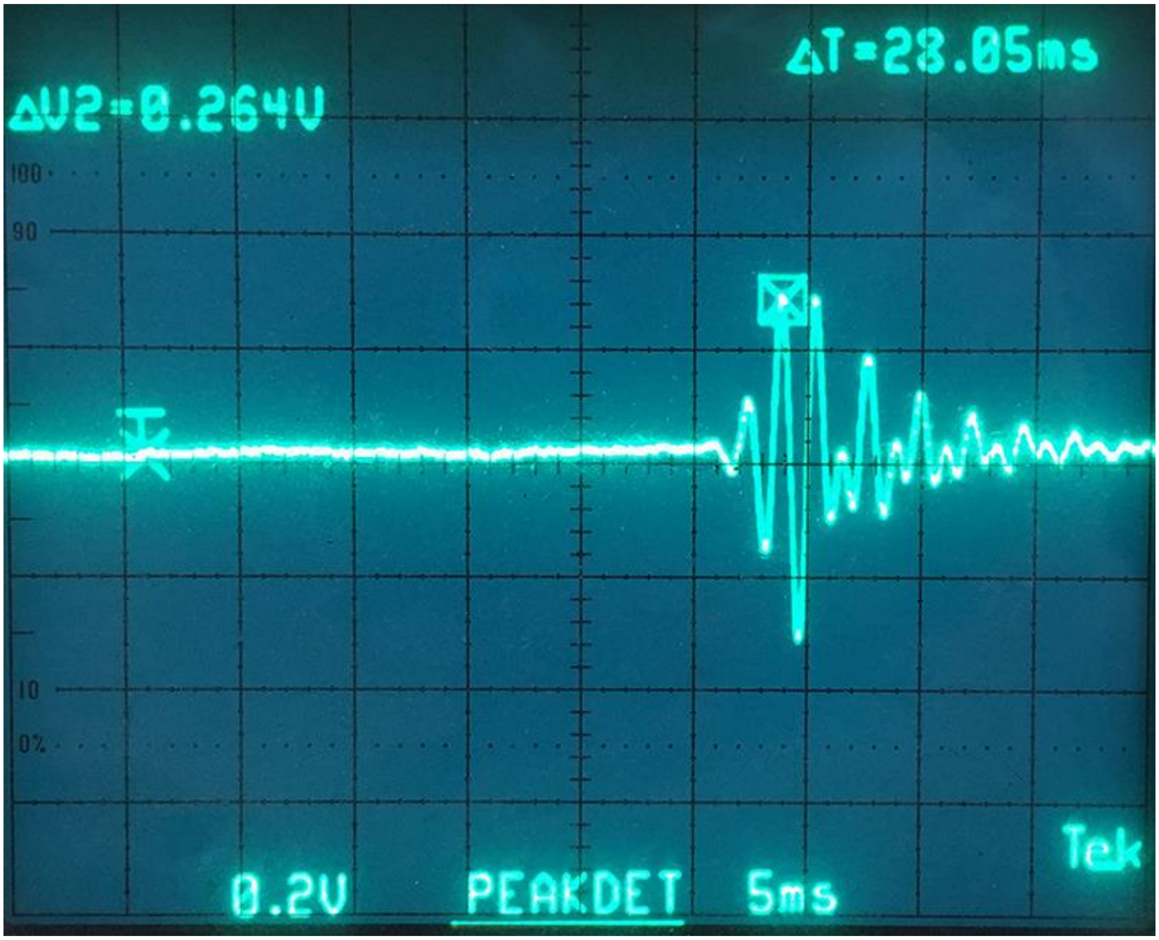
Offset	1 kHz	2 kHz	5 kHz	10 kHz	20 kHz	100 kHz
100 watts	-131	-133	-134	-137	-138	-141
30 watts	-128	-129	-132	-134	-135	-137

Many linear amps require much less than full transceiver output for rated output.

