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QRP Quarterly

Volume 43 Number 2
April 2002
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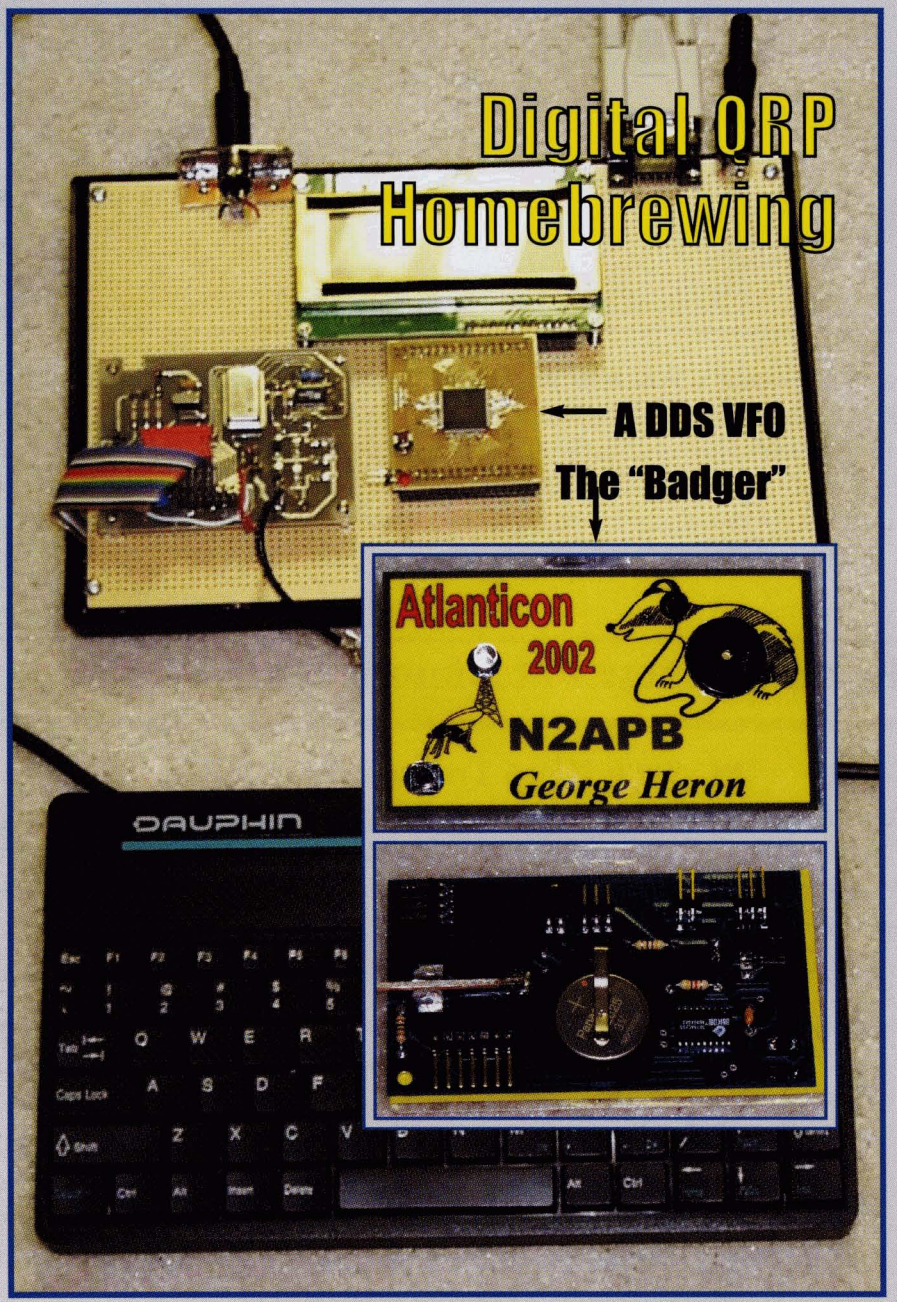
Journal of the QRP Amateur Radio Club International



- W4RNL's Techniques for Building Field Verticals
- Review and Feedback on the Elecraft K-1
- See the *Idea Exchange* for a real "Ham" Radio
- Writing Guidelines from New Editor WB5YJX
- Results of the 2001 Holiday Spirits and Top Band Sprints

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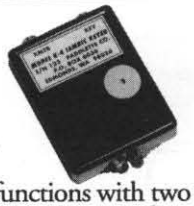

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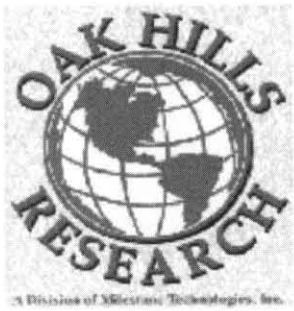

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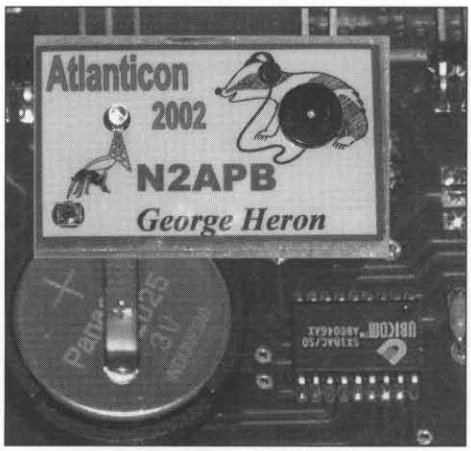

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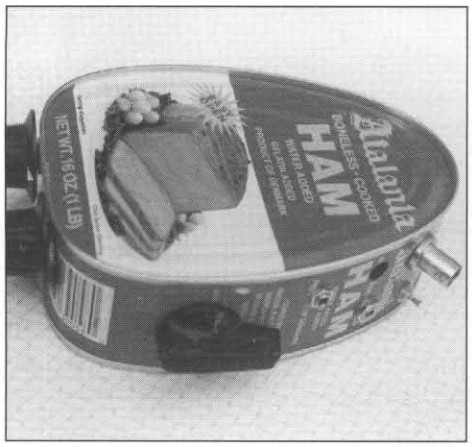

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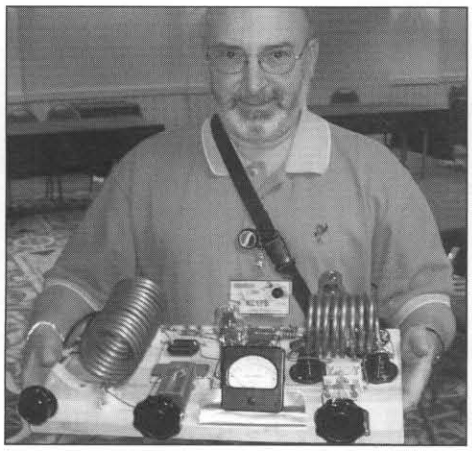

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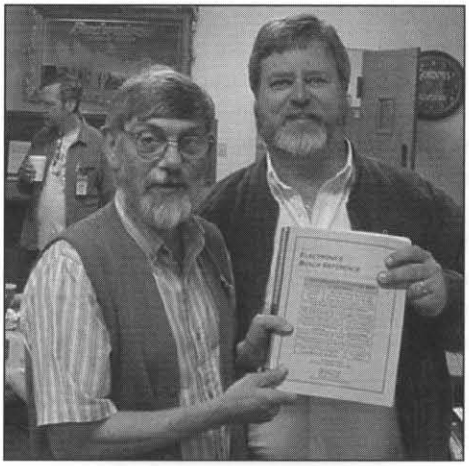
From the Editor's Desk

Michael Goins, WB5YJX—Managing Editor mgoins@usa.net



Your new Editor, Mike, WB5YJX, shows off the Arkiecon 2002 Proceedings with QRP legend Rev. George Dobbs, G3RJV.
—Photo by W5HNS

Thinking about writing an article for *QRP Quarterly*, but not sure just how to go about doing it? Well, let us help!

The following guidelines will help us get your article into print quickly and efficiently, and please keep in mind that we do not expect you to be a professional writer—if you need help putting the article together, or have questions, email the managing editor for assistance.

Guidelines

When preparing your manuscript for email delivery, please observe the following guidelines:

1. Send the manuscript as a Microsoft Word file attachment (.doc or as a .rtf), or within the body of the email. Do not embed images or documents within the article, and there is no need to make the pages look like those of *QRP Quarterly*—we'll take care of all that.
2. Photographs (drawings, or figures) should always be sent as separate files, and should be as large as possible. This means that photos made with a digital camera must have at least 1.2 megapixel (or greater) of resolution when set at maximum (generally the setting that allows the least number of pictures). The resolution needs to be at least 300 dpi for a 4˜5 image (or larger). If your camera has a day/date stamp it automatically adds to the photos, please make certain you turn it off (your image viewing software will answer these questions). Never send images captured from websites or catalogs without written permission from the owner (company, webmaster, other media). And remember, thick lines in schematics and drawings work much better than thin lines.
3. Number the photos, figures, graphs and charts—and name all files sent in a logical way, either with their number or with a descriptive name (for example, VERTANT or VANT for vertical antenna, not VA126.50).
4. Include captions for all photos, drawings, or figures sent, and carefully spell out the names of all prominent people, their call signs, and the location.
5. Schematics/drawings need to be as clear as possible (using a thick lines option if it is available). All components and their values must be clearly labeled (C1 – 50 pF, R7 – 470 ohms, etc.). When building, source information can be critical (and should be included).
6. Dimensions of all construction components (wire, PVC pipe, aluminum tubing, etc.) must be clearly listed. Please list the source if deemed important.
7. Keep all special formatting—equations, subscripts, superscripts, exponents, equations, etc.—as simple and clear as possible.
8. Make certain that your name, call sign, address, and email are included with your manuscript.
9. Manuscripts should be sent to mgoins@usa.net. You may also mail a PC disk copy of the manuscript by regular mail. My address is in the staff list on the left side of this page.

Don't let this list intimidate you; it's not as complicated as it sounds!

—Mike Goins, WB5YJX

●●

From the President

Joe Spencer, KK5NA—QRP ARCI President kk5na@quadj.com

Well, QRP is still growing and glowing in the world of Amateur Radio, and QRP-ARCI is growing right along with it. Here we are into our second issue of 2002, and, though a bit late, we hope you will enjoy it.

You may notice that *QRP Quarterly* has undergone some changes, as has its staff. This is a volunteer operation, and we appreciate both your patience and your understanding as we try to produce as professional a magazine as possible.

The majority of the problems with the timeliness of this issue occurred because the Quarterly staff was undergoing change just as the Board of Directors and President were changing over. Although so many changes at the same time delayed the process, we are about to get everyone settled again, get the *QQ* back on schedule, and get on with other business.

To that end, three of our members are now a part of the Board of Directors, and we will have a new Vice President soon. New Board members as of April, are Tom Dooley, K4TJD, Danny Gingell, K3TKS, and Hank Kohl, K8DD.

Unfortunately, not only the *QQ* fell victim to the changeover and staffing confusion. It is now too late for the Hall of Fame selection process prior to Dayton.

The good news is that we still have an excellent magazine, that QRP is still fun, still growing, and still having a powerful effect on our hobby.

Hope to see you in Dayton and on the air. —*Joe KK5NA*

New QRP-ARCI Board Members

Tom Dooley, K4TJD
Norcross, GA

I have been a ham since late 1996, definitely not a long timer in the Amateur Radio world! In spite of that, I have played with electronics for many years.

I built my first Heathkit in 1969, a FET VOM. I have built over 25 Heathkits, but none of them were Amateur Radio products. Although I loved electronics, I never knew a Ham radio operator while I was growing up...bummer. I loved electronics enough to sign up in the Air Force in 1972 for Airborne Communications training, and I worked on C-124s and C-130s during my military career. I got out of the military in 1978 and college about the same time, and got my CPA certificate in 1981.

I have served many roles in many model aviation clubs, with the longest terms being Treasurer of the International Radio Controlled Helicopter Association (IRCHA) from 1989 to 1997. I was the President of IRCHA from 1997 through 1999.

As part of the leadership team of QRP ARCI, I will work toward continuing and growing the relationship with the ARRL, to both of our benefits. No one organization is a successful island by itself. We must be well connected to grow. I also feel that my experience will bring additional strength to a group that is already strong. I would love to step up to the plate to learn from the group, and to participate in continuing the growth of the QRP ARCI organization.

Danny Gingell, K3TKS
Silver Spring, MD

I am pleased to be on the QRP ARCI Board of Directors for 2002. I have previously served as The QRP ARCI Net Manager for many years, and also several terms on the BoD. I am currently managing The *QRP Quarterly* magazine back issues sales and services, sometimes called "The Warehouse." I will bring continuity and experience to the New BoD. We are growing as a Hobby and as a Club, and it is very important that we keep new members in mind as we consider new directions and plans for QRP ARCI and QRP in General. I believe that I can help keep QRP ARCI on track and continue to lead the QRP Community into the future. I am a LifeTime QRPer and I will vote on every issue presented to the BoD, just as I have in the past.

Hank Kohl, K8DD
Attica, MI

I am ready to serve on the QRP-ARCI Board of Directors as I have done so for the past 8 years. I hope to help keep the club moving forward. The big thing is to keep QRP-ARCI in front of the rest of Amateur Radio, and spread the word that "QRP is!" and "Life is NOT too short for QRP!" Also to support the many events that ARCI helps sponsors. I currently manage the "Toy Store"—all the club items such as books, tee shirts, etc., and I also manage all the rooms for FDIM. I will bring continuity to the club.

●●

Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewski—WA8MCQ wa8mcq@comquest.net

IN THIS EDITION OF IDEA EXCHANGE:

New E-mail Address for WA8MCQ
Getting Lower (Frequency) Performance From Your SSS—Joe Everhart, N2CX
A Real Ham Radio—Arnold Olean, KØZK
The Multi-Mode PSK-20—Jim Hale, KJ5TF
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How to Find Old QRP-L Traffic
Good Source of SMT Parts—Monty Northrup, N5FC
Grinding Aluminum and Brass: Don't!
Schottky RF Diode Info and Sources—WA8MCQ
1N5819 Not Recommended for Diode Detector—WA8MCQ
QRP Online

New E-mail Address for WA8MCQ

Effective immediately, my e-mail address is wa8mcq@comcast.net. Old addresses that are no longer in use are wa8mcq@erols.com and wa8mcq@home.com. (The latter lasted just a couple of months before Comcast stopped using the now defunct @home service and built up their own infrastructure.) My snail mail address is still Mike Czuhajewski, 7945 Citadel Drive, Severn, MD 21144.

Getting Lower (Frequency) Performance From Your SSS

Here's where it all started, in the January 1991 edition of the Idea Exchange, in an item titled "Quickie Audio Oscillator."

I love quickies. That is, I like simple little circuits built for special purposes...

An electrical engineer by profession, Joe Everhart, N2CX of Brooklawn, NJ, promised me an unending string of "Joe's Quickies" if I wanted to run them. At first he sent me one every few issues and then kicked into overdrive, with one for every issue of the QRP Quarterly. In Joe's Quickie #41, he gives us a modification to extend the low frequency limit of the simple, but popular, frequency counter kit put out by the QRPers in Arizona.

The recently introduced SQRPion Stinger Singer (Ref. 1) is a neat device. It is a simple Altoids™ tin-sized low current drain frequency counter designed by N7VE. The real cute thing about it is that the display is not visual, but an audible Morse code readout.

The SSS is very handy for RF measurements above 100 kHz or so. In its quest for simplicity, its input circuit uses one section of a 74HC00 gate biased linearly by a 20k resistor. This gives sufficient gain to allow the counter to work with as little as 10 mV sine wave inputs. The downside is that the linearized gate oscillates at a high frequency with no input, and it will not operate properly with lower frequency inputs.

AC inputs below about 100 kHz are not amplified enough by this circuit to produce the fast-edged inputs needed for successful frequency counter operation.

One simple way to "square up" low frequency sines is to replace the 74HC00 gate with a 74HC132 chip. This is a pin-compatible quad NAND gate, but its inputs have a Schmitt trigger action that will produce the fast rise and fall times needed. Check Schmitt trigger operation in the *ARRL Radio Amateur Handbook* for a full description of this circuit function.

The downside of using the Schmitt input chip is that it needs a large-signal input. Chip-to-chip variations cause this to range from as little as 0.4 to as much as 1.4 volts peak to peak. Alas, an extra amplifier is needed to improve input sensitivity.

Figure 1 shows the full modification. As mentioned above, U1 is replaced by a 74HC132. In addition, resistor R1 and capacitor C4 are removed (be sure to put a jumper wire across the C4 pads on the PCB.) The input amplifier is a simple common emitter amplifier that self-biases the '132 input to about +2.5 volts. A sine wave input of 10 mV to the amplifier should be large enough to operate the counter successfully, and potentiometer Rin can be used to adjust input sensitivity. The circuit is pretty non-critical to input level, so a board-mounted pot is probably sufficient. Keep the pot set as much toward the low end as you can to maintain a high input impedance. When it's set for highest sensitivity, the input impedance is only a couple kilohms and may load down the circuit you are measuring.

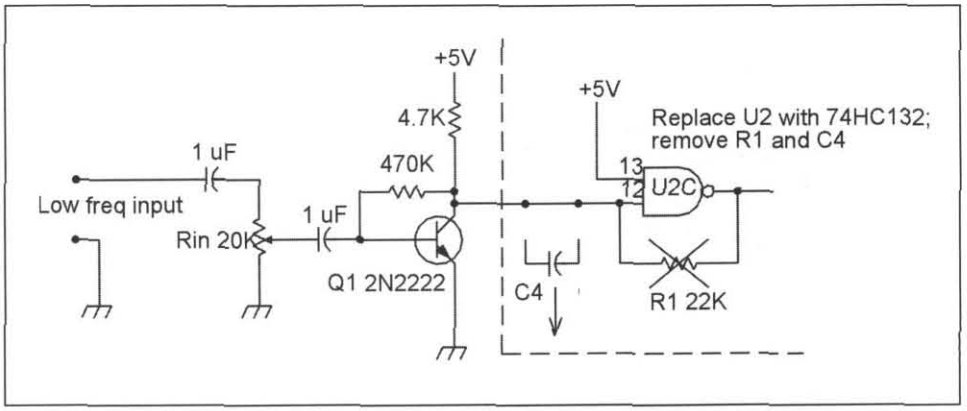

Figure 1—A few component changes and an added amplifier extend the low frequency operation of the SSS frequency counter.

When measuring audio, remember that the SSS must be in the right operating mode. In the "E" mode its resolution is only 100 Hz so, for example if you were reading a 1240 Hz sine wave, the output would be "1R2" which is kinda cryptic. The "F," "L" and "LR" modes give you a reading down to Hertz, which is likely what you want.

This low-frequency mod is tailored for audio and low RF use. It operates well from 100 Hz up to at least 1 MHz, though it begins to lose sensitivity if you go much higher. What you really need is two SSS's, one for RF and one for audio. Shucks, they are cheap enough at $20.00. However, if you are on a budget, N7VE reports that the ScQRPions will sell the pre-programmed PIC chips that are the heart of the SSS.

BTW, the chips are available in two Morse code speed ranges. As originally supplied, there are two selectable speeds of 18 and 27 wpm. Based on requests for slower speeds they now have an alternative one that operates at 10 or 15 wpm.

Ref. 1. AZ ScQRPions page: http://www.extremezone.com/~nk7m/

— de N2CX
n2cx@voicenet.com

Figure 2—A real ham radio!

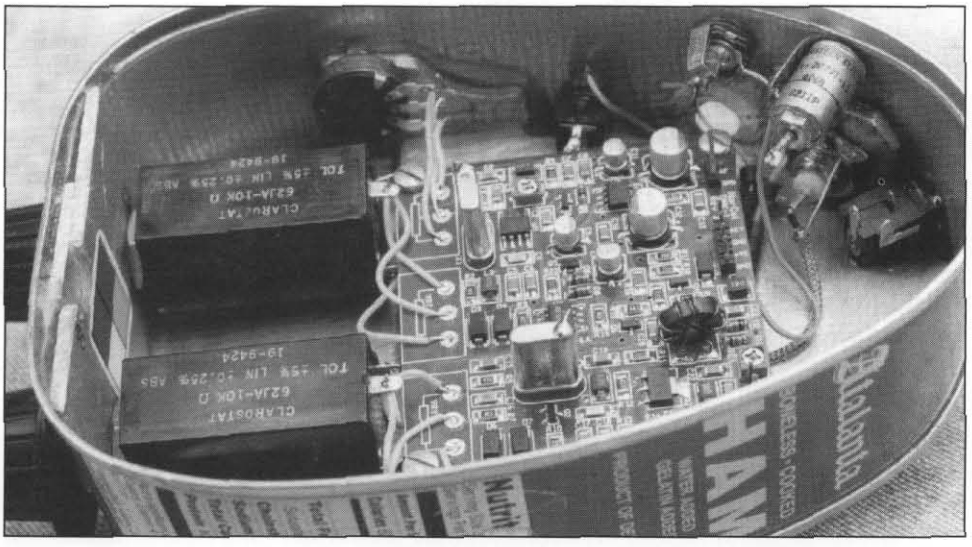

Figure 3—Although it's April, this one really is legit. It's KØZK's NorCal SMK-1 in disguise.

A Real Ham Radio

Sorry folks, this is April Fools month, and this had to be done! See Figures 2 and 3. Actually, this IS a serious radio. This is the NorCal SMK-1 transceiver as packaged by Arnold Olean, KØZK of Lebanon, ME. Instead of using the supplied pots onboard as designed, he mounted one on the can and replaced the two tuning pots with a pair of ten-turn units.

No longer available, the SMK-1 was a fairly simple but enormously popular "introduction to surface mount components" kit designed by Dave Fifield, AD6A, in conjunction with, and sold through, NorCal. It was based on the W1FB Tuna Tin 2 transmitter and the Columbus QRP Club's MRX Receiver, which is itself an offshoot of the Neophyte receiver (NE602 and LM386). In the SMK-1, both transmitter and receiver are VXOs (tunable crystal oscillators).

Back in the January 2001 issue of the QRP Quarterly, Arnold described a "new" knob he made for his Elecraft K2 transceiver. It was actually from an old WWII vintage frequency meter, and his item concentrated mainly on making an adapter so it could be used on the shaft of the K2. Zack Lau, W1VT of the ARRL lab, went one better for his own K1 and K2 radios; he made his own knobs from scratch. Figure 4 shows Zack at his bench in the lab with his K1 and K2, both sporting his own versions of the knob. Says Zack, "The K1 knob is machined out of acrylic, and the K2 out of polycarbonate and brass. I made them on my Sherline lathe and milling machine. I think the details will run soon in QEX."

As old timers know, Zack has done more than his share with, and for, QRP over the years, starting out with his original call of KH6CP/1.

The Multi-Mode PSK-20

Our very own Jim Hale, KJ5TF, posted this modification to this popular rig on QRP-L—

In a very simple (but fun) modification to the NN1G Small Wonders Labs PSK-20 kit, it now can operate above the PSK31 zone.

The kit comes stock with a crystal that covers 14.070 MHz, but I enjoy all the soundcard digital modes, and you can only operate PSK31 on that frequency. So by adding a 5.078 MHz crystal and a switch to the board (at the Y6 position, which comes with one for 5.07 MHz), I can now cover 14.080 MHz as well.

As of now, I think my coverage is as follows: PSK31 zone, 14.068.3 - 14.070.8

Figure 4—Zack Lau, W1VT, shows off homebrew knobs on his Elecraft K1 and K2 transceivers.

MHz, and the new crystal gives me 14.080.4 - 14.084.3 MHz.

I started out with a toggle switch on the case, but the additional three inches of wire may have resulted in drift on PSK. So I found a really small switch from a defunct cordless phone and located the assembly right on top of the Y6 XTAL location on the board. To change crystals I'll have to open the case, but in time I hope to find a better way.

RF Activated Sidetone Oscillator

Steve "Melt Solder" Weber, KD1JV of Berlin, NH, has been active on QRP-L for some time. He is perhaps most well known for the long line of limited edition kits he has been producing for several years. In a recent post to QRP-L, he mentioned an article on his web site about an RF activated CW sidetone monitor, and agreed to let me run it here. Most of our rigs have keying monitors built in already, but there are times when a stand-alone monitor is useful, activated by RF, with no direct connection to the rig.

