FlexRadio Systems®
Software Defined Radios

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Issue: 1

THE FLEX INSIDER

A Word from our CEO

Dear Lori,

Welcome to the first edition of the ***FLEX INSIDER***. For those of you who pre-ordered a FLEX-6000 Signature Series radio, you are signifying your desire to be an early participant in changing ham radio forever. We at FlexRadio Systems are honored by the trust you have placed in us. We take that trust very seriously and want to keep you informed as we complete final software development and production start-up. Our goal is to communicate with you on a monthly basis to provide status updates as appropriate along with useful articles and answers to frequently asked questions. Our team is working hard to deliver a radio that you will be proud to own and use.

73,

Gerald Youngblood, K5SDR
President & CEO

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Upcoming Events

June 22-24, 2012
Ham Radio
Freidrichshafen, Germany

August 3-4, 2012
Summerfest
Austin, TX

August 17-19, 2012
Huntsville Hamfest
Huntsville, AL

August 24-25, 2012
Joplin Hamfest
Joplin, Missouri

Introducing the FLEX-6000™ Signature Series Direct Sampling HF/6m Transceivers with SmartSDR™

On May 18th, 2012, FlexRadio Systems introduced the addition of the FLEX-6000 Signature Series line of radios to our product offering. The initial offering includes 3 radios, the FLEX-6500 and FLEX-6700 transceivers, plus the FLEX-6700R high performance receiver. All three radios are planned to begin shipment in the fourth quarter of 2012. These new radio platforms provide the following benefits to the operator.

PERFORMANCE

With up to 2 Direct RF to digital conversion Spectral Capture Units, the FLEX-6000 Signature Series delivers up to +45 dBm 3rd Order Intercept Point and 110dB IMD DR3 3rd Order Dynamic Range (inside the final filter!) reception on up to 8 Slice Receivers. You'll be able to separate and work pileups with ease 100Hz away from large adjacent signals. Direct conversion also means NO MIXERS to create the auditory fatigue usually experienced with legacy multi-conversion receivers and their crystal filters. The result is amazingly pure and quiet signal reception. One-hundred watts of clean output power is generated in the Direct Up Conversion transmitter - complete with a built in antenna tuner. An optional GPS disciplined master oscillator is also available for unheard of frequency accuracy.

SIGNAL PROCESSING

The FLEX-6000 Signature Series packs more signal processing power into one radio than all the other brands combined. Harnessing the power of a highly integrated Media and DSP processing engine coupled with a state of the art Field Programmable Gate Array (FPGA) yields up to 317 BILLION DSP processing operations per second! FlexRadio has moved the 'heavy lifting' computational horsepower next to the RF signal to drastically reduce latency and optimize processing performance. This extreme performance signal processing power also greatly relieves the burden on the operator's PC. This allows for a flexible 'thin client' architecture for future implementations. And there's plenty of reserve power for future

apps!

NETWORKING
Every FLEX-6000 Signature Series radio is a network radio - whether across the shack or across the world. The FLEX-6000 incorporates a highly integrated Ethernet interface providing up to 1 Gigabit data rate and driverless interface to virtually all modern PCs and home networks. This means an extremely simple interface to your PC today and connectivity to the world in the future. Multi-user and full featured remote operation capabilities are planned for upcoming releases.

SmartSDR
SmartSDR is the perfect marriage of digital signal processing, dynamically reconfigurable FPGA programming, real-time server operating system, and thin client user interface to form an advanced radio operating environment for your FLEX-6000 Signature Series radio. A new simple yet elegant user interface gives you the controls you need when you want them yet hides unwanted complexity from the radio operator. The SmartSDR networked radio server platform supports up to 8 Slice Receivers including panadapters, audio streams, and data streams for digital modes. SmartSDR has been developed from the ground up using a layered architecture to enable high performance radio today and exciting feature enhancements tomorrow.

For more information visit our website at **www.flexradio.com** or view the FLEX-6000 Signature series brochure PDF at **http://www.flexradio.com/FLEX-6000_v2.pdf** .

Dayton Hamvention - A Record Year for FlexRadio Systems

FlexRadio Team Ready for Opening Day of Hamvention.

