The Heterodyne

Bulletin of the West Valley Amateur Radio Association
An Affiliated Club of the American Radio Relay League

West Valley Amateur Radio Association, W6PIY— http://www.wvara.org
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Next Meeting: Wednesday, 7:00 p.m., September 17, 2008 at the American Red Cross, 2731 North First Street at Plumeria (between Trimble and Montague Expressway) in San José. Speaker: Alan Eshleman, K6SRZ — Subject: "DXpedition Medicine"

About Our Speaker — Here is the autobiographical information that our speaker, Alan, K6SRZ wrote on www.qrz.com :

I was first licensed as Novice KN6SRZ in 1956, when I was twelve years old. I got my General in 1957 and spent my on-air time chasing DX with a Globe Scout, Hallicrafters SX-71, and low-hanging long wire. Except for a few months when I operated from W1ET — the Dartmouth College club station — I was inactive from 1962 until 1996.

Since rediscovering ham radio, I spend my time chasing DX (339 worked and confirmed, including 334 current entities) and contesting. I prefer CW, but can also be found on SSB, RTTY, and PSK31. I am proudest (so far) of making DXCC on 80 meters.

In 2004 I went on two DXpeditions. The first was as team physician for the T33C Banaba expedition and the next was a combination SCUBA and ham radio holiday on Christmas Island as T32CK. In September and October 2005 I was part of the K7C DXpedition to Kure Atoll. Most recently, I was a member of the N8S Swains Island DXpedition. Prior to leaving for Swains Island, I made CW contacts from American Samoa, signing KH8/K6SRZ. After the Swains expedition, I operated briefly from Western Samoa as 5WØCK.

I am a member of the Northern California Contest Club, the Redwood Empire DX Association, and the East Bay Amateur Radio Club. I am also the trustee for W6PZ, the Trinity County Contest Club. W6PZ goes on the air each October for the California QSO party, and at other times for other contests.

Check Out the September/October *NCJ*

NCJ, the *National Contest Journal* is what everyone interested in radiosport needs to have in their shack. Filled with the latest news from the contesting world, *NCJ* is the voice of radiosport. Whether you are new to contesting or are a seasoned pro (or somewhere in the middle), you will find something in *NCJ* just for you.

In the September/October issue, Stan Stockton, K5GO and Bob Wilson, N6TV, provide a dialogue on "CW Skimmer: Point/Counterpoint." To go along with this article, Pete Smith, N4ZR, talks about "So You Want to Skim? Practical Issues in Deploying CW Skimmer in a Contesting Environment." Eric Scace, K3NA, writes about "Distributing Receiving Antennas" in the first of a multi-part article. If you' are a top-bander, you do not want to miss "A Simple 2-Element Vertical Array for 160 Meters" by John Barcroft, K6AM.

Dennis McAlpine, K2SX, takes a look at "The Wacky World of State QSO Parties," while Jon Platt, W0ZQ/m gives his take on "One Rover's View on Propagation during the 2008 Minnesota QSO Party." Bill Santelmann, N1AU, remembers his son in "A Tribute to my Son, Stuart, KC1F." Stu, a founding member and past president of the Yankee Clipper Contest Club, became a Silent Key in May of this year. ARRL News Editor S. Khrystyne Keane, K1SFA, lets NCJ readers take a sneak peak at the October issue of *QST* in "October is Radiosport Month in *QST*."

Of course, there are all the regular columns and features you expect from NCJ: "Workshop Chronicles," by Don Daso, K4ZA; "Contest Tips, Tricks & Techniques," by Gary Sutcliffe, W9XT; "Propagation," by Carl Luetzelschwab, K9LA; "VHF-UHF Contesting," by Jon Jones, N0JK; "Contesting on a Budget," by Paul Schaffenberger, K5AF; "DX Contest Activity Announcements," by Bill Feidt, NG3K; "RTTY Contesting," by Don Hill, AA5AU; "Contesting 101," by Kirk Pickering, K4RO, and "Contest Calendar," by Bruce Horn, WA7BNM.

All this and more in the September/October issue of *NCJ*. *NCJ* is published six times a year by the ARRL; it is edited by Al Dewey, K0AD. Subscribe today at http://www.arrl.org/ncj/

FCC Considering Ban on Some Wireless Microphones — by John Dunbar (Associated Press, *San José Mercury News*, August 24, 2008).