If you have an Internet account, be sure to take a look at his web page. The URL is

http://www.qsl.net/kd1jv/

It shows some of the kits currently available, as well as some of his other projects (including this sidetone). But what I think is the neatest one by far, which is NOT available in kit form, is a 40/20M superhet CW transceiver using direct digital synthesis (DDS) for frequency control and putting out at least 2 watts. The punch line is that it fits in an Altoids tin! (It does require a pair of stacked boards to pull it off.) The rig is controlled by tiny pushbuttons, and the frequency is indicated by an Audio Frequency Annunciator in Morse code. (I believe the AFA concept was first introduced by Wayne Burdick, N6KR.) Since this is the April issue, let me assure you that this is no joke, and it has been on his web page for quite some time. Figure 5 is his picture of it. (The Zomboids tin shown was a creation of Rex Harper, W1REX, who had several hundred custom made a few years ago, complete with candy inside. It was inspired by the NorCal Zombies phenomenon of a few years back.)

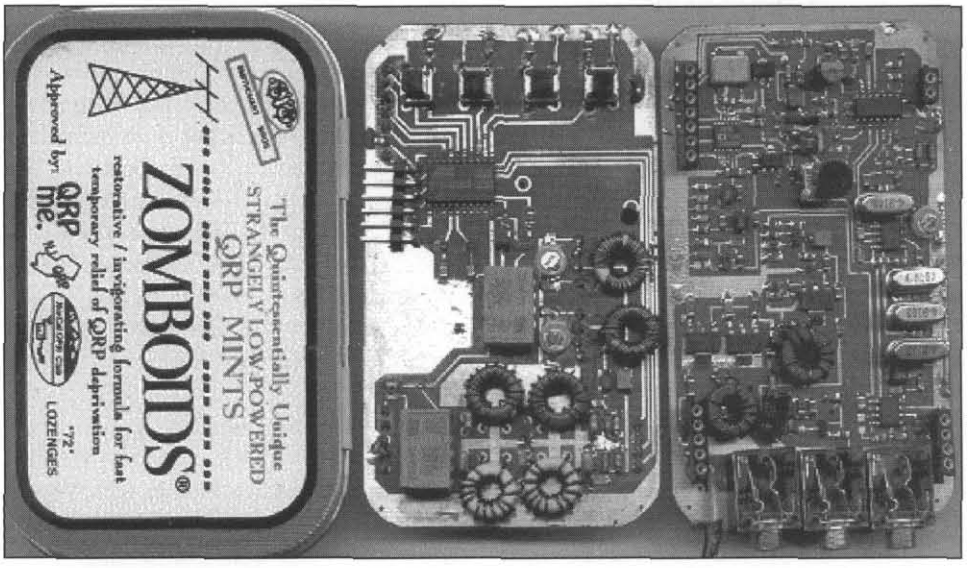

Figure 5—Another legitimate rig, not an Aril Fool's joke, this is a 2-band CW transceiver with DDS VFO that fits into an Altoids box (or in this case, the Rex Harper Zomboids box).

If you look at Steve's web page, you will recognize the schematic of the sidetone monitor. He originally had a hand drawn schematic, and I offered to let him use the one I drew up for the column.

Having forgotten to add a side tone oscillator into a 6AW8–5763 tube transmitter I had just built, I decided to build an external, RF activate sidetone oscillator instead of building one into the tube rig. It is more than sensitive enough to trigger on 5 watts, although, I must say my antenna is roof mounted and one end of it is probably less than 15 feet away! If more sensitivity is needed, replacing the 100k resistor at the input of the diode detector with a tuned circuit for the band in question would probably do the trick.

How it works: The schematic is shown in Figure 6. RF is detected with a short sense antenna, rectified and double by the 1N34 diodes. Silicon diodes like 1N4148 may be substituted, but sensitivity will be decreased. When the rectified RF level exceeds the voltage set on the inverting input of the op amp (set by the sensitivity control) the output of the first op amp goes positive. This turns on the side tone oscillator, comprised of the second op amp.

The 0.01 µF cap and 51k resistor set the oscillator frequency, and with these values, it's about 1 kHz. The tone can be changed by adjusting the 51k resistor value. The exact tone is also influenced by

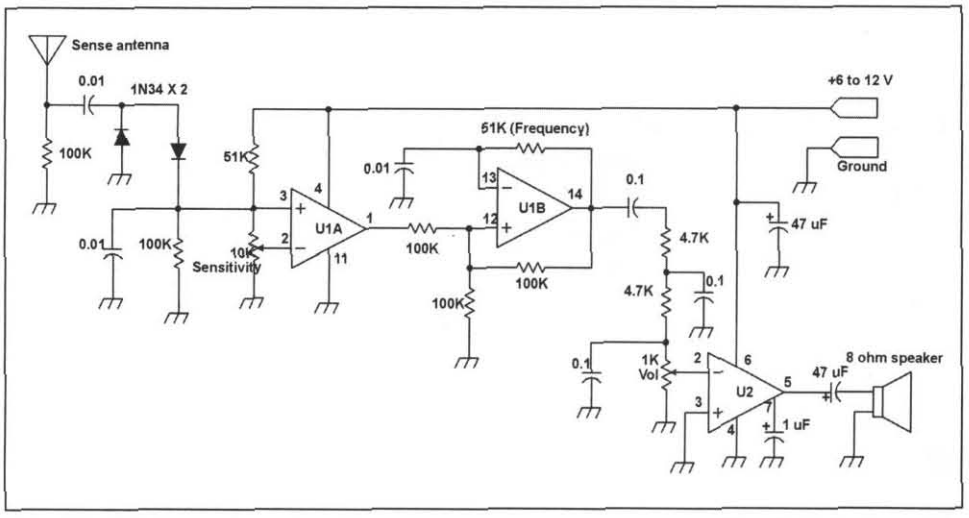

Figure 6—The KD1JV RF-activated CW sidetone monitor. (WA8MCQ drawing, which also appears on his website.)

the supply voltage. I used a LM324 op amp, as I am well stocked with the device, but since only two sections are used, a LM358 could do as well.

The output of the tone oscillator is a square wave, which is then rounded up by a R/C low pass filter. The attenuated signal is then sent to an LM386 audio amp to drive a speaker.

If small trim pots are used for the sensitivity and volume controls, and a 1 inch diameter flat speaker used, the circuit can be built small enough to fit in a popular "Altoids" tin, along with a 9V battery. Power consumption is minimal, so a battery should last a long time (provided you remember to turn it off when not in use!).

— de *KD1JV*
kd1jv@moose.ncia.net

The NE602 is Not Gone for Good

This is a question that some folks were asking in the last year or so. It appeared that the supply had virtually dried up, and some feared they were gone for good. Happily, as it turns out, a combination of circumstances led to the short supply, including a fire at the Philips plant in New Mexico that makes them.

Paul Harden, NA5N, lives less than a hundred miles from the plant and visited them. He had a good talk with some of their engineers, and had two posts about this on QRP-L and one on GQRP-L, explaining the situation quite well. Unfortunately I waited until the last minute to try condensing them into a single article, and I started getting bogged down. Instead of rushing it, and possibly taking liberties with some of his words, I want to give it the time it deserves and present it next time.

In the meantime, here's the short answer. While the part marked as NE602 is obsolete and out of production, they are making exactly the same thing under the number NE612. Also equivalent, as far as we're concerned, are SA602 (obsolete) and SA612. The only differences between the NE and SA are the temperature ranges, and they aren't of concern to the average homebrewer. The parts will continue to be produced for some time and the company has no intentions of discontinuing it, since the cell phone industry uses a lot of them. They are available in both DIP and surface mount forms.

As Paul put it, as far as we're concerned, the bottom line is "NE602 = NE612 = SA602 = SA612." And you can count on being able to get at least one of those numbers for quite some time.

Some Interesting Technical Info on the Web

Here are some good technical references on the WorldWide Web, as posted to QRP-L:

From Mike Boatright, KO4WX (ko4wx @mindspring.com)—"Check out the International Crystal web page for some great info about how capacitance (and inductance) can affect the actual operating frequency of a crystal. The frequency shift is predictable, if you know certain parameters of a crystal. Even if you don't know the exact parameters, you can make educated guesses based on typical values. The shift is in PPM (parts per million), which as many have observed, means the higher you go in frequency, the bigger the shift in frequency for the same number of PPM.

"There's some interesting stuff to read there."

http://www.icmfg.com/tech.html

From Chuck Carpenter, W5USJ, (W5USJ@go.com)—"Looking for software for Amateur use? Check this site."

http://www.ac6v.com/software.htm

"Lots of other amateur radio related info throughout the rest of AC6V's site too."

From Alan Dujenski, KB7MBI (ARDUJENSKI@aol.com)—"Lots of neat circuits."

http://www.uoguelph.ca/~antoon/circ/circuits.htm

From Ian Purdie, VK2TIP (ianpurdie@integritynet.com.au—"This site was drawn to my attention today. It is very useful for locating data sheets, although probably nothing much for glowbugs [vacuum tubes]."

http://www.datasheetlocator.com

From me, WA8MCQ—These are some of the all-time great technical sites for QRPers, each with it's own distinctive characteristic. Harry's site is an incredible mix of useful circuits, while Todd's is the work of a true disciple of Wes Hayward, W7ZOI. Both of these deserve a place of honor in the "favorites" folder of every QRPers Internet browser.

The QRP Homebuilder Homepage is run by Todd Gale, VE7BPO:

http://www.qrp.pops.net/

Harry's Homebrew Homepages is operated by Harry Lythall, SMØVPO, a Brit living in Sweden. Start out looking at this URL, and the opening page will tell you what URLs to check for various things. (Start out with the one for Homebrew

Projects.) I've used a number of his circuits in this column over the years.

http://www.geocities.com/SiliconValley/3569/index.htm#use

Unbalancing an NE602 Modulator for Tuning Up

A while back on QRP-L, Donald Dorn, K5AAR, asked, "I am building an SSB transceiver and using an NE602 for a balanced modulator but have not found a quick and easy way to unbalance it for tuning purposes. Has anybody ever tried this? I made a 700 Hertz generator from a 555 timer IC and can inject it with a small relay. It works but there must be a better way."

Jim Kortge, K8IQY, (jokortge@prodigy.net), had this to say—"I've not tried this, but injecting some DC into one of the inputs ought to unbalance the beastie. I'd start with a current limiting resistor of maybe 100k from Vcc, and work down. I probably wouldn't go any lower than 10k, but something in that range ought to unbalance it."

Dave Fifield, AD6A, (dave@redhotradio.com), followed up with this—"Injecting a DC offset (a 22k resistor to the 6V rail from one of the inputs, pin 1 or 2), is a good way to unbalance the mixer, but ONLY if pin 1 and 2 are isolated at DC.

"I have found, and used in the SMK-1 design, that you can raise the DC voltage on pins 1 and 2 together to get more gain from the SA612 (the old NE602's new identity). Because I raise the voltage on pins 1 and 2 by the same amount, the device remains balanced. If you concoct a circuit that just shifts the DC point of one of the inputs, you will get RF output from the device (CW carrier), which you can use to tune up the TX.

If you don't want to go to all this bother, maybe you could simply remove the relay you have in the output of your 700 Hz tone oscillator, and either mix it into the TX audio path properly (with a simple op-amp circuit), or maybe switch it with an FET instead. Just a thought."

Finally, from Bill Meara, N2CQR, (n2cqr@clix.pt)—"I've just finished another 17 meter DSB rig, this one using NE602s. The RX has NE602 as the RF amp, another one as the mixer, and a third one as the first AF amp. (It is based on a VK3AWC design in SPRAT 93). To unbalance both the RF amp and the AF amp, I just put 5 volts DC on pin 6. I'm not sure this is the best way to do this, but it seems to work. VK3AWC varies the voltages on pin 6 of the RF and AF amp for gain control and AGC.

"I have another NE602 as the balanced modulator in the TX, and hadn't really thought yet about how I was going to unbalance for tuning. Your question made me think of the answer: 5 volts to pin 6 via a pushbutton switch."

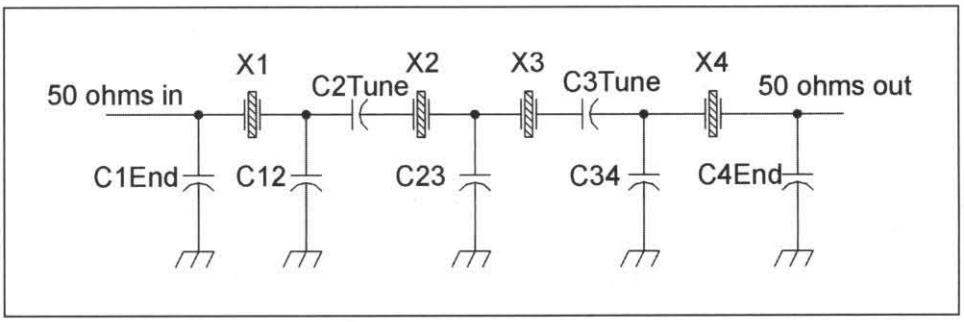

Figure 7—A crystal filter made from dirt cheap 13.5 MHz surplus crystals.

Design for a 13.5 MHz Crystal Filter

Last year there was a bit of excitement on QRP-L when someone noticed that surplus dealer Electronic Goldmine (http://www.goldmine-elec.com/) had boxes of 13.5 MHz crystals (HC49V holders, with wire leads) for sale for four dollars. While that's perhaps a bit of an odd frequency, the price did make it irresistible—they're boxes of 300! A number of people bought some, and I put some on order myself in March. Although up to $6 per box by then, it's still quite a deal.

There was some discussion about the effectiveness of filters at that frequency, mostly in QRP-L Digests 2383 and 2384 (a separate article tells how to view old QRP-L postings).

Not surprisingly the reactions were mixed, but many felt that good filters could still be made that high, and some had actually done so. A while later, Kent Torell, AB7OA, posted this information at the request of the author, Mike Brainard of Arlington, TX, (mbrainard@prodigy.net). Mike isn't currently a ham, having dropped out in 1966, when he held the call WA5KEX. He says he's considering getting a license again, though.

According to Kent, "Mike has actually designed and built a 500 Hz filter with response that is very close to his predicted response. He sent a little write-up about it, and asked me to post to the list. Basically, it's a four crystal, 50 ohm design, that uses nothing but 270 pF caps (he had a large bag of them)."

"The HBO270 13.5 MHz CW Filter"
by Mike Brainard

This describes a CW filter with 3 dB bandwidth of approximately 530-540 Hz and insertion loss of about 5.5 dB. It uses 13.5 MHz crystals available for around 2 cents each in lots of 300. The filter was empirically designed to be constructed from capacitors of a single value, and therefore the response does not follow any of the established filter polynomials (the schematic is shown in Figure 7).

The name HBO270 means "Had a Bag Of 270 pF capacitors." The design resulted when the coupling capacitors C12 and C34 were arbitrarily changed to meet the n^x270 pF criteria in a filter originally synthesized for 640 Hz bandwidth using lossless Butterworth k and q values.

I had been working to measure parameters on these crystals for a few weeks when I noticed others on the QRP-L forum discussing the same crystals for filter applications. After some private correspondence with Leon Heller (G1HSM), Brian Kassel (W5VBO), and particularly Kent Torell, there was some remaining uncertainty about measured parameters and whether a CW bandwidth filter could be built with these crystals at 13.5 MHz. I built a prototype of this filter to test my measured parameters and to provide some initial input on the feasibility question for CW bandwidth filters.

Using high side injection, the described filter provides 39.6 dB rejection of the

USB image when using a 500 Hz beat note, and 54.2 dB when using a 750 Hz beat note. For comparison, a lossless Butterworth design with the same 3 dB bandwidth as this filter and using the available crystals would improve these numbers by 1.3 dB at 500 Hz, and 1.5 dB at 750 Hz, while increasing the already high insertion loss by 0.3 dB. It would not have a true Butterworth response shape. A lossless Butterworth design at 13.5 MHz would approach the true Butterworth response shape if the crystals had a Q of about 650,000 or more!

A true CW bandwidth Butterworth response using the available crystals would require predistorted synthesis techniques, and would have insertion loss predicted to exceed 12 dB according to the Zverev filter tables. Such are the issues and tradeoffs involved when using these crystals for CW bandwidths.

On the plus side for these crystals, 50 ohm terminations are feasible for design bandwidths beyond 1000 Hz and 200 ohm terminations, and should work well for voice bandwidth filters. The CW bandwidth filters, although lossy, should be relatively easy to tune and get working. These crystals are also more uniform in the spread of parameters than some other batches of crystals I have investigated.

Components:

C1End, C4End	270 pF
C12, C34	810 pF (3 x 270 pF)
C23	1080 pF (4 x 270 pF)
X1, X4	13.5 MHz Crystal (matched pair)
X2, X3	13.5 MHz Crystal (see text)
C2Tune, C3Tune	810 pF (3 x 270 pF) (see text)

All capacitors are Silver Mica or NP0 ceramic, and all crystal cases are grounded. Design based on the following measured crystal parameters:

Lm = 4.8 mH; C0 = 6.8 pF; average Q = 91,100 (for crystals offered by Electronic Goldmine in lots of 300 during Fall/Winter 2001).

My prototype filter was constructed on a G10 glass terminal board 5 1/2" long and just over 1" wide. It had 19 press fit solder posts down each side, and was perfect for this project. I added 3M copper foil tape down the center to form a ground plane, and all ground connections are soldered directly to the foil. The crystals are mounted on their sides with minimum length ground connections. The prototype filter has stopband attenuation which exceeds 85 dB over the HF spectrum up to 19 MHz and degrades to 82 dB at 32 MHz. The 6/60 dB shape factor is 5.55. This is not the filter for a high performance receiver, but it certainly seems suitable for some casual receiver projects.

The tuning capacitors (C2Tune and C3Tune) specified are appropriate for filters constructed from four crystals that are all matched in frequency within about 10 Hz. In this case, use the lower frequency crystals for X2 and X3. By using other values for the tuning capacitors, filters can be constructed with only a pair of frequency-matched crystals. The matched pair should be used for X1 and X4. The tuning capacitor required to use non-matched crystals for X2 and X3 can be determined from Table 1.

Assume the matched pair used for X1 and X4 have measured frequencies of 13,500,099 and 13,500,101 Hz. The average is 13,500,100 Hz. The crystal to be used for X2 has a measured frequency of 13,500,078 Hz. The offset is 13,500,078, minus 13,500,100, or negative 22 Hz. The value for C2Tune would be 760 pF.

The crystal chosen for X3 has a measured series resonant frequency of 13,500,139 Hz. The offset is 13,500,139, minus 13,500,100, or 39 Hz. The tuning capacitor will have a value between 1000 and 1050 pF. By interpolation, the value for C3Tune is found to be 1011.2 pF.

In practice, standard value capacitors of 750 pF and 1000 pF would probably produce an acceptable filter.

For those inclined to try to precisely tune the filter, the amplitude response is a poor indicator of tuning. The filter tolerates moderate mistuning without apparent difference in the shape of the passband, but a better indicator of tuning is the return loss at the input of the filter. When precisely tuned, the return loss exhibits good symmetry about the center of the passband.

Other Filters Based on These Crystals *(These are computer designs and have not been built!):*

The voice bandwidth double-tuned circuit using these crystals uses two crystals connected in series between 50 ohm terminations. Add a single coupling capacitor from the node of the two crystals to ground. Values range from 180 pF to 220 pF depending on Q of the crystals. Try 200 pF first, and adjust from there if you don't get a flattop response. Typical 3 dB bandwidth is 2550 to 2750 Hz. The crystals should be matched for Q and frequency within 30 Hz.

A four pole voice bandwidth filter based on the schematic in Figure 7 requires

OFFSET (Hz)	CNTune (pF)
-149.1	500
-134.8	520
-121.7	540
-109.4	560
-98.0	580
-87.3	600
-77.3	620
-68.0	640
-59.2	660
-50.9	680
-43.1	700
-35.7	720
-28.7	740
-22.0	760
-15.7	780
-9.8	800
-4.1	820
1.4	840
6.5	860
11.5	880
16.2	900
27.1	950
37.0	1000
45.9	1050
54.0	1100
61.4	1150
68.2	1200
74.5	1250
80.3	1300
85.6	1350
90.6	1400
95.2	1450
99.6	1500
107.4	1600
114.3	1700
120.5	1800
126.0	1900

Table 1—Capacitor values for non-matched crystals at X2 and X3.

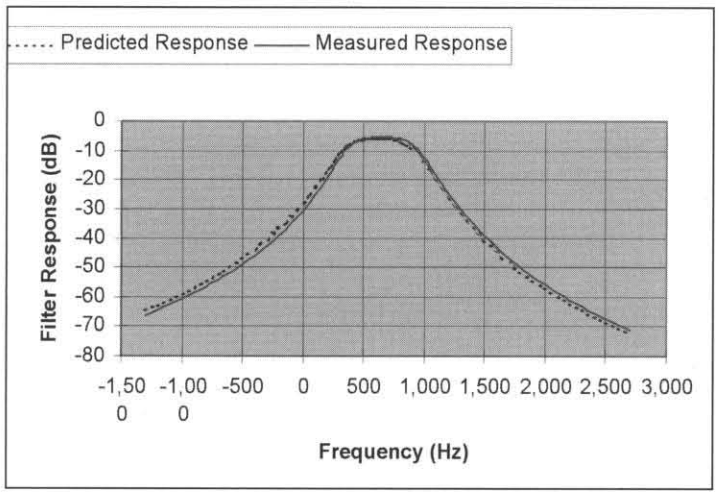

Figure 8—Frequency response of the crystal filter.

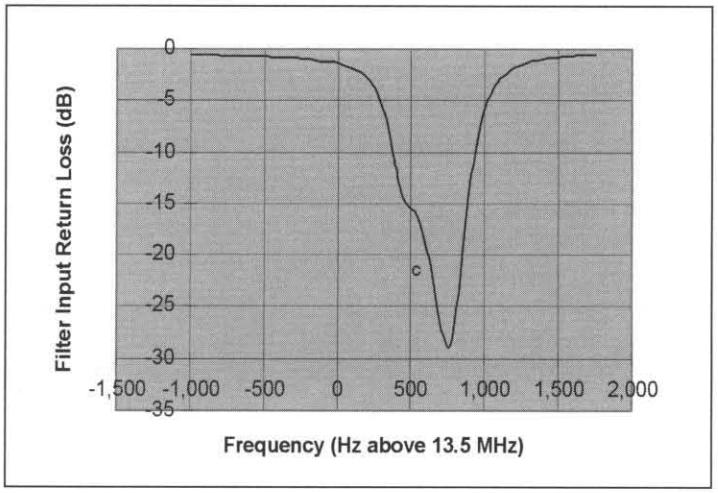

Figure 9—Return loss performance of the filter.

200 ohm terminations and has the following component values:

C1End, C4End	47 pF
C12, C34	150 pF
C23	220 pF
C2Tune, C3Tune	270 pF
X1, X2, X3, X4	13.5 MHz Crystal

The design is based on average Q of 93,000, Lm = 4.8 mH, and C0 = 6.8 pF. The computer thinks this one should have a 3 dB bandwidth of 2578 Hz, and insertion loss of 1.3 dB.

Mike later presented some additional information in private mail, along with the graphs shown in Figures 8 and 9.

"I have evaluated crystals from additional production runs since the article was posted on QRP-L. There is some difference in the production runs, mostly in average Q. The spread of motional inductance for the four production runs of the crystals that I received is 4.6 to 5.1 mH, with 4.85 mH being about the statistical center.

My future plans for these crystals is to try to build a 12 pole IF strip using three separate 4 pole filters cascaded between IF amps, one at the front, one at the tail end, and one in the center of the strip. The 4 pole filters would each be tuned to the same center frequency and each would have a 3 dB bandwidth of about 700 Hz, leading to a 500 Hz bandwidth for the cascade. My feeling is that the insertion loss for CW filters above four poles using these crystals would be excessive, and complicate gain distribution for a receiver design."