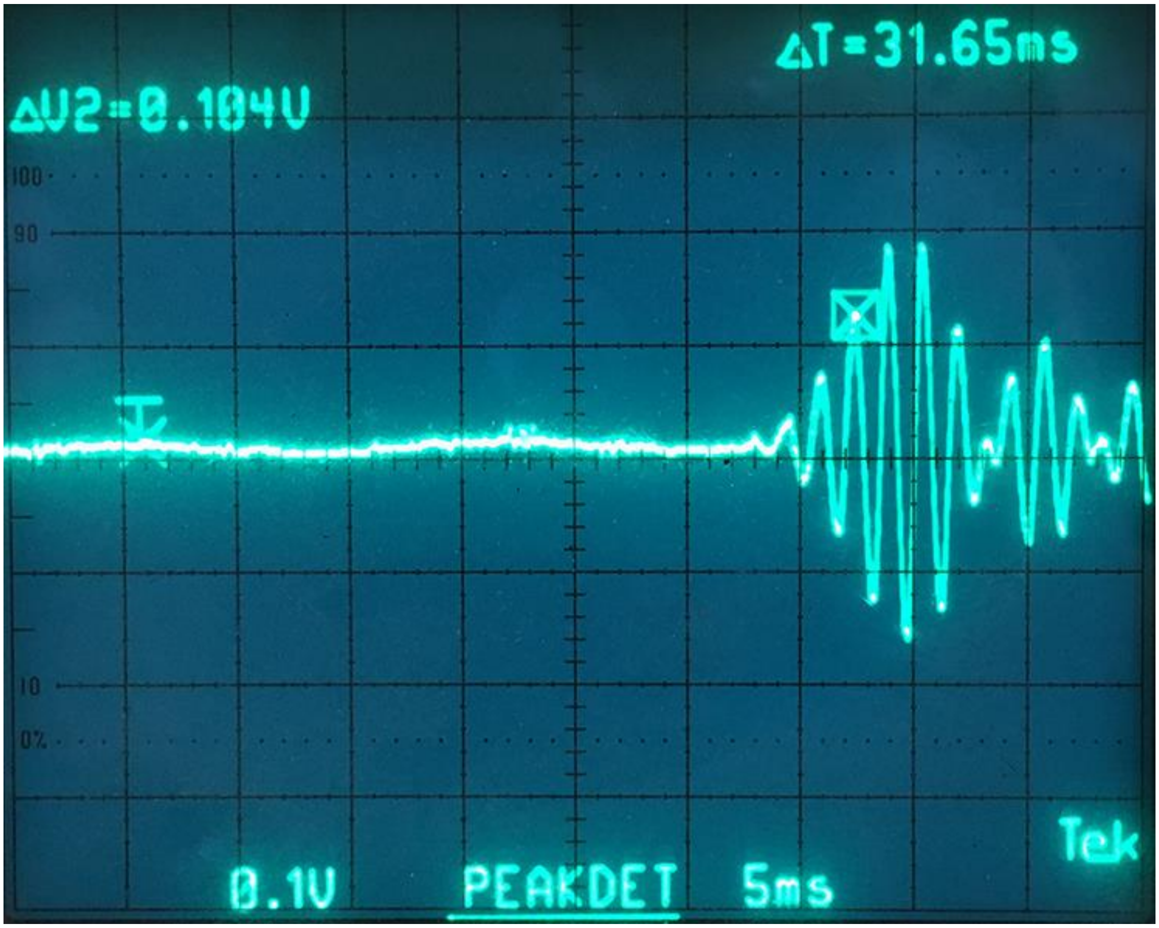
Receive latency 2400 Hz bandwidth   22.4 ms



Receive latency 500 Hz bandwidth   28ms



Receive latency, 250 Hz bandwdith 31.6ms



Latency varies with the type of architecture, and it generally increases with narrower filter bandwidths. Analog transceivers generally have latency under 10ms, while the better DSP variants have latency under 20ms. Some transceivers have latency between 50 and 170ms depending on design trade-offs between filter shape factor and the signal delay. For best QSK performance a latency of 20m or less is desirable.

QSK performance:

A finite time exists for a transceiver to switch from TX to RX so that a CW signal can be heard in-between transmitted dits or dahs of a letter or number. Let's call this "transition time" or "dead time". This measured "dead time" makes it impossible to hear a desired signal in full QSK mode at 24 WPM or faster. On air, I could not hear any signal between continuous "dits" at 22 WPM, and only occasional impulses (clicks or pops) at 20 WPM. At 18 WPM I was able to hear a CW signal between continuous "dits". At 15 WPM QSK was quite functional. The WPM on-air tests assumed the internal keyer speed was reasonably accurate.

A similar on-air comparison was made of the QSK capability of an IC-7610. The results were virtually identical. Of course there is more space between letters and numbers or words than between code symbol elements, allowing time for the operator to cease transmission.

Bandscope anomaly:

The gain or sensitivity of the bandscope / waterfall inside the roofing filter bandwidth is about 10 dB greater than outside that bandwidth. This has not been observed previously with any direct sampling bandscope / waterfall.

AGC and impulse noise:

An impulse such as electric fence, light switch, rotor break solenoid (Hy-gain) or motor start surge captures the FTdx-101D AGC. The impulse can easily reach S9. The S meter will kick higher when using an SSB bandwidth than with a CW bandwidth. This occurs because the narrower selectivity slows the rise time of the impulse.

No pure analog transceiver or receiver I have ever tested has the AGC captured by a low repetition rate impulse noise. Very few DSP transceivers handle impulse noise properly. Elecraft and Apache products may be the only current examples where DSP software does not allow an impulse noise to charge up the AGC until the decay time expires.

Noise Blanking:

Noise blanking level was generally set about 5 out of 10. Line noise blanking or impulse noise (electric fence) was more effective in an SSB bandwidth than a CW bandwidth. This is typical of DSP blankers that are after DSP selectivity.

A signal on the edge or in the roofing filter passband may degrade noise blanking.

Rev G1