WASHINGTON — The Federal Communications Commission is proposing a ban on certain types of wireless microphones and has begun an investigation into how the industry markets its products. Consumer groups alleged in a complaint last month that users of the ubiquitous microphones, including Broadway actors, mega-church pastors and karaoke DJs, are unwittingly violating FCC rules that require licenses for the devices.

The Public Interest Spectrum Coalition accused manufacturers of deceptive advertising in how they market and sell the microphones, which largely operate in the same radio spectrum as broadcast television stations.

The agency, in a notice released Thursday, said its enforcement bureau had opened an investigation. The FCC also is proposing that the sale and manufacture of some of the devices be banned. "These actions would ensure that low-power auxiliary operations do not cause harmful interference to new public safety and commercial wireless services in the band," the agency said.

Most owners of the microphones are unaware that FCC rules require them to obtain a license. Wireless microphones that operate in the same frequency bands as broadcast TV stations are intended for use in the production of TV or cable programming or the motion picture industry, according to FCC rules — not karaoke. The FCC rarely enforces the licensing requirements on the microphones because there have been so few complaints. The microphones are programmed to avoid television channels. But the looming transition to digital broadcasting, which takes place February 17 [2009], has forced the FCC to act.

Channels 52 through 69 in the UHF television band, currently used by broadcasters, will be vacated as they convert to digital broadcasting.

The government sold that section of airwaves for $19 billion in the FCC's most successful auction in history. Other parts of that spectrum will be used by paramedics, police and firefighters. The concern is that microphones that operate in that range may cause interference for the new licensees.

It is not known how many wireless microphones operate there, but Harold Feld, a lawyer for the consumer groups, says the total is probably more than 1 million, based on a trade journal estimate. "These are the favored frequencies because they can be run at lower power and can be used for very high-quality audio," Feld said.

Shure of Niles, Illinois said last month that it had stopped selling microphones that used the potentially troublesome frequencies in November 2007. The company has said it complies with all FCC requirements and "has never engaged in deceptive advertising practices."

WVARA Tuesday Night Net Check-ins:

Call Sign	**Name**	**Aug. 12, 2008**	**Aug. 19, 2008**	**Aug. 26, 2008**	**Sept. 2, 2008**
AB6XS	Kevin		X		
AD6YU	Loren	X	X		X #
AE6LL	Doug		X		
K6EBN	Eben			X	X
K6KMT	Tom				X
K6LOH	Celeste			X	
K6QFO	Mike		X	X	
KD6VOR	Marv			X	X
KF6EMB	Svend	X			
KF6GZQ	Stacy				X
KF6UTE	Casey		X	X	
KG6BKI	Brian	X			
KG6MYR	Harry	X	X		
KG6SEA	Tom	X			
KI6QHY	Eric		X		
KK6VF	Kevin	X #	X #	X #	X
N6BIH	Senad			X	
N6IPS	Roy			X	X
NU6P	John	X	X		
W6HOC	Howard	X		X	X
W6KWF	Ken	X			
W6TQG	Phil	X	X		X
W6ZZZ	Marc		X		
W7UMR	Richard	X			
WB6KHP	Dave	X	X	X	X

<u>Notes</u>:
— Net control operator
X — Checked into net

Club Net: Tuesday, 8:30 p.m. on our club repeaters:

WVARA Repeaters (W6PIY)			
Band	**MHz**	**PL**	**Status**
6 Meters	52.580-	151.4 Hz	Down*
2 Meters	147.39+	151.4 Hz	Operating
1.25 Meters	223.96-	156.7 Hz	Operating
0.70 Meter	441.35+	88.5 Hz	Operating
0.23 Meter	1286.2-	100 Hz	Operating
Note: *6M repeater is out of service. AD6CL is working to restore operation.			

SDR Transforms Amateur Radio — by Louis E. Frenzel, W5LEF
(*Electronic Design Online* , ID#19439, August 14, 2008).

Like almost everything else in electronics, radios are becoming processors with software that communicate via a small amount of RF I/O circuitry. Surely, then, the rise of software-defined radio (SDR) should come as no surprise.