Notes for Figures 8 and 9:

1. Predicted response was computed using W7ZOI's General Purpose Ladder Analysis program (GPLA.EXE), which ships with the ARRL version of his outstanding book *Introduction to RF Design*. The zero frequency reference for predicted response is the series resonant frequency of the matched pair of crystals, X1 and X4. The crystals used had a resonant frequency of about 13,500,070 Hz.

2. Measured response was made using my HP 3586C selective level meter and the built in tracking generator. A 9 dB pad was used ahead of the filter when making the measurements of filter response. Zero frequency reference for measured data is 13,500,000 Hz on the 3586C.

3. The return loss data shown above is the measured input return loss with the output of the filter terminated in 50 ohms. The shape of the curve agrees fairly well with predictions for input return loss, and the deliberate mistuning of my prototype filter is evident in the return loss measurement. A precisely tuned filter would show better symmetry of the return loss curve about the center of the pass-band.

— de Mike Brainard, ex WA5KEX

How to Find Old QRP-L Traffic

The Internet QRP forum, QRP-L, has been around since 1993, when it was started up by Chuck Adams, K7QO (K5FO at the time). Since then, it's had a wealth of info related to QRP (and unfortunately, like a lot of mail reflectors, some that is not). All of the past messages can be viewed if you wish, and are available online. Go to the QRP-L home page at

http://qrp.lehigh.edu/lists/qrp-l/

and click on QRP-L File Archive. (Don't click on "Read the Archives," as that lets you read all the traffic from the last several days only.) After clicking on QRP-L File Archive, you'll be taken to an FTP directory of the QRP-L files. You can handle these via FTP if you wish, which involves a lot of typing, or scroll down the list a bit to index.html, and click on that. You'll then be able to keep on clicking the rest of the way instead of typing in FTP commands. Digests gives the daily digests going back quite a few months, listed by Digest number. Archives takes you to an index where you select a year, then individual digests. In this section, they are listed by date in the format of YYMMDD. (At present, the "archives" only goes back to 2000, but that year actually goes all the way up to the present.)

Good Source of SMT Parts

Monty Northrup, N5FC, (n5fc@io.com), passed this along on QRP-L. Although I haven't ordered from them yet, I checked the web page out and it looks pretty good.

"Those of you who have been wanting to homebrew using surface mount technology, but have been put off by high costs of onesey-twoseys or high minimum orders, may be interested in a web site I ran across a while back.

http://www.engineeringlab.com/

This is a Canadian company which has pre-packaged assortments of surface

mount chips (resistors, capacitors, and zener diodes) at prices that are near the per-piece cost if you were to buy them by the reel. I really don't know how they do it. They have several assortments, but two caught my eye:

Part number 9000805EW is an engineering kit containing 2600 pieces, including every common value resistor and capacitor, including NPO's and decoupling and tantalum caps, and Zener diodes, and in quantities sufficient to keep the heartiest SMT homebrewer busy for years. See

http://www.engineeringlab.com/smt-components.html

Part number 9000805SW is a "student" kit and has all the same parts, but in smaller quantities. Still plenty to get you started, at about half the price. See

http://www.engineeringlab.com/studlab.html

There are other SM component kits starting at $15, and individual pieces can be refilled for $1.50 when you run out.

I didn't say anything about this for awhile, because I wanted to order the larger $89 kit and see if it was everything it was cracked up to be. It is. I ordered it online, and it came via UPS Ground (from Canada to Texas) in 4 business days. Each SM chip is cut in strips from a reel, and labeled very legibly. They can be used a chip or two at a time for hand assembly, and the label remains intact. They also provide you with an extra set of individual peel and stick labels so that you can put them in bins.

I use the little manila 2˜3" envelopes (available dirt cheap at any office supply store), and put the strip of chips in the envelope, with the peel-off label outside, then store them all, file-style, in a Rubbermaid silverware divider. With the SM parts, you can store a whole lotta parts in a very small space, and still stay organized.

Keep in mind these are 0805-package chips (for the most part). "0805" represents the size: "08" for 0.08 inches long, and "05" for 0.05 inches wide. These are somewhat smaller than what was provided in the NorCal SMK-1 transceiver kit, which had 1206 chips (0.12" long, 0.06" wide). You'll definitely need your head-mounted magnifiers.

Getting these parts in reasonable quantities at low prices has always been a problem for hobbyists. These folks may have just solved it. (Be assured, I have no pecuniary connection with Engineering Lab; I'm just a satisfied customer.)"

— de N5FC

Grinding Aluminum and Brass: Don't!

Safety in the QRP workshop is always an important consideration. Soft metals like aluminum and brass are popular for building various things, and some might be tempted to trim them up a bit with a grinding wheel. Here's the short answer: Don't even think about it!

Grinding wheels should not be used on soft metals such as aluminum or brass. They will clog up the pores on the wheel, and could cause it to explode. I'm not sure what the primary trigger of failure is, whether it's heat or vibration, but in any case, a grinding wheel is turning at a very high speed, and if it should shatter, the pieces will fly out at high speed and it can cause a lot of shrapnel damage to a human body, possibly even death. In the machine shop at work, the standard rule is "If it doesn't spark when you grind it, don't grind it!"

We have belt and disk sanders for soft metal. Although the metals load up and eventually ruin the sanding belts and disks, causing frequent replacement, the potential for serious injury is far less.

Here are some comments on the topic from QRP-L:

From David Gilson, KD3EM, (kd3em@velocity.net)—"I was looking through the Fall 2001 issue of *QRPp*, at an article on page 8 about the MP-1 GROUND STAKE MOUNT. I noticed that the author made mention of using a bench grinder to make a point on one end of a 1/2" solid aluminum rod. This, my friends, is a no-no. Never, never put aluminum to a bench grinder, for two reasons. The first being that the grinding wheel will be ruined, and secondly it may blow up in your face. The soft aluminum will clog all of the pores on the wheel and prevent the heat from escaping, possibly causing the wheel to explode. If something doesn't spark when touched to a grinding wheel, then don't grind it."

From Steve Galchutt, NØTU (n0tu@codenet.net)—"In the shop at work they have a magnet stuck on the grinder next to the ON switch. The safety routine is, if the magnet won't stick to the piece you want to grind, DON'T GRIND IT, PERIOD!"

From Ronald Johnson, W2WU (w2wurjj@verizon.net)—"The warning is true. I've worked in a machine shop and on the Emergency Squad, and this was a cardinal safety warning. Check out applicable safety manuals including OSHA. Always wear safety glasses, too. You may feel stupid, but have you ever seen a metal shard in an eye or want to be blind? It isn't a pretty sight (no pun intended), nor is scraping people up. Doubt me? See the safety film! There are accepted methods of machining aluminum—USE THEM."

From former QRP Quarterly *editor, Monte Stark, KU7Y (ku7y@qsl.net)*— "As others have said, aluminum and grinding wheels are a BIG NO-NO. But I thought I'd let you know how we "ground" aluminum at work (back in those dark ages when I had to get up and go to work!). We used a sander. Several styles work fine. They are nothing more than a piece of sand paper that is powered. In other words, they are either a belt that moves like a tank track, or they are round and spin. Use normal precautions such as gloves and eye protection. Also don't inhale! You can use a file on aluminum. It can be hard to clean the file later, but at least it's safe!"

Final WA8MCQ comment—At work the entire company has unrestricted access to the machine shop. Since there were still some rare people who would grind aluminum or brass on the bench grinders, despite all warnings and signs, the supervisor took a drastic step—he put a lockout device on the power plug of the grinder, and only him and one other have the keys. Result—no more telltale aluminum or brass flecks all over the wheels!

There are many items available from safety supply houses that let you positively lock out something if you are going to work on it, to keep someone from accidentally turning it on and injuring you. These devices can be used to disable anything that powers machinery—electrical cables or breaker panels, compressed air lines, hydraulic valves, etc. The one he chose is a plastic clamshell that closes around the

plug, making it impossible to put it into the outlet, and it has holes for a padlock. It's a bit of an irritant to have to track down someone with a key, but it makes things much safer.

Schottky RF Diode Info and Sources

I've been doing some diode experiments, testing output versus frequency, and output versus input with various types used as detectors, and will be reporting the full results in a future column. As part of that, I've been doing a bit of research on Schottky diodes. Many QRPers are familiar with the HP5082-2800 Schottky diode from *Solid State Design for the Radio Amateur* (Hayward and DeMaw), where it is used as an RF detector. Here's where to get them and similar Schottky diodes, along with a place to find more info.

First, to find a lot of info from the manufacturer, fire up your computer and go to

www.semiconductor.agilent.com.

Agilent is the current name of the former HP division that makes electronic test equipment as well as RF and microwave parts like the 5082-2800.

On that home page, look at Product Design Center, and then click on RF & Microwave. Once you get there, look under Select by Product Category. Click on Schottky diodes, and maybe on PIN diodes as well, since those are sometimes useful for QRPers (one application of the latter, which I might describe in the future, is a voltage-controlled attenuator, which is similar in construction to a diode ring mixer.) Also on that same page, on the left, is a section called Hot Links. Click on Application Notes, and that takes you to even more neat information (some of this gets rather deep, but it's all great info). Between all of these, you can end up with considerably over a hundred pages of material to print out and sort through (all of the data sheets and app notes are in the Adobe PDF format. The viewer for PDF files is free and widely available).

When checking out the Schottky diodes, don't forget to look at the HSMS series. Those are in surface-mount packages, and are cheaper than the leaded types like the 5082-2800. Be sure to take the prices shown here with a grain of salt--they're for very large quantities, not in single pieces. For instance, the HSMS-2804 is listed by Agilent at $0.38 each, but they also indicate that's in quantities of 10,000! Single pieces were $0.56 when I got some from Allied Electronics recently, although they drop it to 41 cents for 1000 or more.

In response to my posting on QRP-L about diodes, Nick Kennedy, WA5BDU, mentioned two excellent articles, one in *QST* and the other in *QEX*. I've read both and they make a very good basis for anyone who wants to study the topic of diode behavior as detectors. One is part of the Roy Lewallen (W7EL) article "A Simple and Accurate QRP Directional Wattmeter," from the February 1990 *QST*, and the other is "Calibrating Diode Detectors," by John Grebenkemper in the August 1990 *QEX*.

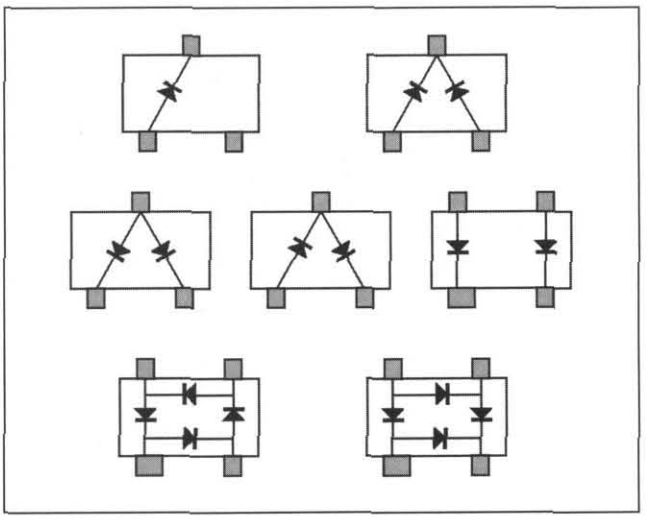

Figure 10—Some of the configurations available in surface-mount Schottky RF diodes. (The Agilent web site shows even more.)

Where to get the elusive HP diodes? It turns out that Allied Electronics carries some of them, including the 5082-2800. Being an old cheapskate and remembering what they used to cost, the price on that one is a bit rich for my tastes now at $1.58 each, although it does come in a standard leaded package (that's only 84 cents from Agilent, if you buy 5000 of them). They also have a number of other RF Schottky diodes in SMT packages at about a half a buck each in small quantities. These are in the HSMS series, such as HSMS-2804. Some are single diodes, while others are dual diodes. Of those, some are independent, while others are either half of a diode ring or half of a full wave rectifier. They also come in quads, arranged as either a full wave rectifier or a ring. Figure 10 shows some of the available configurations.

You can check out price and availability online and a bit of the specs at the Allied web page,

www.alliedelec.com.

The quickest way to get at them is to use the search box at the upper right of the page. Under Select Search Scope, click on "Mfr.'s part # contains," and enter HSMS in the search block (it's not case sensitive). Or if interested in their PIN diodes, use HSMP. Both of these series are surface mount. For the leaded diodes, search on 5082. That will pull up some unrelated info since other things contain that string of numbers, but it will include the HP diodes.

When looking at the SMT parts, you'll see either BLK or TR1 tacked onto the end of the number, such as HSMS-2802-BLK and HSMS-2802-TR1. They are the same part, just available in different ways. The BLK is "bulk," and means that they will sell in small quantities (at slightly higher prices), with minimum order of one piece. The TR1 indicates that it's only available in a minimum order of 50, 100 or 3000, depending on item, and only available in multiples of those quantities. The price per piece is lower.

The Allied catalog (and web page) does have some significant errors, though. Some of the diodes were listed as having pretty high reverse voltages, of 250 and 350 volts (the HSMS-285x and HSMS-286x series). I thought these would be really good to have for my diode experiments, to see if whatever they do to raise the PIV so high has any effect on the high frequency performance when used as detectors.

I ordered a few, but later found that their absolute maximum PIVs are, respectively, 2.0 and 4.0 volts! The maximum forward voltages at a certain current are 250 mV and 350 mV, and somehow that translated into PIV ratings of 250V and 350V in the Allied info. Rather than being intended for high power use, they are actu-

ally designed for detection at very low power levels.

My thanks to local QRPer and fellow Pomona box fanatic Walt Thomas, K3ASW (formerly WA4KAC), who recently placed an Allied order and let me tack on $25 worth of HP diodes.

1N5819 Not Recommended for Diode Detector Use

One of the things I wanted to see for myself was whether Schottky rectifier diodes make good RF detectors. At first glance they would seem to be attractive, since they do have very low voltage drops, which would lead to greater output in a diode detector.

However, the data sheet for the 1N5819 family of Schottky rectifiers shows that they have fairly high capacitance, which hints that they would not have very good frequency response. (The family is 1N5817, 18 and 19, with reverse voltage ratings of 20, 30 and 40 volts respectively.) According to Figure 10 in the data sheet, "Typical Capacitance," the 1N5819 exhibits from about 16 pF to over 100 pF depending on the reverse voltage. The capacitance increases with decreasing reverse voltage, and it hits 100 pF at 2.0 volts, increasing below that voltage.

Note 6 of the data sheet indicates that this diode will provide satisfactory operation up to several MHz. It says that at 2 MHz the "relative waveform rectification efficiency" is 70%. It also says that perfect rectification of sine wave inputs would give a ratio of DC power to RMS power of 0.406, but at this frequency it is only 0.28. The note goes on to say that this doesn't indicate a loss of power in the diode, and that the lowered DC output voltage results from reverse current flow through the diode capacitance.

My test results, presented later, show that the response of the 1N5818 Schottky rectifier does indeed suffer rather severely with increasing frequency, and I would expect the other two members of the family to be similar. That being the case, I would generally avoid using them in any RF detector circuits since they would not be able to provide any significant accuracy for absolute measurements.

On the other hand, you could probably get away with using one where only a relative indication is needed, and absolute accuracy isn't required. The latest QRP Homebrewer from the New Jersey QRP club (issue #7) contains just such a use, in an article by G3MFJ. He describes a field strength meter using a 1N5819, and that's an application where the frequency response of the diode isn't as critical. A FSM is something which is typically used on one frequency or band at a time, tuning for a maximum deflection, rather than comparing readings at different frequencies to determine the absolute values. FSM operation is always subjective since any variation in length or orientation of the FSM antenna or distance from transmitting antenna can make a difference, even when all else remains constant. It's an entirely relative device, and no calibration is needed or provided.

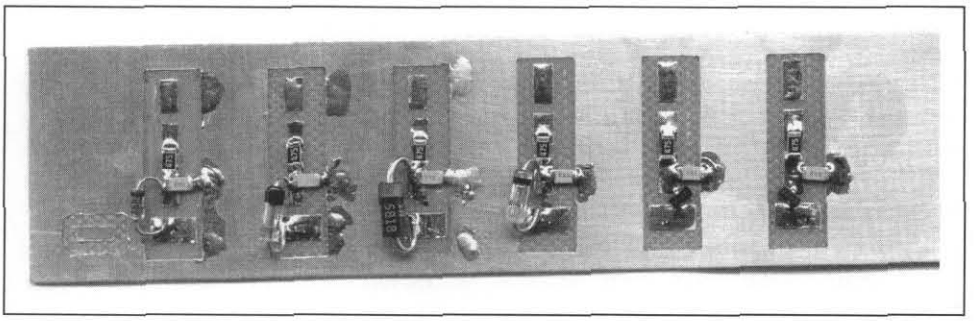

Figure 11—Overall view of the diode detector test fixture (before more positions were added).

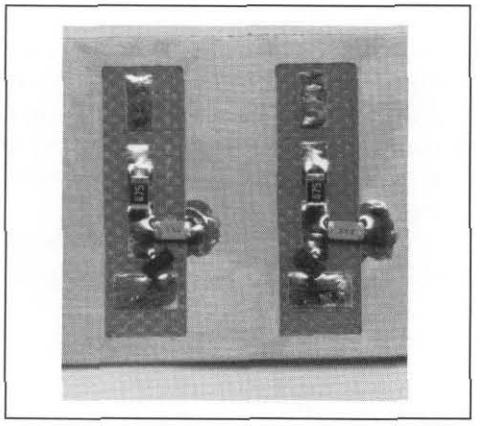

Figure 12—Close-up view of the fixture.

As the numbers show later, for a FSM which is used only on HF, the variation in diode sensitivity (or voltage output) is definitely noticeable but hardly extreme. So in this relatively narrow application we can use a Schottky rectifier such as the 1N5819, since we don't care too much about declining output with increasing frequency. It's not an absolute measuring device, just a relative indicator. If we go to the higher end of HF and the reading drops, just move it closer to the antenna and/or crank up the sensitivity pot on the meter (if there is one).

My diode detector test fixture was made on a piece of scrap double sided PCB stock with pads milled out with a table top milling machine, forming a number of identical positions to eliminate differences between sections. Figure 11 is an overall view (before more positions were added), and Figure 12 shows a close-up. Each has it's own connector, so I can leave each section intact and do instant A-B-C comparisons (as well as go back weeks later and verify repeatability).

Figure 13 is the schematic; all positions are the same except that the diode is a different type in each. This is the classic diode detector circuit. The input is terminated with 50 ohms (since I had a large number of 150 ohm, 1% surface mount resistors, I used 3 in parallel). The output includes the usual 4.7 megohm resistor to form a voltage divider in conjunction with the 10 megohm resistance of a digital multimeter. The capacitor charges up to the peak voltage of the RF signal, and the divider scales that down so that the reading on the meter indicates the RMS value.

Technically, this resistor should be somewhat less for best accuracy. The 4.7M value is a holdover from the days when everyone used vacuum tube voltmeters, which had an 11 megohm input. Used with a 10 megohm input, 4.7M gives an error of about 4%, which is not excessive. Using a value of 4.37M (standard value resistors of 3.9M and 470K in series) gives an error of about 1.5%, but could complicate construction in some cases. The ideal value for a 10 megohm meter is about 4.14M. Considering resistor tolerances, together with the fact that some resistors can be outside their limits, for best accuracy you could sort through a number of appropriate

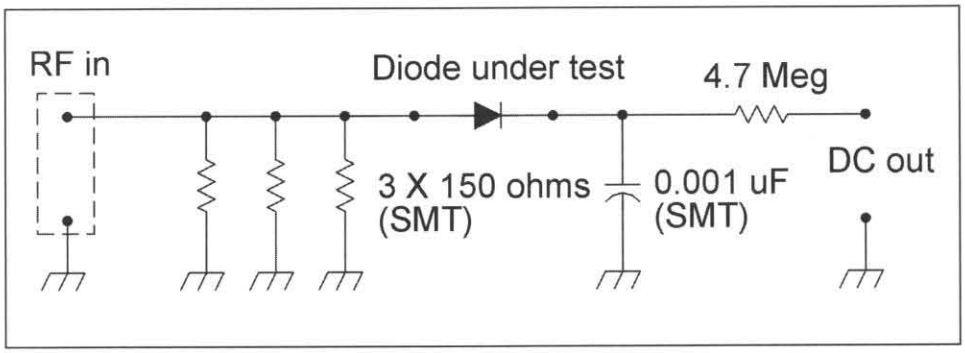

Figure 13—Circuit used on the fixture. All sections are identical except for the diode.

resistors to find the ones with actual values closest to what you need.

These are the DC voltage drops measured on the diodes mounted on my fixture so far, with my Fluke 77 meter in the diode test position:

Device	*Voltage Drop*
1N4148, small signal silicon:	0.574
1N34, germanium:	0.244
1N5818, Schottky rectifier:	0.145
1N87, germanium:	0.229
MMBD352, SMT, hot carrier:	0.423
BAV70, SMT, silicon small signal:	0.595
HSMS-2804, SMT, Schottky RF:	0.292
HSMP-3820, SMT. PIN diode:	0.747
*5082-9496:	0.294

**This was one piece from a sealed package of 4 diodes marked "do not separate." Probably a custom order, the number does not appear in the Agilent data sheets. It is believed to a matched set of Schottky RF diodes.*

The connectors at each position are 2-pin male DIP headers, and my cable from the signal generator has an SMA connector, some Teflon® 50 ohm coax, and a female dip socket to plug onto the headers. Using the DIP connectors is not an ideal RF connection system, but at least it's identical at all positions, eliminating one variable.

For fun I checked out the input SWRs of each position with an HP 8753C network analyzer. Input SWR at most positions was pretty good—they are, after all, terminated with 50 ohms and have low capacitance. However, the 1N5818 position was "pretty rotten," which is hardly surprising considering the large capacitance (I didn't record any of the SWR data yet, but will write it down in future tests. But I do remember that the SWR rose to an unacceptable level well below 10 MHz, while the other diodes were pretty good all the way to 500 MHz.)

The data shown here was obtained with the Rohde & Schwarz SMT 03 signal generator set for a constant output, as high as it would go, and then setting it at various frequencies. The output is flat within 1 dB vs frequency, according to the manual.

Accepting the output from the 1N34 and 1N87 germanium diodes as my "gold standard," some generator output variation can be seen. Although the diodes have somewhat different voltage drops, the output variation is about the same percentage on the 1N34, 1N87 and MMBD352 hot carrier diode (the latter is a pair of diodes in an SMT package, but only one is connected). The voltages start out at a certain value at 1 MHz—the lowest frequency in most of my tests—and hit a peak at 200 MHz, which is about 11% higher than the value at 1 MHz. It falls off above 200 MHz, but even at 500 MHz, the highest frequency used, it is still somewhat above the value at 1 MHz.

When comparing the results of the 1N5818 with the 1N34 (which is similar to the other two diodes), keep in mind that the output of this signal generator rises and hits a peak at 200 MHz, then starts slowly falling off. But the output from the 1N5818 has fallen off drastically by 200 MHz and gets worse above that.

The following data shows the frequency in MHz and DC output in volts as read on a Fluke digital multimeter (the output amplitude of the generator is specified to be flat within 1 dB, and the values for the 1N34 are within that range).

1N34, germanium

1 MHz	1.037 volts
10	1.081
50	1.140
100	1.152
200	1.157
300	1.118
400	1.111
500	1.114

1N5818, Schottky rectifier

1 MHz	0.950
10	1.007
50	0.844
100	0.579
200	0.234
300	0.111
400	0.060
500	0.036

Table 2 shows outputs of the two diodes along with the powers they would translate into across a 50 ohm load. (As the sidebar in the Lewallen wattmeter article shows, diode response below about 1 volt output departs from a straight line. I've ignored that in the table for sake of simplicity.)

