Sherwood Engineering, Inc. Tests on 8/15/2010 (Edited 07/11/2013)

Test data on Flex 1500 transceiver.

Measurements made at my secondary lab, not my main Denver lab.

The computer used with Power SDR was an HP Elite 8000 desktop, Intel quad core PC with 4 GB ram and 64 bit Windows 7.

Test setup:
Two HP 8642A generators at -16 dBm, followed by two HP 8447A 20 dB buffer amplifiers with a 10 dB pad on the output of each 8447A. The buffered outputs then fed a Mini-Circuits hybrid combiner. (ZSC-2-1)

10 dB of attenuation followed the output of the combiner, feeding the Flex1500.

Note: When making third-order dynamic range measurements, isolation between the two generators is extremely important, and needs to exceed the expected dynamic range of the device under test by 20 dB. Simply hooking up two leveled (amplitude stabilized) generators together with a hybrid combiner is not adequate.

This test setup produced two well-isolated -20 dBm test signals on 20 meters.
(14.205 MHz and 14.207 MHz)

Noise floor 20 meter, no preamp: -115 dBm (500 Hz BW), measured with both the dBm meter of the 1500 and with an HP 3400A RMS meter on the output, looking at a 3 dB peak in level vs. the noise

The 3rd order product measured between -111 dB, and -112 dBm on both the high and low side with the Flex dBm meter, and produced the necessary 3 dB peak on the HP RMS meter in a 500 Hz bandwidth.

Measurements with preamp OFF
2 kHz dynamic range (DR3) measured a respectable 91 dB.
IP3 calculated at the noise floor (not the S5 method) = +21 dBm

Phase noise is constant from 10 kHz to 40 kHz offset.
In a 1 kHz BW the noise floor measured -112 dBm. A -10 dBm signal raised the noise floor 3 dB to -109 dBm. -112 dBm - (-10 dBM) = 102 dB difference. Add + 30 dB to normalize to 132 dBc/Hz (in a 1 Hz bandwidth)

While this level of phase noise is about 10 dB better than the Flex 5000 and 3000, it is still about 10 dB worse than a K3, depending on offset. The K3 improves at wider offsets, which is important if one has multiple transmitters on the same band (Field Day), for example.

There were no problems installing PowerSRD.

The only issue I see is when enabling the preamp. During the first hour of testing, after running the radio for about 30 listening to signals on 20 meters, I noticed that when enabling the preamp (+20 dB), the noise went up about 4 dB by simply connecting a 3 foot BNC to BNC cable to the 1500 antenna port. It did not matter whether the cable was connected to one of the HP synthesizers or not.

Initially the noise floor with no cable connected was about -126 to -127 dBm with the 20 dB preamp. Adding a cable with no termination moved that up to about -123 to -122 dBm. This noise was frequency dependent.

After another hour of testing, the noise floor with the preamp, with no cable connected read about -118 dBm on the radio dBm meter, while with a 3 foot cable and a 100 watt termination, it read about -122 dBm.

The inconsistent noise floor was traced to internal CMOS switches in the radio that have DC to DC converters to produce a negative supply voltage. These internal chip switching power supplies cause hash and birdies, modestly affecting the noise floor. This internally generated noise varies with frequency and warm-up time of the transceiver. The switching power supply birdies are particularly noticeable on the broadcast band.

While this internal spurious is generally below band noise with a good external antenna, this limitation may be an issue with less than optimum antennas, or if one is using the receiver as a panadapter. Similarly if using the 1500 as a secondary receiver with a beverage or small loop antenna, the internal noise may be an issue.

Rev A

Flex 1500 data S/N 1810-0001 ?

All measurements on 20 meters.

Noise floor, 500 Hz BW
No preamp -112 to -116 dBm
Pre 1 -120 to -129 dBm
Pre 2 -121 to -136 dB,

AGC threshold (AGC-T @ 85)
No preamp 3.1 uV for a 3 dB drop in audio, reference a -33 dBm signal (S9 + 40 dB).
Pre 1 1.0 uV
Pre 2 0.4 uV

Blocking @ 100 kHz 108 dB for 1 dB increase in noise from reciprocal mixing, 500 Hz BW.

Sensitivity (10 dB S+N/N) 2.4 kHz BW
No preamp 2.8 uV AGC-T @ 74
Pre 1 1.4 uV
Pre 2 0.3 uV

Phase noise -131 dBc @ 10 kHz

Filter Ultimate 95 dB phase noise limited @ 2 to 3 filter bandwidths from center passband

DR3 @ 20 kHz 88 dB no preamp
DR3 @ 2 kHz 88 dB no preamp

DR3 with Pre 1 89 dB
DR3 with Pre 2 86 dB

Observations of the Flex 1500 at NC0B's rural QTH. **August 27, 2010**

Measurements on 30 metes were made between 9 AM and 2 PM. The antenna is a 40 meter extended double zepp (EDZ), my normal 40 and 80 meter antenna. It is 170 feet long, center fed with W7FG open wire line, and tuned with a Johnson Matchbox. The antenna is strung between two Rohn 45 seventy-foot towers that are 310 feet apart. The antenna is broadside east and west.

On 30 meters the antenna is too long for an EDZ, and the pattern will start breaking into multiple lobes.

I observed the fundamental switching frequencies of the solid-state switches to be between 896 kHz and 986 kHz. The spurious these cause is worst case in the 30 meter amateur band.

The table below shows the noise of the receiver terminated, and with the antenna connected, at different gain settings on 10.125 MHz.

Note: the noise from the switching power supplies move around, and the terminated noise floor varied up and down over the five hours between 1 and 2 dB from the value listed below.

Gain	Terminated	Connected to Zepp antenna
0 dB	-100 dBm	-100 dBm
+10 dB	-116 dBm	-113 dBm
+20 dBm	-117 dBm	-113 dBm

While listening to real signals, I observed W0ERE/B (beacon) on 10,129.6 kHz at grid square EM36 running 3 watts into a G5RV. His signal was not copyable with the gain set to 0 dB, but it was Q5 with the gain at +10 or +20 dB. The signal level observed on the 1500 band scope was typically -110 dBm, plus and minus a few dB of QSB.

Since the band noise went up 3 dB at the +10 dB setting, the noise of the receiver and the band noise are equal. Removing the 20 dB pad at the +20 dB setting made no practical difference.

Just as a comparison, the same beacon signal was Q5 on my IC-781 with no preamp. This would be expected, as the noise floor of the Icom without a preamp is about -128 dBm.

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