Digital signal processing (DSP) lies at the heart of SDR. Add to that the arrival of faster analog-to-digital and digital-to-analog converters (ADCs and DACs) and processors, and SDR becomes more viable for a wider range of applications. Simply put, software continues to push hardware aside, assuming more and more processing functions.

SDR first showed up in military equipment, but it is now used in most cell phones. It also is ideal for future public-safety communications by providing a way to deal with the myriad air interfaces and frequency spectra used by first responders in disaster situations. SDR techniques have even joined the mainstream, with services like ham radio adopting them as prices permit.

SDR Defined

According to the SDR Forum and the IEEE, “A software-defined radio is any radio, transmitter or receiver, in which some or all of the physical layer functions are software defined.” That means the core hardware is a processor running software that can emulate hardware functions. As a result, the signals must be digital.

The receiver must first digitize the radio signals in an ADC. In most cases, a downconverter is needed to translate the very high radio frequencies, often in the microwave region, down to an intermediate frequency (IF) that’s within the range of a decent ADC.

Today, many SDR receivers convert directly to baseband. Once the ADC converts the signals into digital form, the processor and software can take over. DSP software routinely implements receiver functions like filtering, noise suppression, and demodulation.

The digital signal processor develops the signals to be transmitted, along with any modulation. A fast DAC then converts these signals into analog form. Next, an upconverter stage translates the signal to its final higher operating frequency before it is applied to a power amplifier and the antenna. The processor uses DSP to perform the modulation, filtering, and other functions previously implemented with analog circuits.

The most common reason for using SDR is flexibility, or the ability to change or adapt to varying radio situations. With SDR, you can accommodate virtually any modulation scheme in the same radio without adding any hardware. All you have to do is download a new software module, and you have a new radio.

Multiple modulation subroutines can exist within the code and allow an operator to change on the fly. A flexible air interface and a wide frequency range make the radio applicable for many different jobs. That's why the military is so enamored with SDR. One radio can communicate with many different sources and terminals, lowering costs and reducing the number of radios needed.

Furthermore, SDR improves radio performance. For instance, DSP filters can make selectivity many times better than what's achievable with inductor-capacitor (LC) or crystal filters. Brick-wall filters become a reality. Intermodulation problems can be significantly reduced. Features like automatic gain control (AGC) and noise suppression can also be improved many times over the performance produced by analog circuits.

In amateur radio, hams want the best performance with the most flexibility, and SDR provides it. Hams use multiple communications modes in multiple bands. Continuous wave or CW (Morse code), AM, FM, single side-band (SSB), double side-band (DSB), radioteletype (RTTY), and packet data are just a few of the schemes used in bands from 1800 kHz to 10 GHz.

Since the ham bands are not channelized, any station can operate on any frequency, making interference and closely spaced stations a challenge to overcome. Superior DSP filtering is a real blessing in most ham communications. While SDR usually costs more, at least today, it's chosen for one or more of these benefits.

It's important to distinguish between SDR and a software-controlled radio, though. A software-controlled radio may not involve common SDR methods, except perhaps for limited use of DSP IF filtering. Instead, it's typically a computer-controlled receiver.

With a number of models on the market, software-controlled radios use a PC to control all or most receiver functions via a graphical user interface (GUI) that emulates the receiver front panel with its tuning dial, S-meter, knobs, and switches. By pointing and clicking with a mouse, users can change frequency, select band and mode, increase volume, and perform other operations usually actuated with a front-panel button or knob.

With PCs so common today, it's an easy transition from a conventional knob, switch, and LCD readout front panel to the virtual front panel with its point-and-click approach. Ten-Tec's RX-320D and AOR's SR2200 are just two of the software-controlled radios now available.

SDR Amateur Radio Equipment

Hams have dabbled with SDR for more than a decade. These inveterate experimenters have been home-brewing hardware of all kinds since the early 20th century, and that includes some SDR in the late 1990s. SDR is very complex and expensive, though, so it has been limited to those hams equipped with the knowledge and money.

Until recently, only a handful of commercial SDR products emerged. Introduced in 1998, the Kachina 505DSP was the first product to use a virtual front panel on a PC. While not fully SDR, it did use DSP for second IF filtering. The 505DSP didn't last long, and it wasn't a commercial success. But it certainly showed what could be done, and it paved the way for other efforts.