Since both detector circuits include a 4.7 megohm resistor to form a voltage divider in conjunction with the 10 megohm input of the digital multimeter, these values represent RMS voltages. The effects of diode voltage drop are ignored here. The actual voltages at the input of the detectors are somewhat higher due to the drops, which are somewhat different for both types of diodes. Because the drops are ignored, the figures above do not represent extreme accuracy, but they do very clearly

Freq in MHz	1N34 germanium diode		1N5818 Schottky rectifier	
	Output, Vrms	Power, mW	Output, Vrms	Power, mW
10	1.081	23.4	1.007	20.3
50	1.14	26	0.844	14.2
100	1.152	26.5	0.579	6.7
200	1.157	26.8	0.234	1.1

Table 2—Measured output from the two diodes at several frequencies.

show the dramatic drop in output from the Schottky rectifier as frequency increases.

The voltage output from the 1N5818 starts dropping significantly even when the generator output is known to be increasing a bit, peaking at 200 MHz. According to the data sheet, the diode has a fairly high amount of capacitance. It varies depending on certain factors, but can be on the order of 100 pF or more, and this is effectively in parallel with the diode. On the other hand, Schottky RF diodes typically have a capacitance of less than 2 pF, with some being under 1 pF (another experiment for me to try some day is to add a 100 pF capacitor across some of the diodes. I expect the results to be roughly similar to the 1N5818).

The data sheet for the 1N5819 family of diodes (17, 18 and 19) can be found on the web site of ON Semiconductor, the semiconductor division of Motorola until it was spun off a couple of years ago. The URL is

http://www.onsemi.com/home

Enter "1N5819" into the part number search at the top of the page, then click on that part number under the Device ID column, and finally click on Data Sheet. That will take you to the full info for the family, in PDF format.

So now the question is, can a 1N5819 Schottky rectifier be used at all in a diode detector circuit? If you are trying to get accurate power readings, no. Although the voltage drop is somewhat lower than a germanium diode, the output varies greatly with frequency and thus isn't usable for accurate, absolute readings. On the other hand, using it in a field strength meter is probably a perfectly good application, since it is inherently a non-precision instrument. And, if the range is limited to HF only, the 1N5819 should be entirely usable. Note that while the output does drop with increasing frequency, the output even at 50 MHz hasn't dropped off all that far. For an application such as that HF field strength meter, the 1N5819 would still give plenty of output to give usable relative readings.

A future edition of the Idea Exchange will contain detailed results of the tests with various diodes, including germanium, Schottky RF, Schottky rectifier, PIN diodes, silicon small signal and silicon rectifiers.

—de WA8MCQ

QRP Online

As I say every issue, there's been a huge amount of QRP info flying around the Internet for years, and it's still there!

QRP-L, which I call the "QRP Daily," is the online QRP discussion forum started in 1993 by QRP Hall of Fame member Chuck Adams, K7QO (K5FO at the time). It continues to run several dozen postings per day on a variety of topics related to QRP.

QRP-F is an alternative QRP forum started by the QRP ARCI in October 1999 to take some of the load off QRP-L. The forum, QRP-F, requires a web browser such as Internet Explorer or Netscape, while QRP-L is a mail reflector and only requires an e-mail account. (If you go to the QRP-L home page, you can check out all the archived messages back to Day One.)

To check out the online QRP world, go to these URLs:

For QRP-L, go to http://qrp.lehigh.edu/lists/qrp-l/ and you're at the home page where you can sign up, read the archives, etc.

For QRP-F, go to http://www.qrparci.org/ and click to enter the site, then click on QRP-F on the menu at the top.

And while you're on those home pages, don't forget to check out their lists of QRP related links, and at each link that you go to, check THEIR lists as well, since not all sites list all others. In addition to the QRP ARCI site, another excellent place to use as a jumping-off point for checking out QRP related sites is the NorCal home page, run by Jerry Parker WA6OWR, at http://www.fix.net/~jparker/norcal.html. You'll find quite a wealth of QRP info online.

The Fine Print

The usual rules apply—just get your technical tidbits to me any way you can, online or US mail, handwritten or on disk, hand drawn schematics, or computer graphics. Some folks send professional material on disk or e-mail, others just jot it down in pencil on notebook paper, and either way is perfectly fine with me! Don't worry if you're not a professional writer or artist; I do all the editing and drafting, and all you need to do is get the rough info to me. ●●

Some Techniques for Building a QRP Field Vertical

L.B. Cebik—W4RNL cebik@cebik.com

The requirements for a QRP field vertical—usually base-loaded—are few, but critical. It must be sturdy and easy to handle in the field, and that field may be anything from a hotel room to an actual meadow. The parts must be easy to hold (but hard to lose) and the entire structure should breakdown into a set of pieces that fit within a small bag or case.

Over the years, I have seen a wide variety of parts used for such antennas, some better than others. These notes simply add to the collection of techniques available to the QRP field operator, as he or she designs a personal field vertical.

Figure 1 shows the basic elements of a field vertical intended for base loading. We must have a main radiator, and the height of this radiator is caught between two very important demands. On the short end, for maximum practicality, it should be usable within the standard eight-foot high ceiling of a hotel or motel room. On the long end, it should be as tall as we can manage for the sake of overall efficiency. The shorter the radiator, the greater the size of the loading coil and, hence, the lower the radiated power for a given amount of power fed to the system.

This antenna requires a support system that will keep it vertical and stable (even in a modest breeze), and the larger the support spread, the sturdier the mount. However, once more we encounter conflicting needs. To provide as much flexibility as possible, the support system should break down (collapse) into manageably short pieces for transport and not be unreasonably heavy. The support system may also form the hub of the radials that we use to complete what is essentially a shortened vertical monopole. And, as with any ground-mounted vertical, the better the radial system, the better the performance.

Finally, we need a way to feed the antenna, and for this type of antenna, feeding also includes loading and matching. All shortened verticals have a low resonant impedance: the shorter the antenna, the lower the resonant impedance and the higher the inductive reactance required to offset a high capacitive reactance. For portability, we need a small assembly—consistent in size with the pieces of the overall system—and a simple, but effective means of connecting it to the antenna and the radials.

With these essentials in mind, let's look at a few of my personal preferences for the pieces of the system.

The Main Radiator

Figure 2 shows how I prefer to make up the main radiator for a field vertical. T6063-832 aluminum tubing is light and readily available from sources such as Texas Towers (http://www.texastowers.com). Even though it comes in six-foot lengths to avoid UPS excess shipping charges, we shall use even shorter sections than this length. The figure shows the largest diameter as 0.75". This specification depends on two major factors. First is the question of weight. The larger the tubing, the higher the weight. For a home, ground-mounted, vertical, I might start with 1.25" diameter tubing, but not with this example. This antenna is for the field.

I use certified 6063-T832 aluminum with a wall thickness of about 0.05" for a reason: the interior will be smooth, allowing me to nest the tubing easily. Hardware store tubing sometimes has a seam that roughens the interior. (At the end of these notes, I shall make some maintenance suggestions, including keeping the tubing interiors clean.) All of the sections shown in the figure collapse into a single unit that is light, compact, and easy to transport.

The section lengths are all equal, and we have a choice for that length. Ignoring

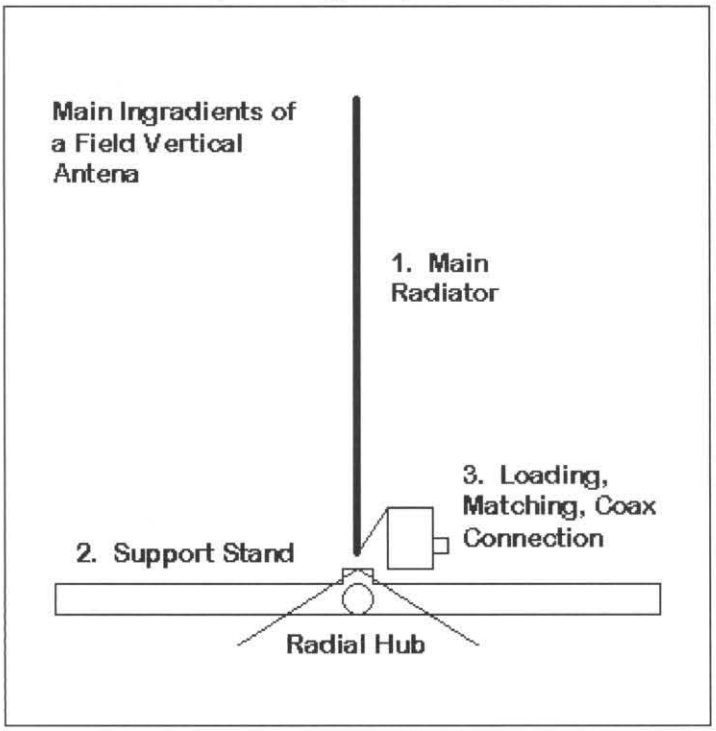

Figure 1—Basic elements of a vertical with base loading.

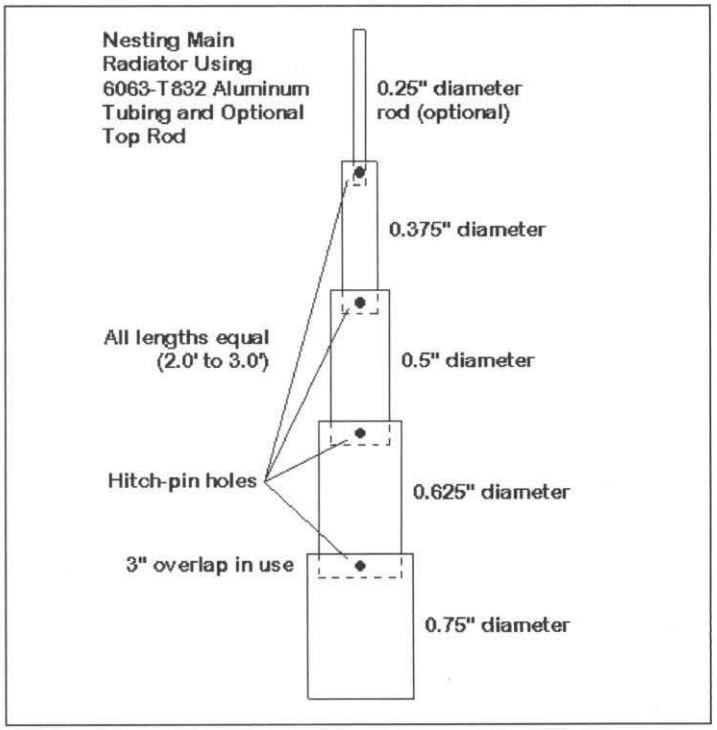

Figure 2—A radiator made up of nested aluminum sections.

the top rod, four sections of two-foot tubing will make a 7' 3" radiator which will fit nicely under a standard room ceiling, if we overlap the section by three inches for strength. Five sections of three-foot pieces, including the top rod, make a 14' tall vertical which is significantly more efficient as a ground-plane antenna. The choice here depends primarily on your intended operations and the length of your carry-bag.

For field use—but not for permanent installations—we may simplify the junctions. The figure shows small holes which can be anywhere from about 7/64" to 1/8". These holes are for hitch pins, shown in Figure 3. The figure also shows the source: page 2971 of the McMasters-Carr on-line catalog (http://www.mcmasters.com). Hitch pin clips, also called hairpin cotter pins, come in a variety of sizes and materials. As always, stainless steel is best, but cheaper plated pins are adequate if never subjected to rain. The main radiator uses a pin size intended to hold 1/2" to 3/4" diameter rods or other similar fixtures. They also have large round ends for easy gripping. Because this antenna is meant for field use, I hot-glue ribbons through the round ends so that the pins cannot hide in the grass.

Now we can return to the optional top rod of the main radiator. A pin of the size specified is a bit large for the 3/8" tube to 1/4" rod junction, adding a different hitch pin size to our hardware, and the weight per unit length of the rod is higher than that of the 3/8" tube. The difference will not make the rod unusable, but only a bit troublesome relative to our otherwise simple structure.

Drill the hitch-pin holes through both pieces to be joined in one operation to assure alignment. Be sure to deburr the holes so that the drilled aluminum tubes still nest smoothly for storage. Since it is likely that the holes will be only close to perfectly centered, make a pencil line from one section to the next for easy field alignment. Renew the line after every few uses of the antenna (or use a permanent marker). Although, the antenna relies on the metal-to-metal contact between tube sections for electrical continuity in the antenna, the hitch pin clips are easy to use and mechanically sound for this application. This practice is satisfactory for short-term field use, but not for long-term permanent home installation (where screws or through-bolts would be more practical). A primary condition of using this type of connecting system is the guaranteeing of clean aluminum for the junctions.

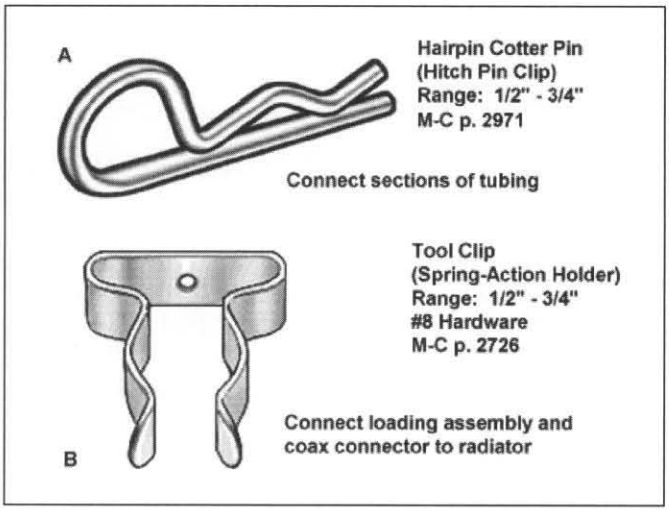

Figure 3—Key hardware items for the portable vertical.

The Support Stand

A 4-legged stand provides good stability for the field vertical under indoor or gentle weather conditions (the stand that I built from scrap PVC appears in Figure 4). It consists of five separate parts. Four of the parts are two-foot long legs of Schedule 40 1/2" nominal diameter PVC (Part A in the figure). Each leg has an in-line junction cemented on the outer end (Part B). This junction allows you to insert additional lengths of tubing for longer legs and added stability. You can also drill the junction to accept aluminum tent pegs to hold the legs firmly to the soil in the field (if deemed necessary or to add additional installation flexibility). Another method of securing the antenna outside is to bend stiff steel wire into "U" shapes that fit over the legs near the outer ends (like giant staples). Simply press these "U"s firmly into the soil.

The hub of the legs is a four-way junction of the same PVC material (Part C) modified by drilling a 5/8" hole through the center. Into this hole, I cemented an eighteen-inch length of 1/2" nominal CPVC tubing, which has a 5/8" outside diameter (Part D). Because CPVC has a thinner wall than Schedule 40 material, I inserted a 3/8" wood dowel and then filled the interior of the tube with the fiberglass resin normally used in auto repairs (Bondo). This addition stiffens the vertical section against stresses created by the main radiator.

At the base of the CPVC is a inch and a half length of 1" diameter aluminum tubing (Part E). On opposing sides of the short

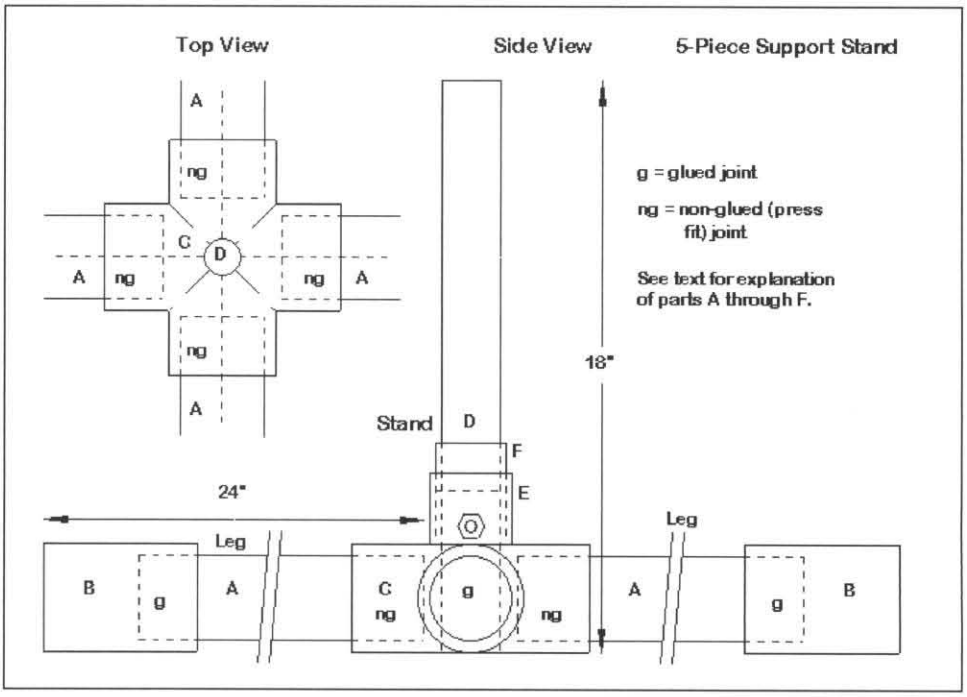

Figure 4—Details of the 5-piece PVC support stand.

tube, I installed half-inch long #10 stainless steel bolts, with the heads inside the tube. A little filing flatted the round heads so that the tube fit over the CPVC. The figure shows one of the bolts aligned with one leg of the stand, but that is a function of my limited drawing skills. The bolt actually is aligned between the legs on opposite sides of the tube. To center the tube and provide an insulated separation between the one-inch tube and the main radiator, I added a very short section of 3/4" nominal diameter CPVC (Part F) to fit inside the 1" aluminum tube and over the 1/2" CPVC. I cemented the CPVC separator in place, thus locking the short base aluminum tube in place as well. The main radiator simply slips over the CPVC and slides down to the separator.

The small base aluminum tube serves two purposes. With a wing nut on each bolt, the tube forms the hub of any radials used with the antenna, as well as for any special ground rod connection. For maximum efficiency, I recommend a full set of radials for each band. You can construct these quite easily from flat 4-wire TV rotator cable, cutting each strand to a quarter wavelength for 10, 15, 20, and 40 meters. The exact length is less important than the presence of as many radials as possible, with a field minimum of four recommended for adequate efficiency. Connect the 4 strands together at the inner end and use a ring connector under the wing nut and over the hub bolt. Above the hub bolts, we connect the match/load/feed system base, with its top end going to the main radiator.

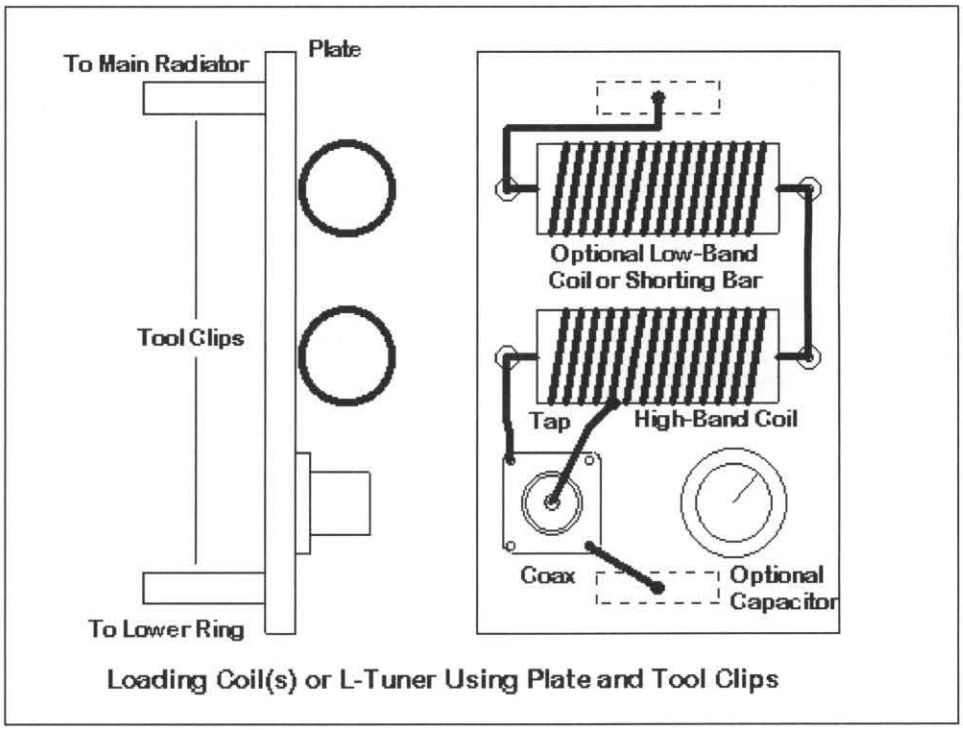

Figure 5—Mounting plate the loading and matching components.

The Match/Load/Connector System

Figure 3 showed not only a sketch of the hitch pin clip, but also the outline of a handy tool clip. The clip is also available from McMaster-Carr (page 2726) and comes in numerous sizes in both plated and stainless types. Once more, stainless steel is best for durability, but plated clips will last well if not subjected to rain. The size shown (1/2" to 3/4") will work, even with the one-inch base tube, but a larger size is also dandy for a base coil and feed system.

Figure 5 shows the outlines of a plate that holds the loading and matching components. I recommend 3/16" thick (or thicker) Plexiglas or polycarbonate. The part of the clips with a mounting hole (which uses #6 hardware) comes arched, and as you tighten the hardware, the section flattens against the plate, forcing the spring section to close very tightly. When fully tightened, the arch exerts considerable force on the plate and can deform 1/8" thick material over the span of a few hours. It is the stiffness of the tool clips that makes excellent electrical contact with the tubing.

The plate shows a sketch of a simple loading system using two coils. The high-band coil covers 10-20 meters with an 8-10-foot vertical. An added plug-in 10 µH coil allows loading on 40 meters. A lead from the coax center pin to coil taps does the tuning for the simplest version of this base-loaded vertical.

However, finding a tap that gives a low SWR is often difficult with higher levels of loading. The resonant impedance gets lower and lower, and by the time we find a tap near 50 ohms, the reactance is considerable. To overcome this problem, you may need to add a capacitor across the coax terminals. A receiving variable with about 1200 pF total capacitance should work with all but the shortest verticals on 40 meters. (Higher bands are less problematical.) The physical size of the capacitor depends on the desired power handling capabilities. For an old-fashioned multi-section receiver capacitor, you can offset the tool clips toward the coax connector side of the plate (there will be about 1/2" of space between the plate and the main radiator, due to the shape of the tool clips).

Adding the capacitor converts the simple base loading system into an L-network which will match low load resistances to 50 ohms while compensating for the capacitive reactance of the short vertical. Jumpers can use banana plugs and chassis jacks to simplify the overall set-up. How much of the assembly consists of plug-in components, and how much you permanently mount to the plate, depends on your operating needs and the sizes that you choose for the main radiator sections.

I have not given any specific values on a band-by band basis for some components, especially for the loading coils and the L-network capacitor. My reasons are many.

