Flex 6700 Review - Part 2

SDRZone

Flex Radio Signature Series Model 6700

Review

Part Two – Comparisons and Measurements

April 15, 2014

Reviewed by Michael Alexander - N8MSA

Welcome back to the continued review of the Flex 6700 Series SDR.

Part two of the series will be delivered in installments. In case you missed part 1 you can read the initial review here. Flex 6700 Review Part 1 by MSA.

Signature Series Model 6700 HF/VHF Transceiver

FlexRadio Systems, Inc.

Retail Cost =$7499.00 (without options – see discussion in review)

Review Type = User experiences (Part One), with some measurements and comparisons (Part Two)

Radio Architecture = DDC SDR HF/VHF Transceiver

Overview

The FlexRadio Signature Series Model 6700 is Flex's "flagship" software-defined radio (SDR) amateur radio transceiver, and the top offering of a series of three radios. The Signature Series marketing materials boast that the Signature Series being the most advanced, capable and easy-to-use transceiver in a rather narrow field of such radios. The design brief of this radio is, in the fewest words possible, to do as much of the digital signal processing (DSP) inside of the radio, thus allowing the use of low-bandwidth network connections for human interaction with the radio. This distinguishes itself from virtually all other "commercial" amateur and most "open" SDR designs that rely on PC to host the DSP routines.

Part One of this review discussed this transceiver as it relates to the things that typical amateur radio operators demand from a radio in this price class: the ability to "hear", how it "sounds" on the air, how it integrates with a modern "shack" and similar topics.

Part Two expands on Part One with some real-world comparisons with several contemporary transceivers, including the Apache Labs ANAN-100D and the Elecraft KX3.

Note that SmartSDR/Signature Series firmware version 1.1.3 was released as this review was underway, and was used for this review.

What To Test, And How To Test It

DDC SDRs, by virtue of their architecture and the significant differences they have from traditional amateur radio transceivers, have presented a bit of a challenge to those in the amateur radio community that perform instrumented RF performance tests. Factors that affect the sensitivity, selectivity and other figures-of-merit (such as roofing filter losses and phase shift) in traditional radios are substantially different, or even completely missing, from DDC SDRs. This challenge has compelled many of the respected authorities in the testing community to re-assess what they should measure, and how they should measure them.

Are the figures-of-merit that are gain the most attention today (such as blocking dynamic range) useful indicators of a radio's performance? They are, in the reviewer's opinion, key indicators of a radio's behavior. But there is a growing trend amongst the amateur radio community that these numbers do not "tell the whole story". Many reviews go, in great depth, into detailed descriptions of minute RF behavior detail…and then quantify the audio coming out of the receiver as "good" or "not so good".