FlexRadio Systems exhibited at the Dayton Hamvention in May of this year to overwhelming crowds coming to check out and pre-order the new FLEX-6000 Signature Series radios. FlexRadio staffers and volunteers were

kept busy throughout the weekend educating current and new customers not only the new radio line but on our leading FLEX-Series products including the FLEX-1500, FLEX-3000 and FLEX-5000 transceivers. We finished Hamvention with record sales and a long list of pre-orders for the new FLEX-6000 line. We are grateful to our committed customers and to the new Flex owners that continue to keep us challenged to innovate and create new and exciting offerings in the field of ham radio.

FlexRadio Owners Enjoy an Evening of Education and Camaraderie at the FlexRadio Systems Banquet

Flex Radio Systems hosted their 7th annual banquet on Saturday, May 19th at the Dayton Grand Hotel, welcoming over 130 FlexRadio owners for an evening of dining, education and camaraderie with fellow FlexRadio owners and employees. In addition to the tasty Italian cuisine, attendees were treated to updates on the current FLEX-Series

radios and PowerSDR, plus informative presentations on the new FLEX-6000. As always door prizes were flying including the Grand Prize FLEX-1500 winner, Bob Hinkle KK8ZZ. Grab your calendar now and save the date for the 2013 FlexRadio Banquet May 18, 2013.

Greg Jurrens, K5GJ presents Bob Hinkle, KK8ZZ with a FLEX-1500.

FLEX-6000 Frequently Asked Questions

What are the benefits of direct RF to digital?
Simply put, direct RF to digital provides an unprecedented level of performance and capabilities not possible on legacy super heterodyne transceivers. Direct digital from the antenna connector delivers the ultimate performance possible in radio technology. By eliminating all non-linear analog mixers, IF amplifiers and crystal filters, the sources of images and distortion disappear. Frequency synthesizers that generate phase noise and spurs are replaced by a single ultra, low noise crystal oscillator. The result is IMD and phase noise dynamic range that exceeds top of the line multi-conversion roofing filter receivers by 10 dB or more. This dynamic range extends inside the final filter bandwidth, where other premium priced transceivers "fold." The same direct digital benefits extend to the transmitter to minimize phase noise and spurious output while maximizing carrier and opposite sideband suppression.

What is the purpose of the enormous digital signal processing capabilities?
The FLEX-6000 Signature Series radios integrate more signal processing power than all other amateur radio transceivers on the market - combined. While a portion of this power is required to accomplish direct RF to digital conversion, it leaves ample headroom for the creation of entirely new classes of radio applications. These new applications, which will emerge over time, will be able to take advantage of the platform's power and flexibility.

What is a Spectral Capture Unit?
A Spectral Capture Unit (SCU) is comprised of the RF front end, 245.76 Msps analog to digital converter (ADC), and all digital signal processing components required to capture the entire spectrum from 30 KHz to 77 MHz (or alternately 135-165 MHz on the FLEX-6700 models). Each SCU digitizes all signals from a single antenna within

the frequency capture range. The FLEX-6500 incorporates a single SCU and the FLEX-6700/FLEX-6700R models incorporate two independent SCUs. The FLEX-6700/FLEX-6700R models can attach their independent SCUs to different antennas or they can share the same antenna through an internal RF splitter. Further, the two SCUs on the FLEX-6700/FLEX-6700R models can be optionally combined to increase total dynamic range.

What is a Slice Receiver?
While the SCU captures a wide band spectrum, Slice Receivers digitally down convert, demodulate to audio, filter the signals and provide spectral display on their respective panadapters. Each slice is a full performance receiver operates with independent control of frequency, mode, filter, AGC, DSP, RIT, S-meter, etc. The FLEX-6700 can operate up to eight and the FLEX-6500 up to four Slice Receivers simultaneously. Each SCU is capable of running up to the total number of Slice Receivers from a single antenna. This means that the FLEX-6700 can share its eight Slice Receivers across its two SCUs and respective antennas or all can be placed on a single SCU/antenna combination.