First, the required values will vary with your selection of the main vertical length. Second, they will vary with the height of the antenna base above the real ground. Third, they will also vary with the number and length of the radials that you use--and somewhat with variations in how you arrange them. Two 10 µH coils—one for the upper bands and tap-able, the other a fixed coil added in series for 30 meters and below—should handle most cases, along with a 1200 pF shunt capacitor on the coax side of the coils, if you choose the L-net-

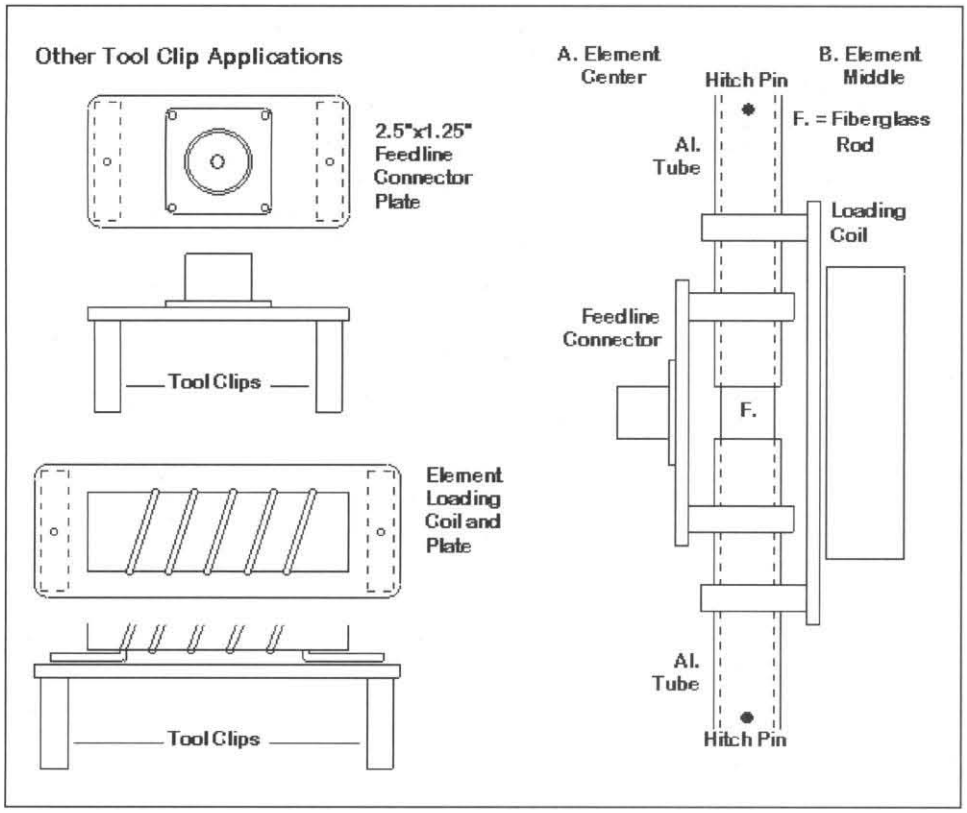

Figure 6—Other ways to use the tool clips.

work option. (You may parallel a 100 pF capacitor with the big one to provide a fine-tuning control.) Nevertheless, there are too many variables involved in the personalized versions of this system to guarantee a good match in every circumstance.

The tool clips are handy in a variety of circumstances that range from field antennas to prototype experimental designs. Figure 6 illustrates a couple of situations where they work well. The simple plate and its coax connector are useful for feeding a dipole center, illustrated by the left side of the vertical sketch in the figure. By using a fiberglass rod inside two sections of tubing—fixed in place with hitch pins—the center connector simply snaps into place. For mid-element loading coils in field or trial use, the plate and tool clip system, along with a fiberglass separator, allows one to develop the exact loading coil or trap needed for a given design, all without having to remove and replace screws in the element.

Maintenance

The system just described requires no tools in the field. The tool clip hardware is shop-tightened and requires no further field work. Everything simply snaps into place, with either a hitch pin or a tool clip, allowing for quicker assembly and disassembly, and leaving more operating time. The entire collection of parts (nested main radiator, 5-part support, and matching/loading/connector plate) fits into a bag as short as 24" long. (Extras, such as additional field braces, SWR meters, etc., are the user's responsibility.)

As with any antenna, it will only work well if it is maintained properly.

1. Before use: Test assemble the antenna to ensure that all parts fit together as prescribed. Perform any adjustment necessary (such as burr removal). If the aluminum has become cloudy during storage due to oxidation, clean the surfaces with a plastic scouring pad (do not use steel wool or course sandpaper.) Check all coils for electrical and structural soundness. Count parts to ensure that everything is available.

2. After Use: Clean all parts of the antenna thoroughly. Remove any dirt from the stand, using any good cleaner or detergent. Check for use damage to the vertical section of the stand to ensure a smooth fit with the lower aluminum tubing at the next use. Clean the outer surface of the aluminum tubes with a mild cleanser to remove field dirt and stains. Clean the inner surfaces of the tubes with a stiff long-handled bottle brush. Recheck the coils for any damage and repair immediately. Count components to ensure nothing is missing. Replace any missing component immediately. Re-wrap components together to restore a factory-like presentation.

With these simple measures, the antenna should provide many years of satisfactory service, although I fully suspect that long before the antenna wears out you will be experimenting with other improved field antennas.

The ubiquitous base-loaded vertical is far from the most efficient antenna that you can use, however it is cheap, compact, and reliable, even if the gain goes down with the frequency and the amount of loading required. The system shown here uses a longer main radiator than most whip-based systems for a modicum of higher efficiency. The L-network can provide a somewhat better match for the rig. Even with these improvements, the system remains light for easy field transport and it requires no tools for assembly and disassembly. Allowing for left-over aluminum tubing and hardware bought in excess quantities (all useful for other projects), the net cost is about $25 to $35, depending on the sources used and the size of your junk box (if you purchase components for the matching/loading system, the cost may go up accordingly).

Even if you do not build your own field vertical, perhaps the use of hitch pin clips and tool clips will give you some ideas for other projects. Try them. I think you'll be surprised at how well they work.

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Product Review: Elecraft K1 Transceiver

A Lean, Mean CW Machine

Bruce Prior—N7RR n7rr@arrl.net

Imagine tossing a contest-grade rig into a backpack! That's exactly what I did this past summer. I needed a rig for a long backpacking trek along the Pacific Northwest Trail from the northeastern corner of Glacier National Park in Montana to the Kootenai River Valley in the Idaho panhandle. For most of the trip I would be out of range of VHF and UHF repeaters and cellular telephone networks, and I wanted multi-band coverage so I could reliably pass formal message traffic to friends and family from a variety of trail locations and under varying propagation conditions. I thought of the Elecraft K1, a lean, mean multi-band HF transceiver kit optimized for pure CW operation, yet it's a lightweight power miser and small enough to carry in my backpack all day long, day after day. The K1 would also serve as an excellent stand-by for use during a disaster or crisis to get a message through when all else fails.

A Builder's Joy

I placed my order with Elecraft. The K1 serial number 833 kit arrived ahead of schedule—before I had cleaned out the shack to welcome it! I chose to do the inventory piecemeal, only opening the bags relevant to one stage at a time.

Elecraft engineers have gone overboard to ease the path for kit builders. The circuit boards are roomy, well labeled and durable. The instructions are clear and explicit, with lots of illustrations—photographs of many parts accompany the parts lists. Resistors are mounted on ladder strings in the exact order they are to be installed, and many potential pitfalls are anticipated. Where alignment is important, instructions for installation include checking and double-checking before moving on to a stage where adjustments would be difficult. If you've never had the pleasure of building your own rig from a kit, the K1 is a great one to get you going.

The Basic K1

For the long hike, I used the basic K1 with a two-band module. I ordered my two-band module configured for 40 and 80 meters. The module can be specified for any two of the amateur 80, 40, 30, 20, 17 or 15 meter bands. Builders can decide whether to configure the K1 for 80-kHz or 150-kHz range within each band. I chose the wider range, which actually turned out to be 172 kHz. I used the rig nightly to pass formal traffic through the Idaho Montana Net on 3647 kHz, the British Columbia Emergency Net on 3652 kHz, and the Seventh Region net on 7048 kHz. I also arranged schedules to meet my wife Margaret, KD7CEL, on 40 meters. Since I hadn't installed the optional internal antenna tuner for my summer hike, I erected separate half-wavelength dipoles for the 80 and 40 meter bands. I usually erected the antennas inverted vee style, first lobbing a fairly large rock over a tree branch which was attached to military surplus parachute cord with a tight noose called a scaffold knot. This very secure knot uses half of a grapevine, or double fishermen's bend, to lock the noose.

An Enhanced K1

My K1 is now enhanced with some options, including the four-band module, the noise blanker, the internal automatic antenna tuner and the wide-range tilt stand. The standard configuration of the four-band module is for 40, 30, 20, and a choice between 17 or 15 meters. The components for all five bands arrive with each four-band module.

Because of space and component limitations, the KFL1-4 four-band module includes two low-pass filters which are designed for adjacent amateur bands. A band which is the second harmonic of a lower band cannot share the same filter with that lower band. So, for instance, if a builder wishes to include the 80-meter band on the four-band module, another band cannot share that filter, and only three total bands could be accommodated.

My K1 now sports a KNB1 Noise Blanker. The Pacific Northwest Trail route took me far from power grid, ignition and other artificial noise sources, so I didn't need the KNB1 Noise Blanker for backpacking, but for other uses including emergency communications using generator power, I thought it might be useful.

I thought that the KBT1 Internal Battery Option would provide added convenience of dispensing with an external battery pack for backpacking. Installing the recessed on/off switch took some fancy finger-work, but I managed the assembly of the KBT1 without significant problems. I decided in the end, however, to dispense with the KBT1 (see the "Quibbles" section for details).

The Wide-Range Tilt Stand seemed like a weighty luxury for through-hike backpacking, but I wanted to try it out for possible use on shorter trips.

Finally, the internal KAT1 Automatic Antenna Tuner seemed an ideal way to simplify the antenna part of operating a multi-band backpacking radio. Because of its latching relays, the internal automatic antenna tuner draws extra current only during the few seconds when it is actively tuning.

I carried lightweight earphones for occasions when I needed to operate without keeping the neighborhood wildlife awake. In spite of the fact that a speaker requires more audio amplification which consumes more current, I prefer using a speaker on a hiking trip. The speaker allows me to listen while doing camping chores, and in practice I didn't use earphones with my K1 on my long hike.

Help from Elecraft

After building the K1, error message E42 told me that the VFO wasn't oscillating (the failure was caused by my swapping one RF choke for another). I had confused a 33-microhenry (orange-orange-black) with a 22-microhenry choke (red-red-black), and didn't catch my error until my e-mail plea to Elecraft elicited a prompt and detailed reply from Gary Surrency, Dr. Fix-It at Elecraft. Gary's first sentence read, "You may have installed the wrong inductor at RFC1." That cured the problem. I was impressed.

When I built my K1, its operating frequency drifted more than the specified <200 Hz/hour after a 5-minute warm-up at

room temperature. Gary Surrency again stepped in to help, and my rig now has replacement varactor diodes and a new 1200 pF polystyrene capacitor in the oscillator circuit, and the drift problem is solved.

Current Consumption and Weight

For backpacking, current consumption and weight go together, and the more current a rig draws the more battery weight needs to be carried. The Wide-Range Tilt Stand weighs 5.3 oz. (150 g), and when you add keyer paddles, power supply and antenna, you have a hot 2-band (or 4-band or even a 6-band) HF station. My entire K1 station including extra batteries, tilt stand and antenna, fits nicely into a 4-L Rubbermaid plastic box and weighs 2.05 kilograms (or 4.5 pounds), so it's definitely in the backpacker class. The 6-band option requires swapping band modules, about a ten minute operation if the antenna tuner is also installed. A summary of weight and current consumption is shown in Table 1.

Example used:	4-Band K1 With Noise Blanker and ATU
Weight:	1 lb. 7.8 oz. (675 g)
Receive through the speaker, with no signal and AF Gain at 9 o'clock:	53 mA
Receive through earphones with no signal, and AF Gain at 9 o'clock:	53 mA
Receive through the speaker with S-9 signal, and AF Gain at 9 o'clock:	56 mA
Receive through earphones with S-9 signal, and AF Gain at 9 o'clock:	54 mA
Transmit at 7 W output:	890 mA
Transmit at 5 W output:	700 mA
Transmit at 3 W output:	630 mA
Transmit at 1 W output:	560 mA
Transmit at 500 mW output:	480 mA
Transmit at 100 mW output:	350 mA

Table 1—K1 Weight and current consumption at 13.8 VDC.

Operating the K1

The finished K1 is one beautiful rig. Like its big cousin K2, the K1 looks snazzy enough to reside in a living room. The impressive Owner's Manual includes a helpful chapter with operating instructions as well as a one-page quick-reference sheet, and a more detailed double-sided laminated quick reference two-card set, the Elecraft K1 Vade Mecum, is available for $6.00 + $1.00 shipping from Kairos Research, 853 Alder Street, Blaine, WA 98230-8030.

With my K1, I use a mini keyer paddle made by G4ZPY. I've removed the heavy magnetic base from the keyer paddle and substituted Velcro®, reducing the total weight while allowing me to use the K1 as the paddle stabilizer. The paddle is further stabilized with a 3-mm kernmantel perlon cord tied with a Grapevine Noose cinched tightly around the K1 cabinet.

Another manufacturer has produced a keyer paddle especially for the K1, which mounts on the Wide-Range Tilt Stand. The BP-K1 is available for $45.50 + $3.00 shipping from The Paddlette Company, P.O. Box 6036, Edmonds, WA 98026 http://www.paddlette.com

For short-trip portable operation, an excellent TacPack® heavy nylon two-part carrying case is available for the K1 in bright orange or black for $39.95, plus $5.00 shipping from Mountain-Ops Communications, P.O. Box 214, Hubbard, OR 97214-0214, phone (503) 982-5786, http://www.mountain-ops.com sales@mountain-ops.com

The LCD display serves various functions, including reporting the operating frequency, S-meter reading, input voltage, and with the automatic antenna tuner installed, SWR as well. The same display gives all the feedback needed to operate the main menu and the automatic antenna tuner menu.

The K1 was obviously designed by and for serious CW operators:

• The sidetone pitch or spot function is a breeze to use for quickly zero-beating with another station. The sidetone, offset, and spot tone can be adjusted between 400 and 800 Hz, and its volume is determined both by a software adjustment and the AF gain setting.

• Most operators will set the iambic mode to A or B and then leave it alone, but it's great to have that choice. Most rigs designed for portable operation offer only one iambic mode. The now-discontinued DSW series by Small Wonder Labs, the Yaesu-Vertex FT-817, and the SG-2020 and SG-2020 ADSP, all operate in iambic mode B only.

• The iambic keyer speed can be adjusted to any integer between 8 and 50 words per minute on the fly with front panel buttons.

• Two different CW memories are programmable, and its beacon-mode repeat function can be programmed to pause for any integer second between zero and 255 seconds.

• The solid state transmit/receive circuit is smooth, with adjustable delay from zero to 900 milliseconds. Mine is normally set for zero delay or full break-in, and I don't even notice it while operating (which is the way I think it should be).

• The combination of RIT and XIT is very helpful for just about any kind of operation, but especially traffic nets and DXing. The RIT/XIT range can be increased or decreased by the builder by installing a higher or lower-value C7 capacitor.

• The three varactor-controlled crystal lattice filters are individually programmable for bandwidths between 200 and 850 Hz, making fine QRM-fighting tools.

• When receiving a very strong signal, I often turn on the 14 dB attenuator and advance the AF gain for low-noise reception. It works like a one-step RF gain control.

Optional Tilt Stand

The Wide-Range Tilt Stand configured with its shorter upright stays is a wonderful accessory for desktop operation. I should have taken the cleverly designed tilt stand with its longer upright stays along on my hike. Trailside operating is almost always awkward. The ability to view and operate the rig from any conceivable angle makes the tilt stand weight worthwhile (I added

some heat-shrink to the back arm of the tilt stand to protect the K1 surface when I use it in the shack). From now on, the tilt stand will definitely accompany my K1 on every trip.

Optional Noise Blanker

The KNB1 Noise Blanker can be turned off, or it can be activated at two different threshold levels, depending on the severity of the interfering pulse noise. The higher threshold can be increased further by substituting a green LED (supplied with the kit) for the 1N4148 diode at D2.

Optional Internal Antenna Tuner

The optional internal KAT1 Automatic Antenna Tuner is a great addition to this diminutive rig, and allows for a lot of flexibility when planning the antenna part of an HF backpacking station. Plug in just about any antenna that's convenient, tune on or near the intended operating frequency, then activate the tuner. After some rapid relay chatter, the antenna impedance is matched with the radio, and the resulting SWR is automatically displayed. Since it uses latching relays, the tuner consumes no extra power once it is adjusted to the operating frequency. With the KAT1 installed, SWR can also be viewed from the front panel LCD without operating the tuner. I've now acquired a BNC-to-dual-binding-posts adapter, and can use the K1 with an end-fed 17.5 meter wire and a counterpoise made of five pairs of small-gauge speaker wire (each 3 meters long soldered together on one end horse-tail fashion to couple capacitively to the ground). That way, I'll save a lot of weight now taken up by two dipoles and an RG-58 coaxial cable feedline.

Built-In Fun

Many kit radios are more fun to build than to operate. This one is easy to build and a blast to operate. Although it's well-designed for trail use, I find that I turn it on frequently in the shack as well for rag-chewing, contesting or traffic net operation. I also like to use it to monitor the NCDXF/IARU beacon network on 14.100 MHz and 21.150 MHz.

Quibbles

I was disappointed with the KBT1 Internal Battery Option, which I feel was not well designed for convenient cell replacement in the field. The smaller KBT1 speaker sounds just fine, but it is held against the cabinet top only by friction. When the cabinet top is opened to change AA cells, the speaker becomes a loose item—awkward to handle in the shack, let alone inside a flapping tent. I decided to disassemble the KBT1 option before leaving on my backpacking trip, and installed the standard cabinet top with its well-mounted speaker. Without the KBT1 installed, the K1 is a solid, well-engineered radio. My power supply is a simple 8-AA cell holder from RadioShack, and worked fine on the Pacific Northwest Trail. Loaded with eight fresh lithium cells, it needed only one replacement during more than two weeks of nightly operation—a fine testimony to the low-current drain of this transceiver.

Unlike the K2, which allows reception on either sideband, the K1 receiver is configured to detect the lower sideband on all bands. That's fine for 80M and 40M. On those bands, cross-mode communications are possible with SSB stations which are using the standard LSB mode within the frequency range of the K1. For example, The Canadian Aurora Net operates on 7055 kHz LSB, Monday through Saturday starting at 0230Z, and the Transprovincial Net starts on the same frequency daily, LSB, at 1500Z. These offer convenient cross-mode traffic-handling outlets for K1 operators. However, on 20 meters and 17 meters, where USB is the standard SSB mode, routine cross-mode communication is not practical with the K1. On the 15 meter band, most SSB operation is above the frequency range of the rig.

Since the K1 incorporates a Colpitts varactor diode VFO circuit with a 10-turn potentiometer for frequency control, band coverage is limited. The high-end Elecraft K2, the simpler, now-discontinued Small Wonder Labs DSW rigs, the Yaesu-Vertex FT-817, and the SGC SG-2020 and SG-2020 ADSP, cover the whole amateur band rather than just 80 kHz or 150 kHz segments. All of those other rigs (except the K2) have other disadvantages, however, such as lack of a choice of iambic keying modes, no keyer memory, and no provision for an internal antenna tuner.

Bottom Line

I feel the K1 is the best genuine backpacker HF rig now on the market. Except for the internal battery kit, all of its options are useful and well designed. The basic rig is packed with lots of excellent operating features, and if the K1 had a digital oscillator which allowed it to cover the entire amateur band using either sideband, it would be a spectacular rig (although more pricey and perhaps not so energy efficient).

Kit and Part designations/numbers:

- K1 Transceiver kit, including one 2-band filter module kit, custom-ordered for any two amateur bands between 80 and 15 meters.
- K1-4 Transceiver kit, including one 4-band filter module kit, covering 40, 30, 20 and either 17 or 15 meters at the builder's option
- KFL1-4, additional 4-band filter module kit
- KFL1, additional 2-band filter module kit
- KTS1, Wide-Range Tilt Stand
- KNB1, Noise Blanker kit
- KAT1, Automatic Antenna Tuner kit
- KBT1, Internal Battery kit

Shipping and handling is variable, according to which options are ordered. Elecraft, P.O. Box 69, Aptos, CA 95001-0069, (831) 662-8345 http://www.elecraft.com

— Bruce Prior N7RR
n7rr@arrl.net

K1 Review—Counterpoint

Excellent review of the K1, and I couldn't agree more about most aspects. It is certainly a marvel to be able to build a kit that packs all those capabilities and features into such a little box. However, I include the KBT1 internal battery option on the plus side of the equation. Fitting all the features and capabilities, and the power source in the little box makes it all the sweeter.

I admit that I haven't done any backpacking with my K1 but I have used in on a few motorcycle camping trips and regularly operate it from my hotel room on business trips. I've even used it air-mobile with its internal batteries. Running 3 watts, and a set of 1800 mAh batteries, I easily get two full evenings of casual operating out of a single charge.

Granted it does take a little care to

swap out the batteries, but considering the compactness and the "cool" factor of a completely self-contained rig, I personally feel it's well worth the effort, especially since (for most people) it doesn't need to be done very often. For someone who is planning to do a lot of operating over a number of days a larger external pack might be a reasonable alternative, but for my purposes I simply added a small in-line connector in the lead for my K1's battery holder so that I could carry a spare set of batteries in a holder and just swap out battery packs.

— Lou W7DZN

Addendum to the K1 Review

Based on feedback from customers, we've made a number of minor changes to the K1 transceiver kit that will make it even easier to build and align. We've been shipping the revised kit (manual revision F) for about a month.

Changes include:

• Simpler transmit offset alignment, thanks to the addition of a small slide switch on the bottom of the RF board that turns the transmit carrier oscillator on/off

• Addition of a jumper block for selecting the source voltage for the RF detector (RF board or KAT1 antenna tuner), making it easier to install or remove the KAT1 option or align new filter boards.

• RF board updated to incorporate all required changes and added components.

• Attenuator on/off audio artifacts eliminated.

• VFO potentiometer tuning linearity improved.

• Owner's manual completely updated to reflect the new 4-band version of the K1.

We'd like to thank everyone who built the K1 and sent us manual corrections and suggestions over the past year.

— Wayne, N6KR and Eric, WA6HHQ

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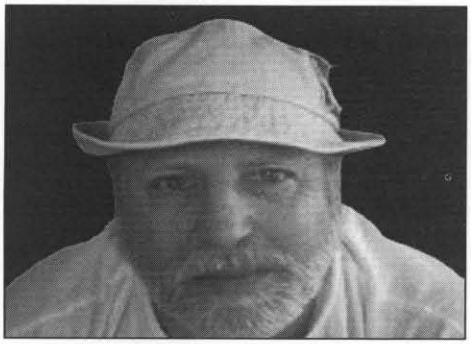
Ramblings of a Peaux Displaced Cajun Lad in Maine

Joel Denison—KE1LA hamjoel@juno.com



High Y'all—I'm gonna try and brought myself to the FDIM this year. I is gonna stay with the "Flying Pigs" at the hotel thair and we is gonna try to hold a QRP net on 7.0475 MHz around 9PM eastern time on Wednesday nite.... so y'all try and check in... all bodies are welcome!

Ah gots a letter from my friend Alphonse today... he be writing from New Iberia, Louisiana... course ah can't read his writing, but the tape he sent with the letter done fine... He say my cajun mama (at 78 yrs of age) done won the 22 rifle shoot out this year... seems she put 5 bullets, one on top of the other, at fifty yards... course it was the last 5 shots what got her in the calibouse... seems them shots were strait burbon...and she commenced to shooting flies offen folks hats... at all kinds of yards...

Alphonse say, Julius Thibideaux, a good friend of mine, done got his ham license and before he even got on the air he hung hisself trying to put his antenna wire up. Course ah thinks things were all said and done when peaux Julius flung his wire ovah the power lines... Them 7,000 volts hit him kinda hard, and tha'ts whan he got disoriented and wrapped the wire round his neck...

Now Julius Thibideaux be a big man, and ain't no 12 guage wire gonna hold him in the air long. So he was one lucky guy when that wire broke and dropped him back on the ground...alive... heck, he'd be home now iffin that snake hadn't bit him.... big sucker, inch and a half fangs...

Alphonse say he went on a QRP field trip to buggy man's island in the atchalafia swamp... Alphonse say the took the lead pellets outta some 12 gauge shotgun shells and put a tin can on the top of the gun barrel....kick like a mule, but it done send that can with its attached string ovah one of them big old cypress tree. Course the can wasn't heavy enough to pull the string ovah the tree, so he climbed up and got it hisself... and he taped a rock onto the next can before he shot it ovah the other tree...

Now Alphonse didn't say what was in them cans to start with, but he did say the whole thing was very satisfying....

He set up his K2 and started to commence to communicate. He figure he done worked a hundred folk when he noticed the water rising.... seems it had been raining all week up in North Louisiana, and all them bayous now be feeding into the atchalafia basin whare he was... and the water was up to his waist by the time he loaded the rig back into the john boat. He decided to wait a while, and sheaux nuff after about 20 foots the water stopped rising... so Alphonse, he set up his station in his john boat...course he didn't make as many contacts as before cause his antenna was closer to the water...