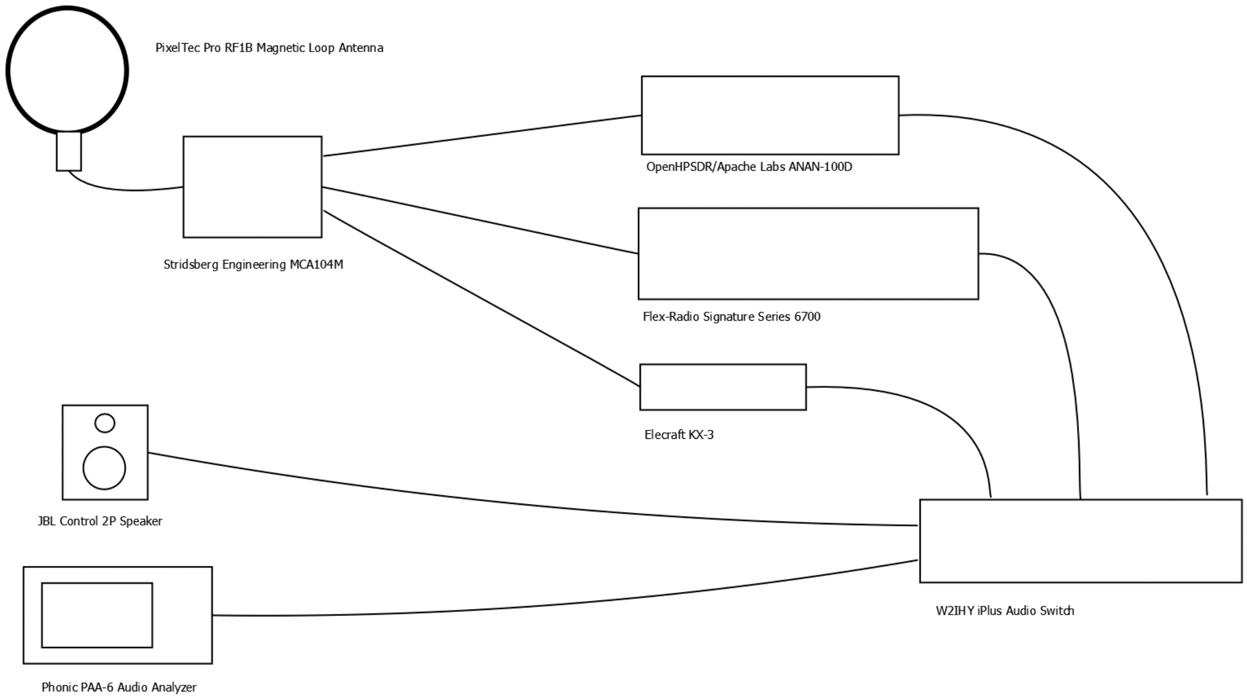
This review was written with the premise that performance factors related to the signal of interest – the baseband ("audio") signal - are at least as important, if not more-so, than the RF performance factors. We want the best possible dynamic range, and to create the fewest transmission artifacts possible, but we ultimately process (either with our ears of with software) the audio comes into and out of these radios. Maybe…we can do better than "good" and "not so good". But how can we do that?

After much discussion and deliberation, a methodology that would provide accurate, repeatable results and was accessible to many radio hobbyists began to emerge: the testing would be based around the use of an audio spectrum analyzer. Audio spectrum analyzers do for sound what RF spectrum analyzers do for, well…RF: they quantify and visualize audio signals. This removes much of the subjectivity from audio testing, and reduces the extreme variation in human hearing that afflicts audio testing.

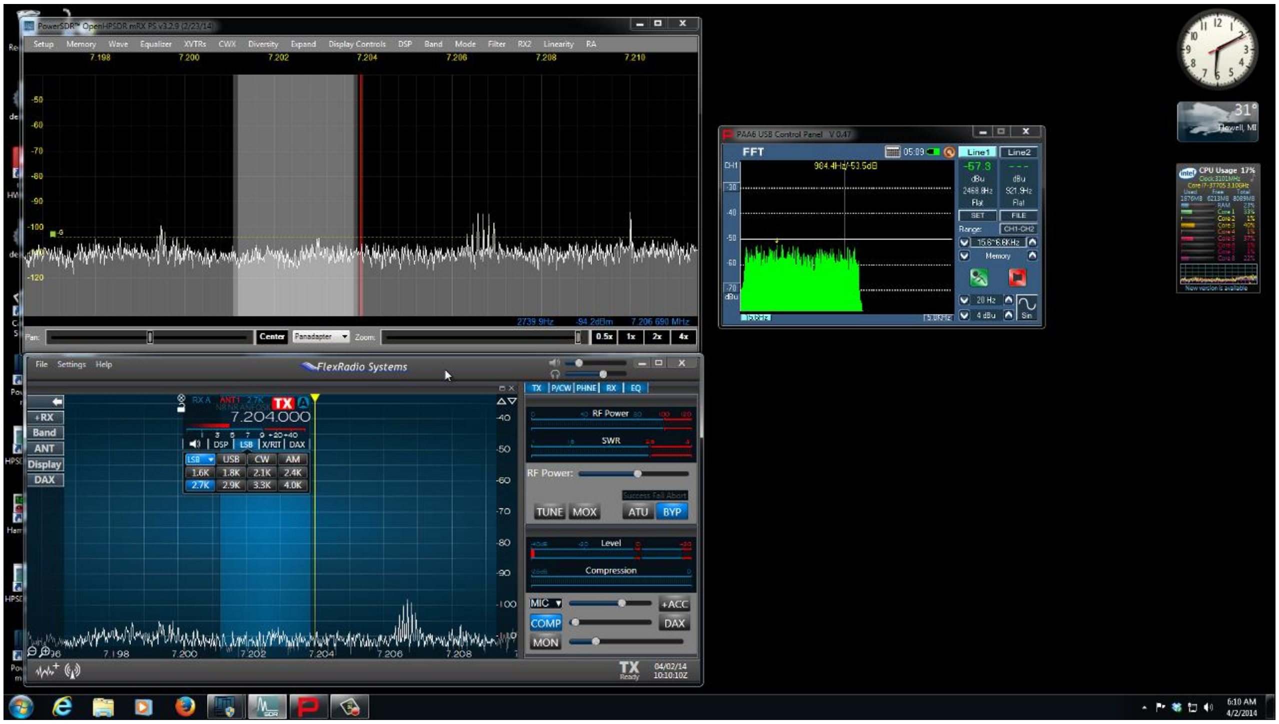
The audio analyzer used in this test is the Phonic PAA-6 Professional Audio Analyzer (http://www.phonic.com/en/paa6.html). This unit features two audio input channels, via calibrated microphones or balanced line-level inputs. The PAA-6 performs a number of functions that, as we will see, are very relevant to this review. One of the most important is the FFT function, which performs a Fast Fourier Transform computation in the incoming signal and displays a very detailed picture of the audio spectrum. Another reason for choosing the PAA-6 is that it features PC connectivity, which is used by a companion utility to display the screen on the PC desktop. This allows the user, for example, to compare the audio coming from the radio's receiver against the graphic user interface's (GUI) view of the RF signal. Finally, the PAA-6 is priced within the reach of radio hobbyist, costing as much as a quality amateur radio antenna analyzer.