A big breakthrough in ham SDR came in 2002. Gerald Youngblood (K5SDR) wrote the first of a series of articles on SDR basics describing the construction of a complete SDR transceiver called the SDR-1000 ("Software-Defined Radio for the Masses, Part 1," QEX, July/August 2002) for the American Radio Relay League (ARRL). This ultimately led him to found FlexRadio Systems, producing the SDR-1000 as a commercial product …[and] to the creation of FlexRadio's latest product, the FLEX-5000A.

1. The FlexRadio FLEX-5000A amateur radio transceiver operates on all ham bands from 6 to 160 m in all modes. It features a unique quadrature switching detector front end on the receiver, a 100-W output transmitter, and SmartSDR software that runs on a PC to implement all receiver and transceiver functions and provide the virtual front panel.

Typical of what you'll see from other manufacturers in the future, the FLEX-5000A is a full-blown SDR transceiver. It follows and improves upon the SDR-1000's design. Specifically, it eliminates the need for the PC sound card and adds its own ADC and DAC. The PC still handles the DSP, receiver control, and display functions and communicates with the radio by an IEEE 1394 FireWire interface.

The FLEX-5000A is stealthy and probably the most powerful ham transceiver available. It covers all ham bands from 1800 kHz to 54 MHz (160, 80, 40, 30, 20, 17, 15, 10, and 6 meters). Also, it can operate in virtually all common ham modes, including CW, AM, SSB, DSB, FM, and RTTY, along with a variety of digital packet modes like PSK31. Its direct-conversion receiver has a unique front end.

The transmitter puts out 100 W of RF power in all bands. The specifications for both transmitter and receiver in terms of harmonic and sideband suppression, third-order intermodulation distortion, sensitivity, and image rejection are world class. An impressive and flexible switching matrix allows any of three antennas to be connected to any of the two possible receivers or the transmitter.

The input to the antenna is applied to a low-noise amplifier (LNA) and bank of input bandpass filters (BPFs) for each major ham band. After the LNA, a low-pass filter (LPF) serves as an anti-alias filter. The signal is then applied to the quadrature switching detector (QSD). While the first stage in most receivers is a conventional mixer, the FLEX-5000A uses a unique switching circuit called a Tayloe detector, named after its inventor, Dan Tayloe (N7VE).

The circuit is essentially a one- to four-MOSFET switching demultiplexer with a capacitor on each of the four outputs. The demux switch commutates at a rate four times the desired signal detection frequency. The output resistance of the driving source and the switched capacitors form a selective bandpass filter. The switching rate sets the filter's center frequency, and its bandwidth is a function of the resistance and capacitance values.

But more importantly, the outputs are shifted 90° from one another as they sample the input signal. Combining the output signals in low-noise operational amplifiers produces the familiar in-phase (I) and quadrature (Q) signals at baseband, which makes the Tayloe detector a direct-conversion circuit. Given the I/Q signals, the demodulation of any kind of signal is possible.

The I and Q signals are then sent to a 24-bit sigma-delta (S-Δ) ADC. Sampling rate is selectable between 192, 96, or 48 thousand samples per second. The ADC outputs go to the PC via the FireWire interface. An audio codec takes the demodulated, filtered, and otherwise processed signal from the PC and sends it to the audio amplifier, speaker, or headphones.

The Tayloe detector's local-oscillator signal is derived from a direct digital synthesizer (DDS1), whose input is derived from a 10-MHz temperature-compensated crystal oscillator (TCXO) driving a phase-locked loop (PLL) with a 500-MHz voltage-controlled crystal oscillator (VCXO) output. The DDS1 oscillator can set the receiver to any frequency with an increment as small as 1 Hz.

A second receiver that's identical to, and independent of, the main receiver can be installed as an accessory. A separate local oscillator (DDS2) is used as well. For the transmitter, the audio-frequency (AF) input signal from the microphone is digitized in the codec and the PC for modulation. The signal generated in the codec is then sent to a DAC, where it's converted into the I and Q signals. A quadrature switching exciter (QSE) serves as the modulator.

After amplification and low-pass filtering, the signal is sent to the final power amplifier (PA), which is a push-pull MOSFET class AB amplifier with an output of 100 W. The signal is low-pass filtered one more time to clean out the harmonics before making its way to the switching matrix and the antenna. DDS1 sets the transmitter frequency.