Ah guess I needs to make a tape and send it to Alphonse later tonite...

But don't it just make u proud to heah what folk are doing with low power? Not that us old folk didn't try some QRP ourself, yew kneaux...

Ah can remember keying that old Heathkit VFO into the antenna... made lots of contacts... sometimes on two bands at once... and the crystal checker... u put a long wire on that sucker and somebody's gonna hear u... a bit chirpy, but hey, can't have it all now, can you... and that was back when the dark ages was heah,, but we didn't kneaux it... we hauled batteries and weird power suplies all ovah the place...

With today's equuipment u can take some real hot shot radios into the woods and play radio. The only thing what hasn't changed much is the antenna... still the bigger and higher the betterer... but the challange to got one of them aerials up without killing u self or burning down the house still remains...Ah guess some things nevah change no matter how much things change...

Bye now, *— Joel, KE1LA*

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Digital QRP Homebrewing

George Heron—N2APB n2apb@amsat.org

In this third installment of the DQH column we extend the Direct Digital Synthesis (DDS) technology introduced last time, but now as part of the Digital QRP Breadboard project. By adding DDS hardware and control software to the BreadBoard, homebrewers following along on their workbenches will be able to generate precision sine waves from the sub-audio range all the way up to 20 MHz ...quite the useful addition to the shack, and we're one step closer to our first major milestone for this project. (Shhhh, you'll soon discover the nature of this useful piece of test gear.)

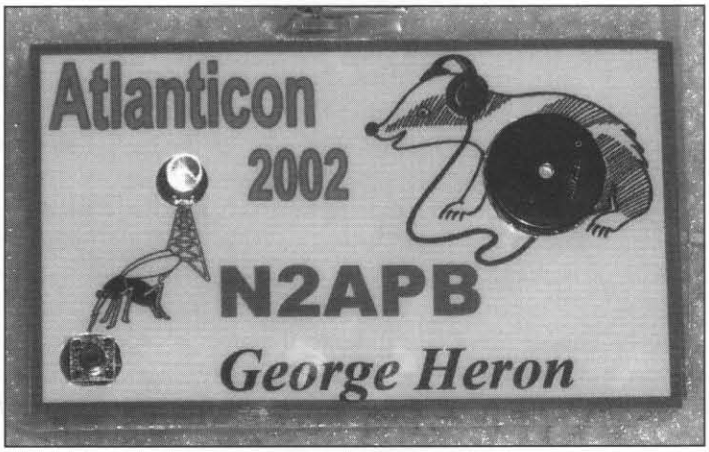
Our "Spotlight" section in this installment focuses on yet another use of the SX microcontroller—this time as a keyer called the Badger. But you say "not another keyer project?!" Well my friends, this is no ordinary keyer. The Badger is something you can wear with pride at your next club meeting or while walking around the Dayton flea market.

Spotlight on The "Badger," a Morse-Identifying Smart Badge

In previous "Spotlight" installments of this column, I've described the simple, fast and inexpensive SX microcontroller from Ubicom (formerly Scenix) in the form of the PSK31 Audio Beacon project. Then, later in the pages of NorCal's QRPp magazine, I overviewed the design of another SX project, the serial logging frequency counter, using that same chip and board.

Hoping that QRP readers find these SX-based projects interesting and quite reproducible, I present this time a unique application of this PIC-like microcontroller in the form of a Morse-annunciating callsign badge.

The Badger, as it is called, consists of a piezo sounding device with a SuperBrite LED on the front of the pc board, and a small pushbutton that is used to start the beeping and blinking of the owner's callsign. An SX-18 microcontroller and several other components also reside on the board which is overlayed with a custom-designed laminated callsign badge. A 3V lithium battery is provided on the pc board, allowing the annunciating badge to be operated free of an encumbering heavier battery. Add a common badge clip, and the Badger can be worn at club meetings and other ham radio events to the amazement of everyone!



Features

This project has many special features, so I'll summarize the specs before getting into the meat of the hardware and software design.

- Badge size—pcb is 2" x 3.5"; laminated overlay is 2.5" ˟ 3.5"
- Piezo—approximately 4 kHz (adjustable for peaking to individual unit)
- LED—a red SuperBrite LED
- Pushbutton—micro-size (initiates annunciating sequence)
- Annunciation—piezo and LED are modulated using Morse code at given speed to announce callsign and other features
- Key/Paddle—pads on pcb are provided for builder to add a miniature, on-board homebrew key or paddle, and signals are provided off-board via a 3-position pin header connection
- Keyline output—buffered output line delivers Morse to external transmitter via a 2-position pin header connection
- Expansion connector—provides access to special functions (described later herein), accessible by 7-position pin header
- Programming connector—4-position pin header connector allows user to connect the SX-Key or SX-Blitz programming tool for custom programming of the SX micrcontroller chip
- Operating modes—annunciate callsign via piezo and/or LED, repetitive "beacon mode," iambic keyer, keyer speed adjust, piezo tone adjust, and straight key tone oscillator
- 3V lithium battery—standard watch battery provides circuit power. SX chip "sleeps" during quiet times, ultimately providing infrequent need for battery replacement

Hardware

Refer to Figure 1 for the following discussion.

The SX-18 microcontroller contains the software program that provides all the features of this project. Clocking for this chip is provided by an on-chip RC oscillator. Timing accuracy of the tones frequency and the Morse code speed is not overly critical, so we can live with slight chip-to-chip variations in clocking rates when using the built-in oscillator mode—this is a nice price to pay for reduced parts count!

Power is normally provided by an onboard 3V lithium battery when Jumper J1 is in place as shown, or by an external 5V source when J1 is in the pin 2-pin 3 position on pin header P3. External 5V is required only when a new program is being burned into the SX chip. This "in-circuit programming" capability of the SX device makes it very easy to re-use in projects.

When the Badger smart badge is quiet, the SX controller is "asleep." In this state, the SX clock oscillator has stopped, and the chip only draws several microamps of current from the 3V battery.

However when the smart badge is triggered by pushbutton PB-1 being actuated, the SX chip wakes up and begins executing its internal software program.

Turning the smart badge on by means of a quick tap is reminiscent of the activation scheme for the communicator worn on the shirt in the old Star Trek series ... "Beam me up Scottie!"

Once triggered, the program in the SX chip wiggles the output bit RB1 at about a 4 kHz rate, causing piezo device X1 to

emit a reasonably loud tone. The software program modulates the tone with Morse code at about a 15 wpm rate to sound the owner's callsign.

The RB2 output pin is also turned on and off at the same Morse code rate and buffered by transistor Q1 to drive the KEY input of a transmitter. In this way the Badger can key a transmitter, which will be seen as a more useful feature when we describe some other Badger features in a moment.

LED D1 is also turned on and off according to the Morse code being sounded, giving visual indication of the callsign being announced. The blinking SuperBrite LED is very useful in helping one to copy the Morse code. The specs for the piezo state that the sound pressure generated (i.e., audio output level) is at least 80 dB, which is pretty easy to hear in a typical environment. However when the room is filled with talking people and other noise, the beeping can easily be drowned out. Thus LED blinking in time with the sounding of the piezo greatly helps by correlating visual and audible inputs to the person trying to copy the callsign.

Paddle inputs are available for connection of a standard iambic paddles, enabling the SX chip to perform as a keyer. When the smart badge is placed into "keyer mode," grounding of the dit or dah input lines (SX ports RB4 or RB5, respectively) activates the piezo and LED for the corresponding dit or dah time periods. Another related mode, Straight Key mode, instructs the SX program to recognize grounding of the dah input pin as a straight key closure, which in turn sounds the piezo and turns on the LED.

The Badger pc board was laid out to allow the builder to construct a miniature homebrew paddle right on the back of the smart badge. As shown (sticking out on the left of Figure 2), a thin strip of pcb material is soldered in between two grounding stubs so that when the strip is moved from side-to-side by the operator's hand, the Badger sounds off just like a code practice oscillator. Additionally, when pin header P5 is connected to a transmitter, the smart badge acts as a full-fledged iambic keyer. Captain Kirk never had it this good!

The pc board was designed to use a surface mount version of the SX-18 microcontroller. This package was selected over a DIP package because of its lower cost, lower profile and lighter weight. Even the pc board was fabricated using .031" material, providing for a lighter weight badge hanging on one's shirt pocket.

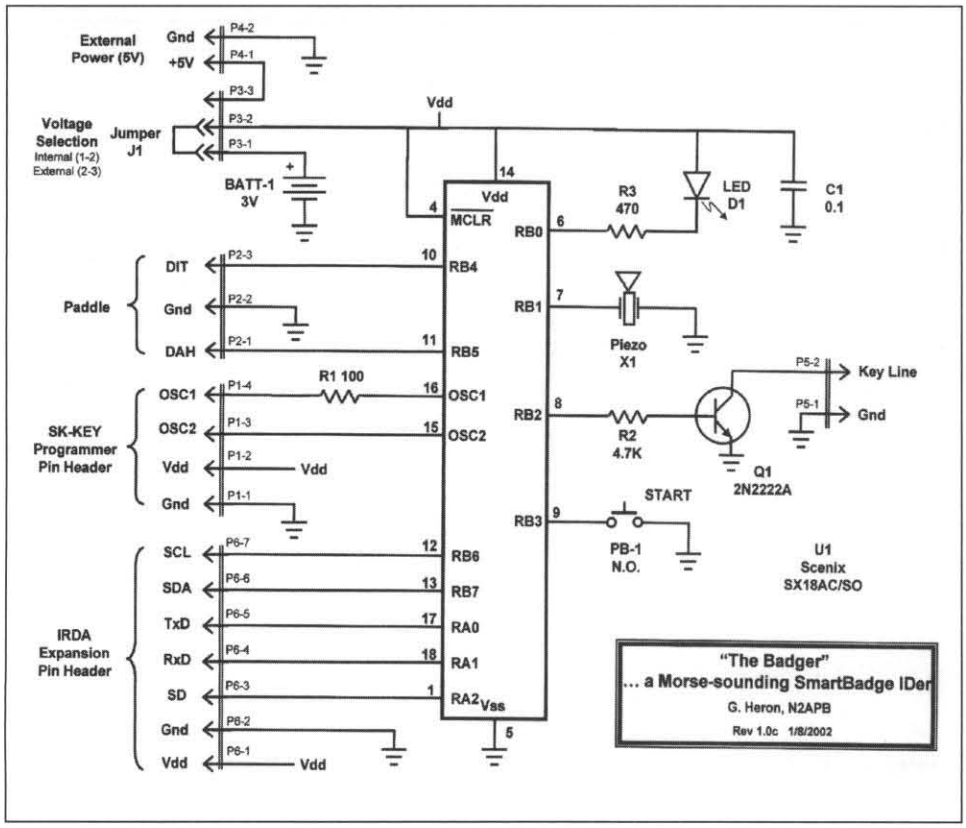


Figure 1—Schematic of the Badger "smart badge."

Because we used a surface mounted SX chip, we needed to provide the means to initially program the chip after it was soldered in place and for reprogramming the chip when a different or improved program is ultimately available later on. The 4-position pin header P1 is provided in order to allow the SX-Key or the SX-Blitz programmers to connect to the board and feed new software to the SX chip. This connector and in-circuit programming function will not normally be used by most people—its only use is when a new program is desired for the chip.

Software

In order to follow along with this software part of the discussion, you need to refer to the Badger assembly source code listing provided on our companion website (listed as a reference at the end of this article).

The software design is based around a recurring interrupt, which is set to happen every 148 µs when the RTCC counter (which counts clock cycles) rolls around past zero. This is a common way for PICs and SX chips to generate a constant stream of interrupts, and is determined by a setting of the RTCC reload value at the end of each interrupt.

Thus, whatever operations done during the interrupt service routine (ISR) happen at that 148 us periodic rate. As it turns out, µgenerating the frequency for the piezo sounding device is the highest priority for the program, and we toggle the bit connected to the piezo every time we pass through the ISR. Since a "cycle" of wiggling this bit takes two passes through the ISR (bit set on one pass, bit reset on the next), the basic default frequency of piezo operation is 2 ˇ 148 µs = 296 µs, which sounds the piezo at 3.37 kHz.

If we programmatically modify the RTCC reload value, the piezo tone will vary around that default frequency, and the operator could "calibrate" the piezo output for its natural peak resonance. That is actually the operation done in the Calibrate mode of the software. Once in that mode, when the operator taps the pushbutton two times, the software reduces the RTCC reload value a bit and the resultant ISR rate (and the piezo frequency) is increased. When the operator taps the pushbutton once, the RTCC value is increased, which lengthens the interrupt rate and lowers the

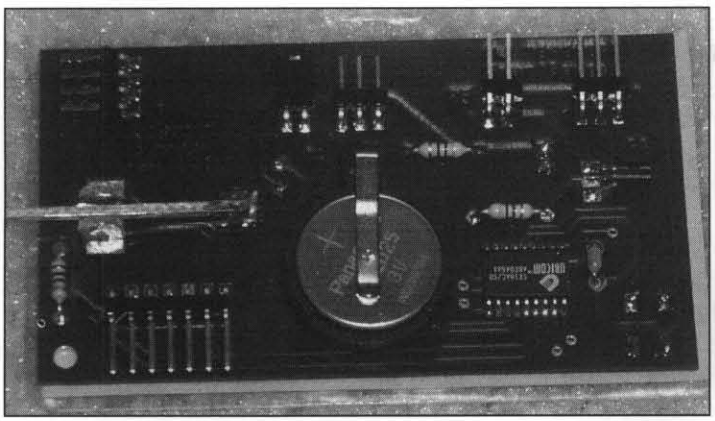


Figure 2—The back side of the Badger. Note that the various pin header "options" have all been populated, and that a miniature paddle was fabricated on the left side of the smart badge. The 3V lithium battery is held in place via a clipped socket in the center of the board, and the surface mount SX microcontroller is just to the ight of it. It's hard to see it in this photo but there is a piece of clear acetate glued over top the components on this back side of the Badger, protecting it from possible shorts when worn.

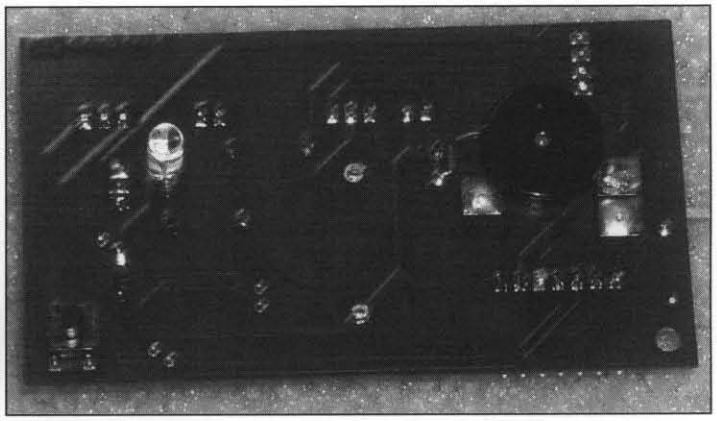


Figure 3—The front side of the Badger pc board, with laminated badge removed. Only three components are mounted on this side: the pushbutton (left), LED (middle) and the piezo (right). The laminated badge with corresponding holes slips over the components and is glued to the surface of the board.

piezo tone.

The rest of the Badger's program is really quite elementary and standard, as done by many of the PIC keyer chips/programs available today. We first determine the ASCII character of each letter in the pre-programmed callsign, use a look-up table (LUT) to turn it into an equivalent pattern of 1s and 0s that represent the character's dits and dahs, and then control the length of the piezo "beeps" and the spaces in between those beeps based on the dit and dah sequence.

A default 10 ms element of time is used as the Morse unit—a dah is 3 units with the piezo tone on, a dit is one unit, a character space is one unit with the tone off, and a word space is 3 units. Put all these unit tones and no-tones together according to the Morse-equivalent of the ASCII character, and you have Morse code beeping and blinking at you at about 12 wpm!

Timing of the Morse output is easy to adjust via the "Morse Speed" mode settings. When this mode is entered, the basic default unit length is increased or decreased slightly, effecting a corresponding decrease or increase of the Morse output speed.

Once the desired tone frequency and Morse speed selections are made, the software saves the settings in its onboard RAM memory. These settings are retained even during the sleep modes of the processor, and as long as the battery is not removed, the settings will remain intact. If, however, the battery is removed or replaced, it will be necessary to perform the Badger calibration steps again.

Operating Modes

The Badger smart badge has a number of modes to allow it to be calibrated and to operate in the prescribed ways.

Mode selection is made by actuating the pushbutton at the end of the callsign annunciation sequence. When pushbutton actuation is detected, a series of Morse letters are annunciated, each signifying a specific mode. When the operator hears the desired mode letter, the pushbutton is depressed, and that mode of operation is entered. The modes are described below according to their assigned letter.

Mode A (Normal)—The callsign is played once whenever the pushbutton is tapped, and then the SX chip goes to sleep. Tapping the pushbutton at any time during callsign play will silence the Badger, and put it to sleep.

Mode B (Beacon)—The callsign is played repeatedly, separated by a short pause in between the times played. Holding down the pushbutton for a second anytime during this mode will silence the Badger, return it to Normal mode (A), and put it to sleep.

Mode C (Calibrate)—A steady tone is played by the piezo device, enabling the user to peak the frequency for that specific device and battery voltage. A single quick tap on the pushbutton will raise the frequency of the steady tone. Two quick taps will lower the frequency. The operator should adjust the piezo tone for maximum output. Holding the pushbutton for one second stores the tone setting, returns the Badger to Normal mode, and puts it to sleep.

Mode D (Iambic Keyer)—The paddle inputs to the SX chip are activated. Grounding the dit input sounds a short tone, and grounding the dah input sounds a longer tone. Iambic operation is achieved by dit/dah insertion, as appropriate. Actuating the pushbutton for one second returns the Badger to Normal mode, and puts it to sleep.

Mode E (Morse Speed Adjust)—A constant series of Morse dits is played. Tapping the pushbutton once increases the Morse speed, and tapping the pushbutton twice lowers the speed. Actuating the pushbutton for one second stores the speed setting, returns the Badger to Normal mode, and puts it to sleep.

Mode F (Straight Key)—The piezo and LED are sounded whenever the dah input line is grounded. Connecting a straight key to the dah line will allow the Badger to perform as a classic code practice oscillator. Actuating the pushbutton for one second returns the Badger to Normal mode, and puts it to sleep.

Mode G (Piezo Only)—Only the piezo

will be sounded for callsign and keyer annunciation. The Badger is returned to Normal mode and put to sleep.

Mode H (LED Only)—Only the LED will be blinked (i.e., no piezo sounding) for callsign and keyer annunciation. The Badger is returned to Normal mode, and put to sleep.

Mode I (Both Piezo and LED)—Both the LED and piezo will be used for callsign and keyer annunciation. The Badger is returned to Normal mode and put to sleep.

Construction

As you might have guessed, the Badger can be constructed using a pc board. The NJQRP Club designed this kit for use at Atlanticon and sells the board, personalized programmed SX chip (pre-mounted on the board), on-board components, and a personalized laminated callsign badge.

One is also able to homebrew the Badger from scratch using a piece of perf board, for example. A personalized programmed DIP version of the SX-18 is also available from the NJQRP for this case.

Summary

No matter how you build the Badger, its use is an exercise in understanding how simple microcontroller devices can be programmed to perform some real fun and useful ham projects. We described last time how to obtain and use the tools necessary to make your own software mods and programs for the SX chip ... it can't get much simpler than doing it with this Badger project. Try it, you'll like it!

—73, George N2APB

Badger Notes

1) Per usual, I thank my cohorts in crime—Joe Everhart, N2CX and Dave Benson, K1SWL—for concept iteration and helpful approaches to the Badger design.

2) Also per usual, a more detailed version of this project—photos, description, photos, source code—is contained on our companion website www.qrparci/digitalqrp

3) A basic Badger kit is available from the NJQRP Club. Contains electronic parts, pc board, personalized pre-programmed SX chip soldered to the pcb, and laminated callsign badge and badge clip. Price is $18 and includes shipping to US and Canada. (DX orders add $5.) Pay using PayPal to n2apb@amsat.org, or write check/MO payable to "George Heron. N2APB" and send to 2419 Feather Mae Ct, Forest Hill, MD 21050.

The Digital QRP Breadboard—Adding a DDS VFO

So far in our evolving BreadBoard project we've presented the overall block diagram of the design, the first instance of project hardware in the form of the HC908 microcontroller Daughtercard, keyboard interface and LCD for I/O, and the first hardware-software application—a scaling voltmeter. If you've been able to build along with us you have the start of a powerful and flexible little station accessory.

This time, leveraging the Direct Digital Synthesis technology we presented in the Spotlight section of the January 2002 issue, we'll add a DDS to the BreadBoard to create a basic VFO. Sharp readers will note that we've been dropping hints relative to an approaching milestone, and this DDS VFO brings us a huge step closer to realizing it. I don't want to say too much more right now, but most homebrewers will want to keep up with the BreadBoard project in order to easily bring it all together later this springtime.

In a nutshell, this installment adds a digital VFO to the BreadBoard in order to generate good sine waves ranging from one Hertz up to 20 MHz. We accomplish this by employing the AD9850 DDS chip from Analog Devices and an output filter to eliminate the aliasing signals, thus producing a fairly good waveform that can be used as a test signal or as a local oscillator in a transceiver.

A simple 3-wire serial interface links the HC908 Daughtercard with the DDS

Figure 4—The BreadBoard system

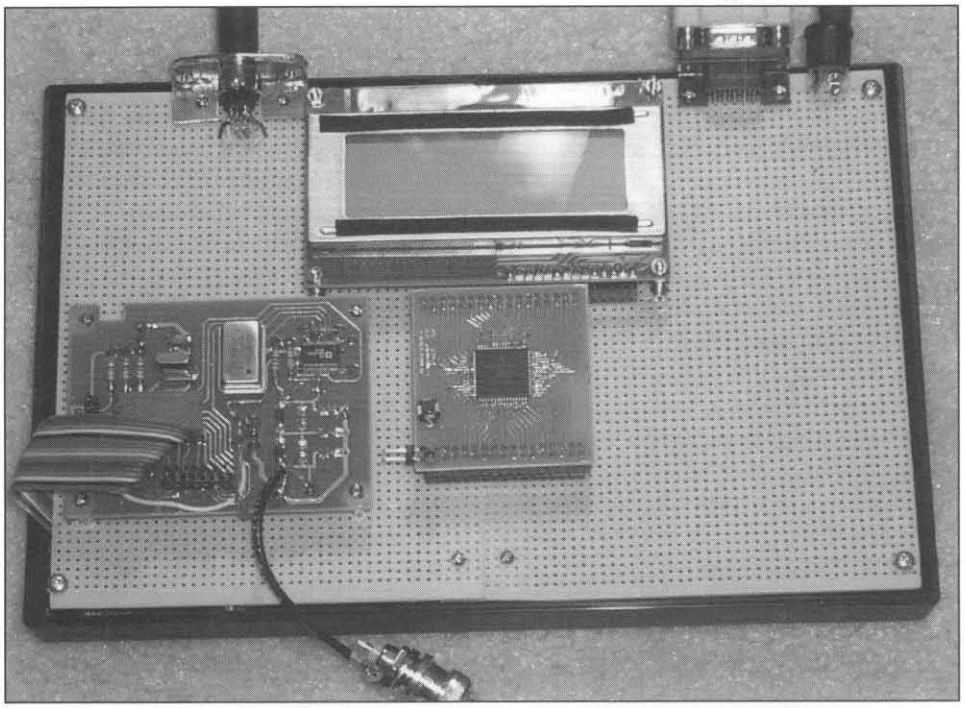


Figure 5—Zooming in on the BreadBoard real estate. IBM keyboard connector is at the top left, +12V power connector and RS-232 connector (for programming interface to a PC) is shown at the top right. A 4-line LCD is in the top middle, with the HC908 Daughtercard below it. The DDS VFO board from FAR Circuits is shown to the left.

chip. This enables the VFO software running on the microcontroller to load the DDS control registers with specific values that set the precise DDS frequency.