An important aspect of this review is to ensure that each radio is fed the same RF signal to the receiver and the same audio input into the transmitter. To help reduce the switching complexity, and reduce the possibility of coax switch contact resistance variation impacting the test, a "military-grade" Stridsberg Engineering MCA104M 4-port "active" Receiver Multicoupler (http://www.stridsberg.com/prod01.htm), used by signal intelligence-gathering organizations to provide identical signals to multiple receivers. Performance of this device was confirmed with a Rohde & Schwarz FSH4 spectrum analyzer, and the outputs were found to be the same within fractions of a microvolt.

The rest of the receiver test setup consist of a W2IHY iPlus switch (to route audio signals), and a loudspeaker. Below is a diagram of the test setup:



There are several easily-understood measurements that can be taken with this system that can help us explain seemingly subjective differences between radios. One measurement uses the PAA-6’s “FFT” display, which shows a highly-detailed spectral view of the incoming audio signal. This view confirmed, and quantified, the differences heard between receivers. Several methods for comparing voice and data signals were tried, and the method used for this particular test was to set the receiver adjustments (AGC, DSP, etc.) for the test, and adjust the audio output on all the receivers to produce the same level on background noise.



Visible in this image is OpenHPSDR's PowerSDR mRX (version 3.2.9), Flex-Radio's SmartSDR (version 1.1.3) and Phonic's PAA6 USB Control Panel. Easily visible in this image are both radio's panadapters and the FFT spectral view of the audio from the 6700. This particular still frame was taken during the process of matching noise levels between both receivers, which involved tuning both radios to the same "empty" frequency and switching the iPlus between the radio's audio line-level outputs.

Note: Just for fun, note that the CPU utilization of the host PC (at the precise instant this frame was extracted) is 17%. The vast majority of the CPU load is from TechSmith's Camtasia (15% at 1920/1080 resolution), with only 2% be used by radio programs! This is especially good when one remembers that PowerSDR is both a graphic user interface AND the DSP execution environment. More information on this PC can be found on the reviewer's blog at http://n8msa.blogspot.com/2014/02/using-hpsdr-system-dealing-with.html.

Now that we have established the method by which we will compare the new Flex radio, part three will explore actual measurements.

Reviewer

N8MSA, Mike Alexander. You can read more about the reviewer's background using the link at the bottom of the review.

About the Reviewer

You can learn more about Mike [N8MSA] on the site at the link below:

http://n8msa.blogspot.com/