What is the benefit of dual Spectral Capture Units?
The FLEX-6700 and FLEX-6700R have two identical SCUs that may be connected to two independent antennas. The FLEX-6500 has a single SCU that is connected to a single antenna. Dual SCUs with their respective antennas enable Enhanced Signal Clarity™ (ESC) capabilities. ESC enables not only simple spatial diversity but also the ability to phase the antennas in software to improve signal to noise ratio or mitigate interfering signals. Dual SCUs also allow simultaneous reception from two different antenna systems such as single band and multi-band antennas. Another option allows both SCUs to be summed synchronously from a single antenna to increase input IP3 and blocking by up to 3 dB. Further, the higher level of signal processing power provided in the FLEX-6700 and FLEX-6700R allows four additional Slice Receivers for a total of eight.
What are the antenna selection options?
Let's start with the FLEX-6500, which has a single SCU.

1. A Spectral Capture Unit (SCU) digitizes the entire spectrum from 30 KHz to 77 MHz in one swallow using a 245.76 Msps A/D converter.
2. The SCU consists of the RF front end (pre-selectors, RF pre-amps, Nyquist filter, ADC, FPGA, and DSP) to capture and process that spectrum.
3. This SCU can connect to only one antenna at a time because there is only a single RF to digital path.
4. However, this SCU can connect to any one of ANT1, ANT2, RX IN A, or the XVTR port through a relay-switching matrix.
5. The Slice Receivers are full performance digital receivers that do direct digital down conversion to audio with independent demodulation, filtering, AGC, NR, etc. for each receiver.

6. Each of the four Slice Receivers and their respective panadapters on the 6500 can be tuned independently and concurrently to any frequency and mode within the 77 MHz spectrum. All receivers have the exact same high dynamic range performance.

Now to the FLEX-6700, which has two identical SCUs in parallel.

1. With two SCUs we now have two independent RF to digital paths that can be connected to two independent antennas or can share one antenna through a RF power splitter.
2. With two SCUs, one can be on ANT1 and the other on ANT2. Slice Receivers on SCU B can receive on RX IN B while Slice Receivers on SCU A can transceiver on ANT1. Slice Receivers on SCU B can alternately transceive on the XVTR port.
3. With two SCUs and two antennas, we can do spatial diversity, beam forming and steering, noise mitigation, etc. that involves phasing the antennas in software. Many customers enjoy this feature (ESC) today on the FLEX-5000 with RX2.
4. With two SCUs, one can be connected to a narrow band SteppIR for transceiver while the other is connected to a multi-band antenna watching for band openings or multipliers in a contest.
5. With the additional signal processing on the 6700, you currently get up to a total of 8 Slice Receivers that can be used on a single SCU or allocated across both SCUs.
6. The 6700 adds the option of tuning 135-165 MHz on either SCU. Note that the 30 KHz to 77 MHz and 136-165 MHz ranges are mutually exclusive on a single SCU. It requires two SCUs to use both ranges simultaneously.
7. On the 6700, you might choose to monitor up to seven 2m repeaters on one SCU while working 20m with the other. You could also monitor 10m and 6m on one SCU while watching 2m on the second SCU for weak signal openings. The combinations are endless.
8. You could also monitor the 50.110, 50.125 and six beacons simultaneously on 6m (the magic band). You could even set some of the Slice Receivers to monitor MUF on signals below 6m or any other band for that matter.

What are my options for receiving software upgrades?
Each FLEX-6000 Signature Series radio includes one year of free SmartSDR software upgrades and phone support. This includes the base radio software/firmware and a single client user interface (e.g. Windows client). In addition, customers who pre-order the Limited Edition also receive a second year free. This means that you will receive all SmartSDR software upgrades within the time period at no additional cost. After the original free upgrade period expires, FlexRadio will offer the option to purchase either annual

upgrade/support packages or purchase major upgrades on a per release basis. Bug fixes will be incorporated into point releases between major releases at no additional cost.
FlexRadio also intends to develop and offer specialized add on software applications that will be priced separately and are not included in the basic SmartSDR software releases. These applications will be of interest to subsets of the amateur community.

Will there be an API available for SmartSDR?
SmartSDR is based on a client/server architecture where all signal processing is performed within the radio. An application-programming interface (API) acts as a control and streaming channel interface between radio and client devices. FlexRadio plans to make the API available to software developers who wish to create their own client applications using the FLEX-6000 series radios. Both commercial and non-commercial license structures will be announced and made available as the radios near production release.