Building the DDS VFO Board

In the long run we'll be providing a pc daughter board for the DDS chip and its related components. This will help homebrewers quickly assemble a working system without having to worry about soldering many little wires to the various surface mount devices used in the project. This approach was followed with our first functional module, the HC908 microcontroller, as seen pictured below the LCD in Figure 4.

However for the short-term breadboarding and experimentation needs in this project, we've employed the DDS VFO pc board used by Curtis Preuss, WB2V in his landmark *QEX* article from 1997. This inexpensive pc board is available from FAR Circuits and contains the near-minimal amount of circuitry required for our application. Most importantly the DDS VFO board has the pc traces for the surface mount DDS chip, enabling us all to easily use the DDS chip within our homebrew BreadBoard.

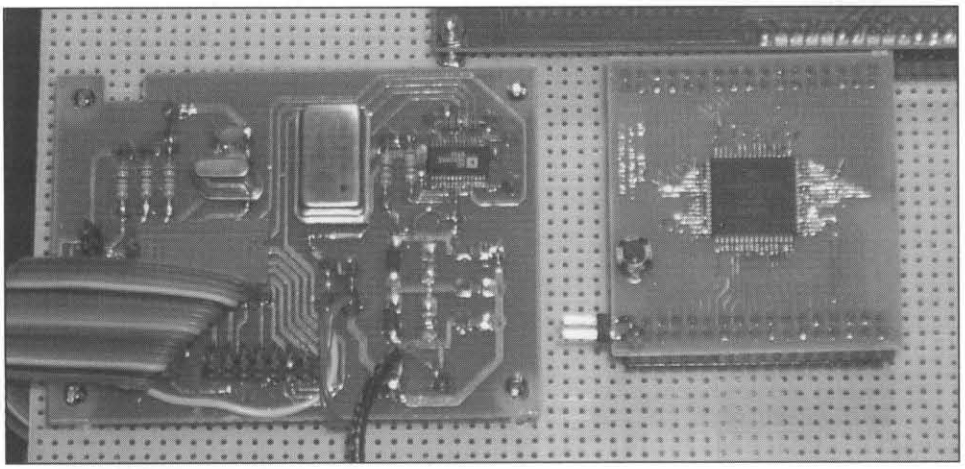


Figure 6—Close-up on the DDS VFO pc board (left) and the HC908 Daughtercard (right).

As can be more clearly seen in Figure 5 and Figure 6, the DDS VFO pc board is mounted to the left of the HC908 Daughtercard. We get the three control lines over to the DDS board by means of a ribbon cable that plugs into the unused 18-pin IC socket. Ground and +5V wires are conveniently contained in that same ribbon cable. The RF output from the board is provided by way of a short piece of RG-174U mini coax terminated in a BNC jack. A standard BNC patch cable is shown taking the signal ultimately to an oscilloscope for monitoring.

Hardware Circuit Description

Please refer to the large schematic in Figure 7 for this discussion.

We have the same HC908 Daughtercard interconnect as used last time. After all, we're merely adding on to the current design, once again leveraging the AT keyboard and LCD as the system I/O and user interface. Similarly, we again need the RS-232 serial connection to the external PC in order to burn the new DDS VFO program into the HC908 microcontroller.

[Recall that everyone is able to download new software programs from our Digital QRP Homebrewing website and directly program the microcontroller without the need for any special programming hardware. The bootstrap program provided in all new HC908 Daughtercards provides the protocol for downloading and burning new software into the microcontroller directly from one's PC. Thus, whenever we introduce new software features or updates, you'll be able to quickly and painlessly get it loaded into your BreadBoard.]

Last time we described some analog signal conditioning components for measuring voltages. These functional blocks are shown in dashed boxes connecting into Port B0 and B1. Refer to our last column or to the online website for those details ... don't forget to include them when building up your BreadBoard, as we'll be using them again shortly.

The DDS circuitry that we'll be using this time is shown at the bottom of the schematic. The AD9850 contains a 32-bit

phase accumulator, a 14-bit lookup table and a 10-bit D/A converter. It can be clocked at 125 MHz to produce a 41 MHz sine wave output, although we'll use the 66.666 MHz "can" as a commonly available oscillator for now to generate a top frequency of 20 MHz. (Be sure to use a socket to mount this can in the pc board so we can later substitute a higher frequency oscillator to allow us to generate up to 30 MHz in our mystery application coming soon!)

A 40-bit control word is serially loaded into pin 25 using pin 7 as the data write clock. By toggling pin 8 the input register is shifted to the DDS core. The 40-bit control word contains a 32-bit frequency, 3 control bits and 5 phase modulation bits. These bits determine the generated frequency and some software calculation guidelines provided in the AD9850 data sheets.

The output of the AD9850 is a differential current on pins 20 and 21. A resistor placed from pin 12 to ground determines the full-scale output current for the D/A converter. Setting the resistor to 3.92 kohms yields a D/A converter current of about 10.2 mA and a voltage swing of about 250 mVpp into a 50-ohm load.

The output of the DDS is a digitized or sampled sine wave. Such a wave shape has strong frequency components at the reference clock frequency plus or minus the output frequency. Filtering out these components produces a clean sine wave. Using a clock frequency of 66 MHz and a maximum output frequency of 20 MHz, the low pass filter must cut off frequencies above 46 MHz while passing frequencies below 20 MHz. A fifth-order elliptic low pass filter used in this circuit has a 55 dB or greater attenuation at frequencies above 46 MHz.

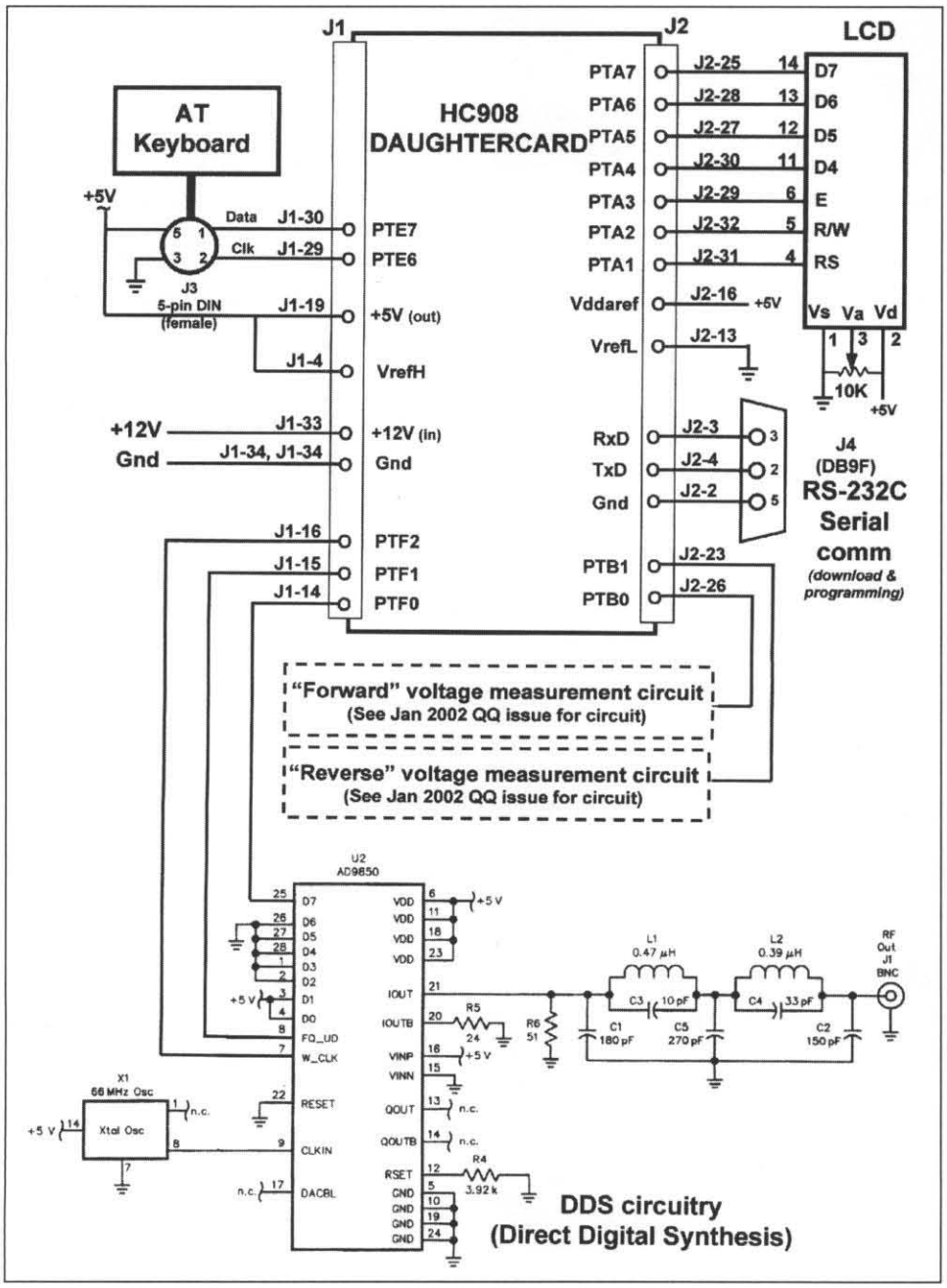


Figure 7—BreadBoard schematic ith DDS VFO capabilities.

Software Description

The dds_vfo_1.src software program provided on the website for this DDS VFO installment of the BreadBoard is a simple VFO that is tuned by means of the keyboard.

Upon power-up, the DDS is set to output a 10 MHz signal and that frequency is displayed in kHz on line 1 of the LCD as "10,000." A new frequency may be entered by using the keyboard, and is set to the DDS upon typing the <ENTER> key.

Frequency changes may also be accomplished by hitting the <UP> or <DOWN> arrow keys, which change the DDS frequency correspondingly up or down by one kHz.

It's rather fun to watch the signal change on an oscilloscope, or hear the signal change while monitoring it in a receiver, when making the changes on the keyboard.

The complete source code is provided on our companion Digital QRP Homebrewing website. It is liberally commented for those wishing to follow the actual assembly language code used to calculate the DDS frequency control words. The I/O libraries are the same as used last time in the Scaling Voltmeter software program—keyboard input, LCD output and various "glue" subroutines. This time the mainline of the program collects numeric and arrow keyboard input to control the DDS.

This initial dds_vfo_1.src program is heavily based on the work presented in the Ham-PIC forum spearheaded by Craig Johnson, AAØZZ and Bruce Stogh, AAØED (and some others). Their ongoing DDS VFO project is popular with the PIC microcontroller crowd. The basic control, display, memory handling and calibration routines used here in the BreadBoard were shamelessly borrowed (with permission) from this group of experimenters. Although the processor is different in our case here with the BreadBoard, the same

"algorithmic" approach is used for DDS chip control.

That's it ... for now

Okay, order your DDS VFO boards from FAR Circuits and get the various components from your favorite suppliers. We may even have the bandwidth to provide a DDS VFO components kit to enable you to more easily get started. (Check on this at our website.)

It doesn't take long to get the new hardware capabilities set up in your BreadBoard and you'll soon be using the project to generate some nice waveforms.

Don't forget that we'll have just one more relatively small hardware addition before we'll be unveiling the Big Milestone for this project ... and it'll be very interesting, useful and educational for all.

Visit often to our companion website to check on further details and capabilities with this DDS VFO project, and with the BreadBoard as a whole. We make incremental changes and improvements in between quarterly printings of QQ and you can stay in lock step with us as we proceed.

— 73, George N2APB

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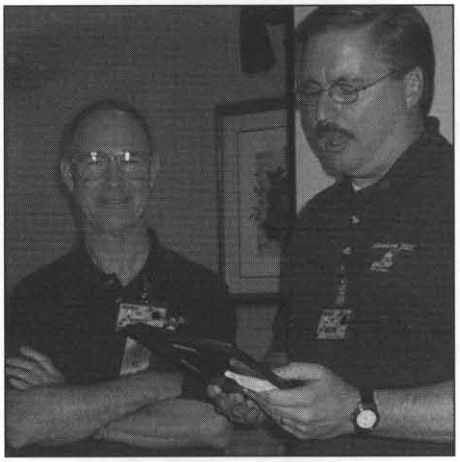
"Most Significant Contribution to QRP" Award Goes to K8IQY

As is characteristically done at the annual Atlanticon QRP Forum, the prestigious "Most Significant Contribution to QRP" award was presented by the NJQRP this weekend to a very deserving individual in the QRP community—Jim Kortge, K8IQY.

Jim's contributions to the QRP and homebrewing community over the last four years have been nothing short of spectacular. He is a meticulous and creative RF designer, a producer of kits, a patient and informative instructor, a public speaker at QRP events, an accomplished and published technical writer, and a absolute master craftsman who has done more to champion the extremely successful "Manhattan-style" construction technique than anyone else in our hobby.

Kortge is the designer of the immensely popular 2N2/40 Transceiver —a 40M transceiver constructed solely of 2N2222 transistors and a winner of an ARCI design contest a number of years ago. He wrote an article published in NorCal's *QRPp* magazine concerning his 2N2/40 design, and it was the subject of tremendous excitement in ensuing years as others built his design.

In the most recent eight months, Kortge has sponsored and actively manages a very popular "2N2/40" email list on Yahoo, wherein over 150 hams have been building their own versions of Jim's 2N2/40 transceiver. He has painstakingly encouraged every neophyte homebrewer, helped to source and find parts, and has updated his design to yield more readily reproducible results—the sign of a good design, and of an excellent designer. There are many 2N2/40 transceivers on the air now because of Jim's assistance and careful guidance along the way, and that group is very loyal and appreciative to Jim.



N2APB (right) presents the award to K8IQY (left) at Atlanticon.

Since designing the 2N2/40 Transceiver, K8IQY has evolved the design to produce a 2N2/6 Transverter. This project was the subject of a paper and talk at a prior year's Atlanticon and FDIM QRP forums. To listen to the presentation, and to read the very thorough technical manuscript which was published in the respective Proceedings, even a staunch and inveterate QRP technical veteran (such as some of us) stood in complete awe at his work.

Kortge then went on to build another variant of the 2N2-series, but this time focusing on the Manhattan-style technique that made him famous. He designed and produced the 4017 Transverter, which again was presented in full technical glory at Atlanticon and FDIM QRP forums. Further, the design was so good and so sought after, the NJQRP collaborated with Jim to produce a kit of his 4017 design. This project was very well received and it has ultimately sold over 200 kits around the world.

His next project is not yet as well known because of its being so new on the scene, but many people will got a chance to see and hear of it at the Atlanticon QRP Forum this past weekend. Jim presented a topic close to his own interests—crystal calibration and measurement techniques, and I can tell you that the paper is just awesome. Further, the NJQRP Club is once again collaborating with Kortge to produce the test equipment he's presented, in the form of a Precision VXO Kit which was announced during the Atlanticon weekend. Many are predicting that this project will be of great interest to many hams in the QRP and homebrewing community.

About a year ago, Kortge teamed up with Chuck Adams, K7FO to participate in a very public "construction contest" concerning the Iowa QRP 10 Transceiver project. Over the course of months, both Kortge and Adams meticulously documented and described their modular Manhattan-style construction of the project, publishing detailed photos, circuit descriptions and assembly techniques on the NorCal website (sponsors of the event).

Jim Kortge is an affable, modest and very accomplished technician in the QRP and homebrewing scene. His technical, speaking, publishing and educational contributions stand head-and-shoulders above the average QRPer, and we are so fortunate to have K8IQY in our hobby.

— George Heron, N2APB and Joe Everhart, N2CX , for the NJQRP Club http://www.njqrp.org)

P.S.—Prior years' recipients of this award were Dave Benson, K1SWL in 2001, and Dave Meacham, W6EMD in 2000. ●●

QRV? Putting Together a Good Bench

Mike Boatright—KO4WX ko4wx@mindspring.com

Well, it's hamfest season again. Since I already have more ham gear than I'll ever reasonably use, and enough unbuilt kits to last for many a rainy day, I go to hamfests mostly to see my friends and to restock my junque box. Last year, for the first time, I went to FDIM and the granddaddy hamfest of them all, Dayton. Wow! FDIM was like a four-day long North Georgia QRP Club meeting and the Dayton boneyard was pure sensory overload!

The problem with shopping for stocking your workbench at a hamfest is remembering what it is that you need, especially if you're just getting started in construction. There's so much stuff and it is all so cool! So in this article, let's take a look at some of the basic things that you can do to put together a good construction workbench.

KO4WX's construction workbench.

Locating Your Bench

Ideally, you should locate your bench where you can work for several hours at a time undisturbed, and if possible, where you can leave your project and return to it later. Your work area should be well lit. In my construction area, I have an overhead light on the ceiling, a fluorescent lamp mounted underneath a storage cabinet, and a swing-arm lamp with magnifying lens directly over the workarea. It's best to not locate your workbench in a carpeted area-you be totally amazed how carpet (even short pile) will consume any and all parts dropped on the floor. If you have no choice, try getting a large plastic floor mat from an office supply store.

My first bench was a piece of plywood over a couple of metal filing cabinets in the den (I learned about carpets and radio parts the hardway). When I moved into my present house, I custom built melamine counters and cabinets. What is important is to not use your great-great-grandfather's antique desk! Over time, you will drop tools, solder, chemicals and various and as sundry other things that will wreck a precious family heirloom.

Tools

Proper tools will make or break any construction project. However, you can get started with a basic set of common and easily available tools. A good soldering iron is a must. Weller makes the best, in my opinion. If you can afford it, get a variable heat iron, in the $50 to $100 range. It will pay off in the long run. If not, consider getting a couple of inexpensive 25-Watt and 40-Watt soldering irons, like the ones sold at Radio Shack. A heavy soldering gun is helpful for larger projects, metal work and making PC board cabinets, but isn't necessary right off the bat. Your best bet for solder is "44" rosin core. You can usually find it at hamfests for about $5 a pound. Get lots of solder wick too!

Here are some of the basic tools you need for most construction projects:

- Small needle nosed pliers
- Small diagonal pliers ("dikes")
- X-acto knife
- Small set of screwdrivers
- Decent VOM meter
- "Extra pair of hands"—very helpful
- Pair of scissors
- Tweezers
- 3/8 inch drill
- set of Allen wrenches (hexagonal wrench)

With experience, you'll find all kinds of tools available for every kind of special need. Some of the more useful tools that I use all the time include a nibbling tool (to cut holes in thin metal), hog-shears (also called "tin snips"—useful for cutting PC board, brass, aluminum, etc.), and the most useful of all—the Dremel tool.

Parts

You can never have too many parts! Believe it or not, one of the best places to get parts is still your neighborhood Radio Shack store. Different stores carry different inventory, but almost all still carry some assortment of parts. I sometimes walk into a store just to see if they've got some old discontinued parts you'd never see in any other store. I've found some real gems at times!

While this isn't a plug for Radio Shack (and sadly, the RadioShack.com stores are going out of business), one thing that you should definitely get to jump start your bench is one of their 1/4-Watt resistor assortments (RS271-312, $9.99 or the smaller assortments, RS271-306, $4.99 or RS271-308, $3.99). Some of their capacitor assortments are good to prime a junque box as well.

Here's my recommendation for a good

starter set of parts for your bench:

Resistors—1/4-Watt, 10%, 30 of each: 1K, 10K, 100K; 10 of each: 1, 10, 51, 100, 120, 150, 220, 330, 470, 560, 1.5K, 1.8K, 2.2K, 3.3K, 4.7K, 15K, 22K, 51K, 68K, 120K, 220K, 470K, 680K, 1M, 10M

Variable Resistors—3 - 5 of each: 500, 1K, 10K, 50K, 100K

Disk Capacitors—(ideally NPO or C0G if you can find them) 10 of each:3 (or 3.3) pF, 7 (or 6.8 pF), 10 pF, 15 pF, 33 pF, 47 pF, 68 pF, 100 pF, 120 pF, 150 pF, 220 pF, 270 pF, 330 pF, 390 pF, 470 pF, 680 pF, 910 pF, 1200 pF, 1800 pF, 2200 pF, 3300 pF

Bypass Capacitors—20 of each: .1 µF, .01 µF, .001µF

Electrolytic Capacitors - (16V or 25V) 1 µF, 3.3 µF, 4.7 µF, 10 µF, 22 µF, 33 µF, 47 µF, 100 µF, 220 µF, 470 µF

Inductors—1.8 µH, 2.7 µH, 5.6 µH (or 4.7 µH or both), 10 µH, 15 µH, 22 µH, 47 µH, 100 µH, 1 mH, 2.5 mH

Toroids—10 of each (if you can): T-37-2, T-37-6, T-50-2, T-50-6, FT-37-43, FT-37-61, FT-50-43, FT-50-61

Transistors—10 of each: 2N3904 (the cockroach of semiconductors), 2N2222/ 2N2222A, 2N4401, 2N3906, MPF102, 2N7000, 2N4416A; 5 of each 2N5179, 2N3866, 2N2907, 2N3053

Diodes—10 of each: 1N34/1N34A, 1N914, 1N4148, 1N4001/1N4004

Integrated Circuits—5 of each: 78L12, 78L08, 78L06, 78L05, LM386N, LM741; 3 of each LM747, NE602A (also called SA602AN) or NE612A (SA612AN)

Neat (and cheap) trick for storing tools on your bench.

Crystals—3 - 5 of your favorite popular QRP frequencies (3.579, 3.686, 7.040, 10.106, 10.112, 14.060, etc.)

You may not be able to build that super-dooper all-band, all-mode rig with these parts, but you'll make a good start. Even if you only build kits, it is helpful having these parts on hand—I just hate it when I have to stop work on a project because I don't have any extra .01 µF capacitors on hand!

Some of the older "through-hole" parts are becoming harder and harder to find (I went crazy recently trying to find a CA3020A driver amp!)—many are being replaced by surface mount parts. You'll find that surface mount parts are a lot cheaper than the older parts we are used to working with, because they are easily manufactured by machines (this is one of the reasons that consumer electronics have gotten so cheap lately!). Be careful, because unless you are skilled in working with surface mount, it can be challenging and frustrating.

There is a great list of parts suppliers available on the QRP ARCI website. Some of my favorites are: Amidon, Inc.; Dan's Small Parts; Digikey, Corp; Kits and Parts; Far Circuits; Halted Electronics, International Crystal; Mouser Electronics, National Semiconductor and RF Parts. Most have their catalogs available on-line, and some you can even download. Many have direct ordering over the Internet, and usually ship within 24 hours if the parts are in stock. Depending on the project, you may have to shop at several suppliers to get all of the parts necessary for a specific project.

So next time you go to a hamfest (or, maybe I'll see you at FDIM!) you'll know better what to look for to look for to get that junque box stocked up! Then get that solder melting, build something and get QRV!

— 72 de Mike, KO4WX

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First Look: Elecraft K2/100 QRO/QRP Transceiver Kit

Normally, the introduction of a 100-watt SSB/CW transceiver would not be relevant to most QRP Quarterly readers, but the new Elecraft K2/100 may just be an exception.

Consider that it's a kit—the first 100-watt ham transceiver kit offered since Heathkit went out of the ham business. (Remember, the K2 is also available in a 10-watt version that is otherwise identical, at lower cost.)

QRPers are, for the most part, avid kit builders, and the new K2/100 is one of the most sophisticated transceiver kit you can get your hands on. Equally, if not more important, the new K2/100 jumps through hoops to be a great QRP rig. You can actually connect two 12-V power supplies to the rig (one low current, one high current), and drop into an efficient QRP mode of operation by simply turning off the high-current supply. If the low-current supply was a battery connected to a solar panel, you'd have a self-switching emergency-power station.

Another way to operate the new K2/100 QRP is to twist the POWER knob down to the low end of its range. Anything below 10 watts automatically puts the internal high-power final into "thru" mode, with power setting resolution of 1/2 watt (0-10 W). If you'd prefer, you could simply turn the PA off in the menu, in which case the POWER knob would provide the same 0-15 watt range as the original K2.