While the FLEX-5000A's hardware is impressive, its PowerSDR software makes it all work. It performs all of the DSP functions and implements the front panel and all other radio controls. Written in C#, this full open-source software is available for free download at www.flex-radio.com. It's maintained and updated by a bunch of highly interested and knowledgeable SDR experts. Additionally, the software is designed to run under Windows XP or Vista. A generic version is in the works so customers can run it on a Mac or Linux machine.

The receiver local-oscillator frequency displays are at the top of the video display screen on the PC, showing the receiver and transmitter frequency and the second receiver frequency if installed. The really interesting display is in the middle of the PC video screen. This is the so-called panadapter display, which shows a segment of the band being received. The width of this band is half the sampling speed of the receiver ADC.

With 192 thousand samples per second, the displayed bandwidth is 96 kHz. Therefore, users can see all of the signals in that range via the spectrum analyzer. With its point-and-click tuning, users simply move the cursor to a point on the frequency display and click. This tunes the receiver there and sets the transmitter to that frequency, which becomes the center frequency on the display.

Its waterfall display option appears above the frequency spectrum display. Sometimes called a spectrogram, the waterfall display shows frequency on the horizontal (x) axis, time on the vertical (y) axis, and signal amplitude on the (z) axis in color, indicating signal strength. The display moves from top to bottom and looks like a waterfall. It's great for picking weak signals out of a noisy background.

Options for the FLEX-5000A include a built-in automatic antenna tuner and a transverter that will convert the transceiver to the 2-m and 70-cm bands (144 and 440 MHz). With its 28-MHz IF, the unit can operate on these two popular ham bands, both of which are also used for amateur satellite communications.

As for software, the HPSDR boards work with the PowerSDR software available free from FlexRadio. Check out the HPSDR Web site at www.hpsdr.org and peruse the group's work and extensive projects and offerings.

If you want to learn SDR, the ham radio community is a great place to start, whether or not you are a ham. The available products make it possible to get up to speed quickly without the hundreds of hours typically needed to design hardware, write code, and run endless tests.

Programmable Low-Voltage Circuit Breaker and Tester — by Terry Greenfield for the John F. Kennedy Space Center, Florida (*NASA Tech Briefs*, August 2008, p. 36).

An instrumentation system that would comprise a remotely controllable and programmable low-voltage circuit breaker plus several electric-circuit-testing subsystems has been conceived, originally for use aboard a spacecraft during all phases of operation from pre-launch testing through launch, ascent, orbit, descent, and landing. The system could also be adapted to similar use aboard aircraft. In comparison with remotely controllable circuit breakers heretofore commercially available, this system would be smaller, less massive, and capable of performing more functions, as needed for aerospace applications.

The circuit breaker in this system could be set open or closed and could be monitored, all remotely. Trip current could be set at a specified value or could be made to follow a trip curve (a specified trip current as a function of time). In a typicalapplication, there might be a requirement to set a lower trip current or lower trip-curve values to protect circuits curing initial testing, and to set a default higher trip current during subsequent pre-launch and launch operations.

In the open state of the circuit breaker, one of the circuit-testing subsystems could obtain electrical-resistance readings on the load side as indications of whether faults are present, prior to switching the circuit breaker closed. Should a fault be detected, another circuit-testing subsystem could perform time-domain reflectometry, which would be helpful in locating the fault. On the power-line side, still another circuit-testing subsystem could take a voltage reading, as an indication of whether the proper voltage is present, prior to switching the circuit breaker closed.

The system would be contained in a housing, with input, output, and data/control connectors on the rear surface. All monitoring, control, and programming functions would ordinarily be performed from a remote console. On the front surface, there would be a push-button switch for optionally locally setting the circuit breaker in the open or closed state, plus a lamp that would provide a local visual indication of whether the circuit breaker was in the open (initially set), closed, or open (tripped) state.

The aforementioned monitoring, testing, state-setting, and trip-current-setting functions would be effected by circuitry on an integrated-circuit card inside the housing. Also on the card would be (1) input and output circuitry for remote monitoring and control and (2) a tag random-access memory as an electronic means of identifying the system by serial number, location, a reference designation, and operational characteristics.

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