What are the differences between FLEX-6500 and FLEX-6700 transceivers?

Capability	FLEX-6500	FLEX-6700
Spectral Capture Units	1	2
Simultaneous RX Antennas	1	2
Antenna Diversity Reception	No	Yes
Slice Receivers	4	8
Receiver and XVTR TX Frequency Coverage	0.03 to 77 MHz	0.03 to 77 MHz 135 to 165 MHz
Receiver Preamplifiers	1	2
ARM CPU Speed	1.2 GHz	1.4 GHz
DSP Performance	78 GFLOPS, 191 GMAC	121 GFLOPS, 317GMAC
Frequency Control	0.5ppm TCXO, 0.005ppb GPSDO Optional	0.02ppm OCXO, 0.005ppb GPSDO Optional

What is the front display for and what will it show?
The front panel of the FLEX-6000 Signature Series radios incorporates a programmable OLED graphics display. Like the rest of the radio, it is software defined. We anticipate showing operational parameters such as metering information (power output, voltages), user information (call sign of operators on the radio), etc. This functionality may be selectable by the user and may be part of the particular software release or options in the radio.

For network communications, are you supporting IPv4 or IPv6 in the radio?
The radio is designed around IPv4, but can be upgraded to IPv6 in the future as the need arises.

Are the FLEX-6000 Signature Series radios capable of operating in the MARS service?
Both radios employ the use of 11 half-band 7th order low pass filters in the transmitter, which provide continuous coverage with low passband ripple. This makes the FLEX-6000 Signature Series radios ideal for operation in MARS, SHARES or other licensed services that require operation outside of normal amateur bands.

Is the radio full duplex - can I receive at the same time that I transmit?
Yes, both radios are full duplex and will continue to receive at the same time they transmit. Full duplex operation requires the use of two different antennas.

What operating systems will the client software run on?
The initial client will run on Windows XP or newer, but the SmartSDR architecture is designed as a lightweight "thin" client. This means that the client does minimal signal processing and makes few decisions about how the radio operates, but rather passes along control functions and displays the results of those functions and other display elements such as panadapters and waterfalls. This makes creation of other clients on other operating systems far simpler than before and opens the window to build other client interfaces. Having said this, our focus at the moment is completing the initial platform software and Windows client that comprise SmartSDR.

Is SmartSDR the same as DeepImpact?
DeepImpact is an architecture that we presented for future network based radios about two years ago. SmartSDR was built around these concepts, so in a word, "yes," SmartSDR is DeepImpact.

Do I have to have an Internet connection to use the FLEX-6000 Signature Series radios?
No. The radio and client can operate connected together, forming their own network, without the Internet. The Internet can be used to enhance the operational capabilities of the radio both for remote operation and as a data source providing information such as DX spots through the Internet. In order to take advantage of this advanced functionality, the radio must be connected to the Internet.

What basic functionality will be included in SmartSDR 1.0?
SmartSDR 1.0 included with the first shipments of the FLEX-6000 Signature Series will provide functionality for all basic operating modes: QSK CW, SSB, AM, and FM as well as third party digital modes either through virtual audio cables or direct line audio connection. Full support for multiple slice receivers and panadapters will be provided. Only local operation (client adjacent to

the radio) at the radio will be supported in the initial 1.0 release.

Is it possible to find out where I am in the pre-order queue?
The simple answer is, no. While this may seem like an easy question to answer, there are several dynamics related to our development program that make it problematic to tell you exactly where you are in the delivery queue. Rest assured that if you ordered your FLEX-6000 early, you will be at the beginning of the delivery queue and we will be contacting you before the radio ships to finalize your purchase.

PowerSDR™ Update

PowerSDR Version 2.4.x has entered beta testing and the results have been very promising. Details will be provided when the software goes live...but we can tell you there's a brand new and improved Firewire driver! Stay tuned!

FlexRadio Systems
4616 W. Howard Lane, Ste. 1-150
Austin, TX 78728
512-535-4713(main), 512-233-5143 (fax)
www.flexradio.com / sales@flexradio.com

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