Regardless of its configuration, the new K2/100 draws only a small fraction of the receive-mode current of other full-power rigs—and that's with all of the bells and whistles activated. There are various power-saving menu settings that can reduce RX current to as low as 150-180 mA, making the rig work at either end of the power spectrum. Both weight and current drain are important considerations for Field Day, camping, or business trips, and at around five pounds, the new K2/100 weighs less than nearly all other 100-W rigs.

Let's face it: there are lots of QRPers who occasionally use higher power when the going gets rough. Since we're just a few years away from another dip in the solar cycle, this will likely start to happen more often. The new K2/100 maintains its QRP pedigree, yet provides higher power output if you need it. What other rig can make this claim? ●●

Test Topics and More...#11

Joe Everhart—N2CX n2cx@arrl.net

Coming To Terms

Test Probes

A common item used with most electronic test equipment is a test probe. Generally we need to connect the measuring equipment to whatever circuit we are trying to evaluate. As with many things in the world (like our spouses!), we cannot take them for granted or things will not turn out as we anticipate.

The simplest form of test probes are the test leads we use with digital multimeters (DMMs), or volt-ohmmeters (VOMs.) They are simply insulated conductors that plug into the test gear, terminated in a probe or clip at the other end for circuit connection. For voltage or resistance measurements, they parallel a part or test point, while the leads are connected in series to make current readings. Now that's very straightforward for most DC or low frequency AC measurements.

However even with DMMs, more sophisticated probes allow us to make more sophisticated tests. For example, DMMs are designed to read voltages only up to several hundred volts. Safety and insulation considerations dictate that kilovolt levels require special handling. For those applications a specially designed high voltage multiplier probe is used. It incorporates a very high resistance voltage divider and well-insulated handle to convert high voltages to lower levels so that users and common DMMs can safely handle them.

Similarly, high current circuits are not suitable for connection directly to a DMM. To minimize loss, large low-resistance conductors must be used with high currents. The simplest (and safest) means of making high-current measurements with a DMM is to use a clip-on current probe. This type of device uses a special magnetic core that can be separated and clipped over a high-current conductor. Special circuitry associated with the core converts the current to a calibrated voltage that can be read by the DMM. Besides safety, this has the advantage that the high current circuit never needs to be disconnected.

Most homebrewers are also familiar with RF probes. DMMs read AC voltage only for audio and low frequencies up to 100 kHz or so. Above that, their accuracy is very poor. The solution is to use a diode detector probe that rectifies the high-frequency RF and outputs a DC value that can be read by the DMM.

More sophisticated test equipment similarly needs more complex test probes. One type that comes immediately to mind is the oscilloscope. This indispensable instrument lets us look at time varying signals like sine or square waves to measure voltage, frequency and other characteristics at a glance. Using the right kind of test probe lets us make accurate repeatable measurements.

In a way, using an oscilloscope is like atomic physics. The brilliant physicist Werner Heisenberg observed that one cannot simultaneously measure the position and velocity of a subatomic particle. The very act of observing it perturbs its characteristics. Similarly, connecting an oscilloscope to a circuit can adversely affect the circuit's operation (actually this is true of any test equipment.) The best we can do is to understand how we load a circuit with our 'scope and minimize the result. Ideally, the perturbation will cause an error too small to measure.

Most oscilloscopes used these days have a one megohm high impedance input. While this is fine for DC and low frequency measurements, unfortunately this high resistance has a shunt capacitance that affects high frequency circuits. It varies between manufacturers, but is usually about 10 to 20 pF. Let's see how this affects things.

At low frequencies even 20 pF is negligible, but a simple calculation shows that 20 pF corresponds to a reactance of 1 megohm at about 8 kHz. So loading can be expected, even at this frequency, in a high impedance circuit. And to further compound things, this is only the 'scope's input capacitance. We thus need a cable of some sort to connect the 'scope to the circuit being tested. Short clip leads add only a couple of pf additional loading, but are often too short, and their lack of shielding can cause unpredictable results.

Several feet of coax cable can be used, but this adds about 30 pF of additional loading for each foot of cable. Okay, we don't usually use this setup with high-Z circuits but it can cause problems. The circuit impedance and load capacitance form a low pass filter whose 3 dB rolloff frequency can be calculated. Figure 1 shows the equivalent circuit. Table 2 shows the upper frequency limit for various levels of circuit impedance level for several lengths of coax cable.

Worse yet, if you are trying to test an RF circuit, there is likely a resonant circuit present that will be drastically retuned by all that capacitance! So, what's a ham to do?

Actually there are several options. First, many 'scopes have a selectable 50-ohm input impedance. If you can find a good 50-

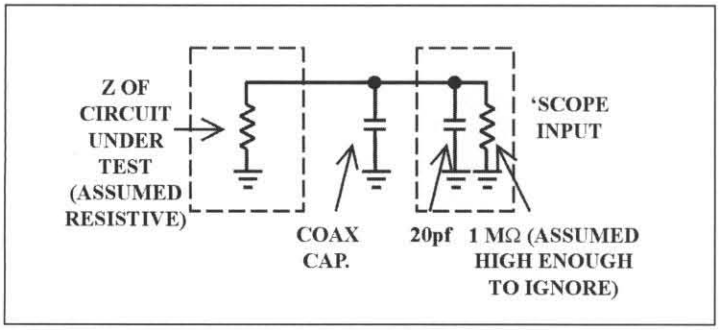

Figure 1—Equivalent circuit of a 'scope probe.

Cable Length	None (20 pF)	1 ft (50 pF)	2 ft (80 pF)	3 ft (110 pF)
Z (ohms)				
100	80 MHz	32 MHz	20 MHz	14.5 MHz
1k	8 MHz	3.2 MHz	2 MHz	1.45 MHz
10k	800 kHz	320 kHz	200 kHz	145 kHz
100k	80 kHz	32 kHz	20 kHz	14.5 kHz

Table 1—3 dB frequency rolloff due to 'scope probe loading.

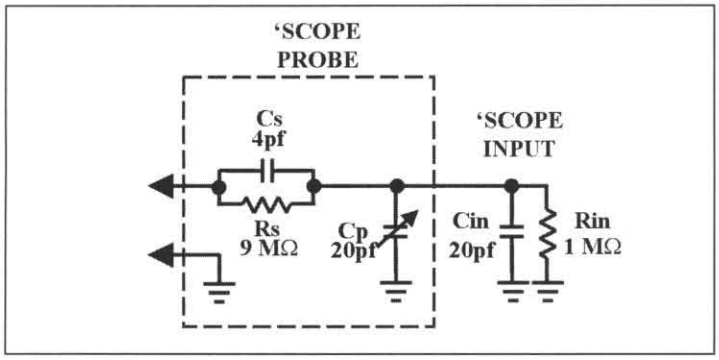

Figure 2—Equivalent circuit of an attenuator probe.

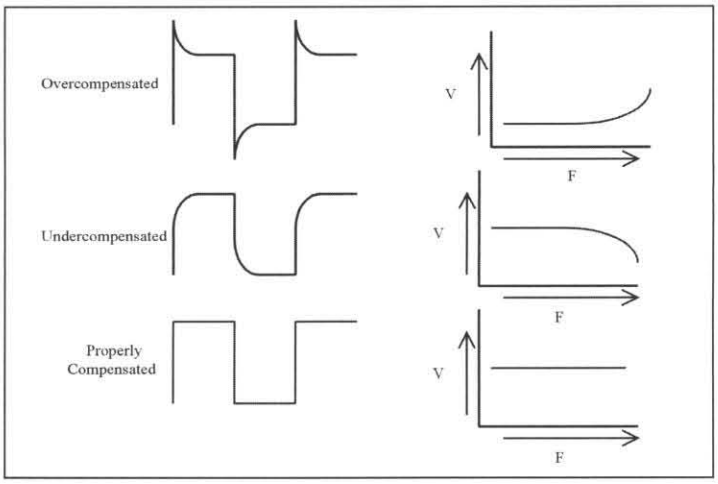

Figure 3—Effects of the compensating capacitor.

ohm point in the circuit you are measuring, you can use a 50-ohm cable and stay matched. Just don't try to connect this to a point that's already terminated, or you will end up loading with 25 ohms instead!

Second, you can use an attenuator probe. These are manufactured specifically for oscilloscopes to trade a loss of sensitivity for lower capacitive loading. Figure 2 shows the equivalent circuit of one connected to a 'scope input. Resistors Rs in the probe, and Rin in the 'scope, form a 10:1 voltage divider. For DC and low frequencies, this is all we need to know. However at high frequencies, the Cin of the 'scope would cause drastic attenuation (scale the numbers in Table 1 for 9 Megohms!)

We can compensate for this. If we put a capacitor across Rs that is 1/9 the capacitance across Rin, the high frequency roll-off due to Rs will be exactly cancelled. Think of it this way. Rs and Cin form a low pass filter. If we add Cs across Rs, it forms a highpass filter with Rin. If the values are balanced exactly, they cancel any roll-off. The downside is that they do have to be carefully balanced.

Note that there is a variable capacitor Cp across the 'scope input. This accounts for the capacitance of the probe-connecting cable and a small variable capacitor. Most 'scopes provide a calibrator output signal consisting of a square wave signal with known amplitude. It is used to adjust Cp exactly to frequency compensate the probe. Cp is adjusted for a perfect square wave display on the 'scope. If it is "peaky," high frequency response is overcompensated while rounded rise and fall times spoil high frequency response. Figure 3 illustrates this.

There is a third method. So far the probes described are passive probes with no amplifying elements. There is a class of devices called "active" probes that incorporate active amplifier devices that offer very high input impedance and low capacitance while suffering no attenuation. Commercial active probes are very expensive. The "Designed For Test" section will show how to build a simple one yourself.

Designed For Test

The Holy Grail for a 'scope probe is one that allows accurate measurements without affecting circuit operation. As explained above, this is difficult to achieve. However it can be approached, depending on how complicated a solution you want. This section will describe an active probe that offers an input impedance of about 30 megohms shunted by about 2 pF. The downside is that it suffers a slight loss. But it does give a means of checking waveforms in high impedance circuits with far less loading than common passive type probes.

Figure 4 shows the schematic diagram for a "Poor Man's" Hi-Z probe. It is really quite simple, consisting of a 2N5486 source follower to provide a low-capacitance high-impedance input followed by a 2N3904 emitter follower with a low output impedance. The 2N5486 is an RF type junction FET with low input capacitance while the input impedance is set by the three series connected 10 megohm resistors. The downside of this high input impedance is that the FET is subject to damage from static charges. This potential is somewhat reduced by the three 10 meg resistors, and the FET is cheap enough that occasional replacement is no great handicap.

To get the absolute minimum input C, special construction is warranted. As shown in Figure 5, the circuit can be built "Manhattan style" on a long strip of pc board material. To keep input C low, the copper cladding is removed from all of the last inch or so except for a 1/4-inch rectangle. The gate of Q1 and the three resistors are soldered here, along with a sewing needle to be used as the probe tip. A short length of small-diameter coax cable connects the active probe to the 'scope input, and a pair of leads feeds the circuit from a 9-volt battery. For protection, the majority of the board can be enclosed in a suitable small enclosure or length of tubing with the "business end" left in the open. Of course, a master craftsman might be able to construct a cylindrical housing for the entire circuit.

SPICE simulation shows that the input capacitance is less than 1 pF and the low frequency impedance is 30 megohms. Being AC coupled, the probe does not oper-

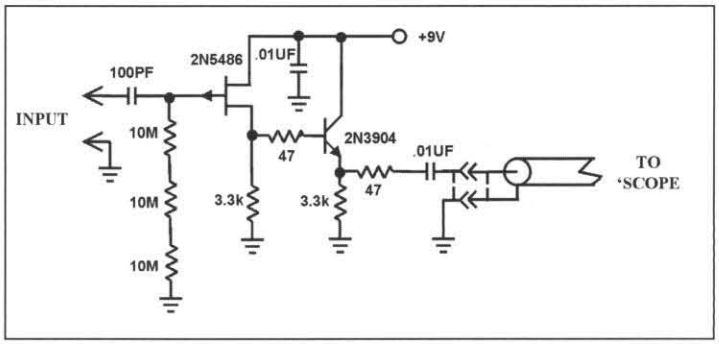

Figure 4—The "Poor Man's" high impedance probe.

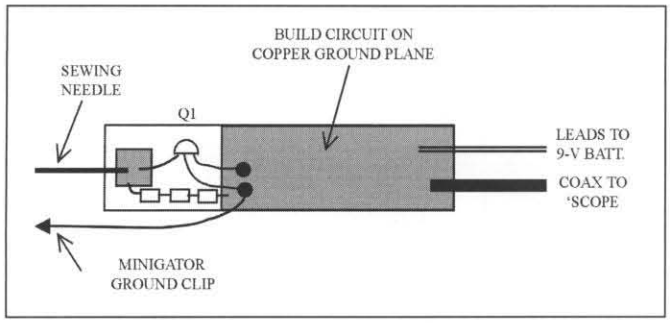

Figure 5—Hi-Z probe construction.

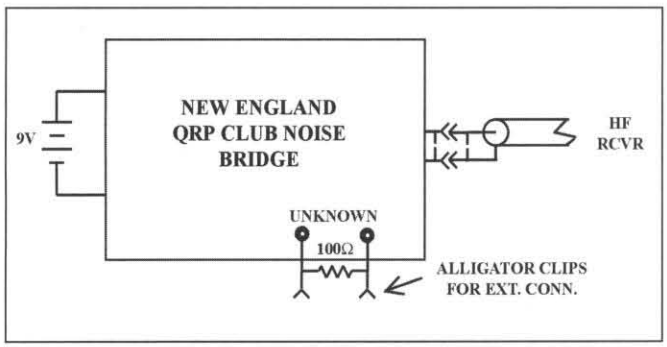

Figure 6—NE QRP Noise Bridge Test Circuit for antenna traps and transmission line stubs.

ate down to DC. Its response is about –2dB from 100 to 20 MHz or so, then peaking to near unity gain at about 30-40 MHz and sloping downward higher in frequency with a –3dB point of about 60 to 70 MHz. While its calibration is not perfect, it is very handy for relative measurements with light loading from low audio frequencies up through at least the 6-meter ham band.

A much higher performance probe is described in Reference 2. This book, by the way, is an extremely good book for ham homebrewers. Though it focuses largely on low frequency and operational amplifier circuits, it is a valuable reference with practical useful advice that is, at the same time, theoretically sound. The probe described in the book is about twice as complicated as the "Poor Man's Probe," and requires both positive and negative supplies. For this price, however, one gets a DC-coupled probe with less than 1/2 pF input capacitance and a usable range from DC up through 90 MHz.

Stimulus and response

The New England QRP Club recently announced a simple, inexpensive noise bridge kit for only $15 postpaid (Ref 2.) This kit contains the heart of such a bridge—a noise generator and a basic bridge circuit. Applications information provided (written by its designer, K1SWL) outline its use for adjusting antenna traps. All you need, in addition to the basic kit, are a 100-ohm resistor, some scrap wire and clips, and an HF receiver. I have to mention my admiration for Dave. After moving to a new QTH and wanting to put up new skywires, he decided to erect a trap antenna. Being a dedicated homebrewer, he designed and built his own simple noise bridge to tune them. Now that's a real homebrewer!

Ok, that's not correspondence but it is relevant...

A recent correspondence to me queried: "What can I use the NEQRP Noise Bridge for?" I answered that in general noise bridges are useful for resonating antennas and measuring RF impedance. While this is true, that particular use requires adding external variable controls. I suspect that in the near future lots of folks will do just that and write up descriptions of how to use the NEQRP kit as a general-purpose noise bridge. Not wanting to steal their thunder, I will defer for the moment.

Now K1SWL's (he's Dave Benson, QRP Hall of Famer and proprietor of Small Wonder Labs) technique is a very good way of adjusting antenna traps exactly on frequency on the bench without needing to employ the usual trial and error method of installing them on an antenna, measuring SWR in the installed antenna, tweaking the traps, etc.

Precisely the same method can be used to measure quarter wave and half wave transmission line stubs, another common antenna component. Details of the method are described in the noise bridge documentation, but I will briefly paraphrase them. Hook up the bridge as shown in Figure 2, connecting an external 100-ohm quarter watt resistor across the "UNKNOWN" terminals. Add two one-inch wires across the resistor terminated with alligator clips. Set the test receiver to the desired trap frequency and adjust on-board pot R1 and trimmer capacitor C1 for a distinct null in the noise heard in your receiver. Tweak both for the deepest null.

When an external circuit is connected across the resistor, it will change the impedance of that bridge leg, unbalancing the bridge, and spoiling the null. A parallel resonant circuit has a very high impedance at its resonant frequency, and if this impedance is high enough (a high Q circuit) it will not load the 100 ohm resistance so the null will remain intact. So when the circuit is tuned on-frequency, the null can be observed. Transmission line stubs show the same behavior. As we all remember (if not check out the *ARRL Antenna Book*), a quarter wave transmission line inverts impedance. That is, a short circuit at one end appears as an open circuit at the other, and a half-wave line repeats the impedance between ends. Thus, an open circuit at one end appears the same at the other end.

Now cut the stub a little longer than you think necessary. For using 300 ohm TV twinlead for a quarter wave stub at 7.1 MHz, the calculated length is about 984 ˘ 1/4 ˘ .80 ˘ 1/7.1 or about 27.7 feet so start with 29 feet. Short-circuit the far end and clip the noise bridge alligator clips (shown in Figure 2) to the open end. Now tune the receiver to null the noise, and note the frequency. If all is well, it should be lower than 7.1 MHz, probably about 6.8 MHz. Now trim the line an inch or so at a time, tuning for the best null. Repeat trimming until the null is at the desired frequency.

For a half wave, cut the stub to twice the quarter wave value and leave the far end open-circuited.

Answering this last question was fun, since it allowed me to come up with a use for the noise bridge that I'd wanted to do anyway! Please send me more good questions at:

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214 New Jersey Rd
Brooklawn, NJ 08030
N2CX@ARRL.NET

References:

1. Pease, Bob, "Troubleshooting Analog Circuits," Chapter 2, page 16, ISBN 0-7506-9949-3.

2. New England QRP Club website: http://www.qsl.net/wq1rp/ ●●

Clubhouse Corner

Mike Fletcher—KL7IXI/7 kl7ixi@attbi.com

Punxsutawney Phil saw his shadow, but as this column is being prepared, spring weather is beckoning. Winter may have put ice on the barbeques and covers on the swimming pools, but QRP club activities didn't diminish much.

The Arizona ScQRPions sponsored their annual Freeze Your B* Off (FYBO) winter field day in February. Winners and stats were to be announced in April.

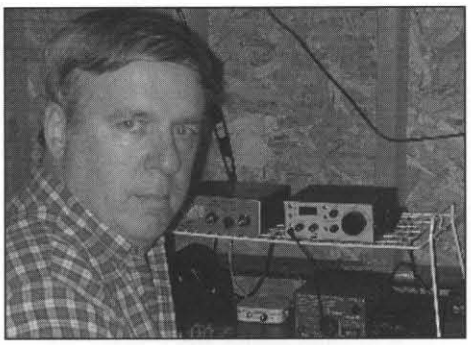
The Minnesota QRP Club attempted to defend their last year's FYBO title with a 2002 temperature multiplier from the 18° F operating site. The club lamented that this year was a mild winter.

The Northern Vermont QRP Society has a tradition, started by one of the founders, Bob (WE1U), of Friday night dinner in Colchester, Vermont at The Hoagie Hut, and then off to Dan's (N1FYL), for solder smoke. The group conducted a QRP Forum with a QRP exhibit at the RANV Vermont State Convention in February.

The DL-QRP-AG Club of Germany is offering a new multiband CW transceiver. The Tramp 8 CW transceiver is a compact hybrid SMD and standard parts kit with plug-in modules.

The Michigan QRP Club sponsored a January CW contest, and has another scheduled for Memorial Day. Rules are at http://www.qsl.net/miqrpclub/rules02.htm.

The New England QRP Club is offering the NEQRP Noise Bridge, a design by Dave Benson, K1SWL, and Seab Lyon,



AA1MY.

The Colorado QRP Club's Annual Banquet in February featured guest speaker, Arnie Coro (CO2KK), of Radio Havana Cuba's program, "DXers Unlimited" Radio Havana Cuba broadcasts Arnie's program twice each week.

April 5th-6th was the date for two major QRP events—Atlanticon in Baltimore, Maryland, and Arkiecon in Ft. Smith, Arkansas. These events draw QRP ops from both coasts and as far the UK. There is coverage elsewhere in this issue of *QRP Quarterly*.

After four years the New Jersey QRP Club is again offering the Rainbow Antenna Tuner kit. This Altoid case-sized kit tunes a 40 meter half-wave end fed wire. The club also sponsored the annual Atlanticon, April 5th-6th. Visit the club website at: http://www.njqrp.org/.

The Cascade QRP Club said their farewells to member Phil Teck, N7OY, in February. A well-known Portland, Oregon area ham and avid QRPer, Phil became a Silent Key September 18th, after a battle with double pneumonia and diabetes.

The Calgary QRP Club is another group that enjoyed brisk winter temperatures this year. They are an informal group that meets once a week on Thursdays. The meetings are a combination rag-chew and build-it/fix-it session, and the club emphasizes building and CW. If you're planning a trip through Calgary, contact David Judd, VE6DV, david.judd@cadvision, for information. The club website is: http://www.cadvision.com/judds/QRPgroup.htm.

The Northern Virginia QRP Club, NOVA-QRP, meets at 11:30 a.m., on the second Saturday of alternate odd months at Mama's Restaurant near Fairfax Circle in Fairfax, Virginia. This informal club encourages visitors to attend and bring any homebrew or kit items to show off, schematics you're working on, pretty QSLs you've received lately, and your best QRP stories.

That's it for this month. Send me your club activities announcements and recaps of events as they occur. A new website? Offering a kit or class? A junior batch of QRPers? Let me know as early in advance as possible in order to meet our publishing deadlines. Pictures of events and projects are encouraged, and always welcome. If you send digital images, I need them large enough for print quality (300 dpi or better if at all possible).

— 72, Mike KL7IXI/7

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QRP Contests

Randy Foltz—K7TQ rfoltz@turbonet.com

This issue of the QRP Contests contains the results from the Holiday Spirits Sprint and the first running of the Top Band Sprint. I hope you had fun in both of them. Included in this issue are announcements for the Hoot Owl Sprint, Milliwatt Field Day, and the Summer Homebrew. Each of these will be a great opportunity for you to work other QRP fanatics, further your two way QRP Worked All States count, and just plain have fun operating.

On the QRP ARCI Contesting web page at http://personal.palouse.net/rfoltz/arci/arcitst.htm are links to the scores of any club contest in 2000 and 2001, sorted by score as well as information on upcoming contests. Don't forget that you can use the High Claimed Scores form at http://personal.palouse.net/rfoltz/arci/form.htm to send me your contest summary. Use either regular mail or e-mail to send me your logs.

Before we go to the results, I'd like to thank K9WIS, Brian Cieslak, who prints and mails the contest certificates. Next time you find him in a contest, or even not in a contest, give him a TU for his hard work. Now, on to the results....

Mark your Calendars:

Hoot-Owl Sprint
May 26, 2002

Milliwatt Field Day
June 22-23, 2002

Summer Homebrew Sprint
July 14, 2002

Holiday Spirits Sprint 2001

The Holiday Spirits Sprint was held December 2, 2001, with a solar flux in the 210s, an improvement over last year's value of 155. Log submission also improved from 57 to 65 reports. Several folks reported that this was their first contest log submission, and I guess this is a good indication of the growing popularity of QRP contests. Perhaps the attraction is the homebrew rig bonus that rewards folks for building their own rig!

Holiday Spirits Sprint 2001
Top Three:

VE5ZX	455,700
N9NE	375,966
N4BP	352,906

Band Winners:

10	KN6YD	1,911
40	K9PX	74,223
15	K3HX	18,900
High Bands	K6III	81,234
20	WA4DOU	79,695

Conditions on the higher bands were good, although the Tennessee QSO Party was a contender in the 40 meter band. So many contests...so little time.

The next running of the Holiday Spirits Sprint will be December 1, 2002. Will you have a new homebrew rig by then?

Soapbox

AA9NF—I used two different homebrew rigs. On 40 meters, I used the OHR explorer. At 2137, I got fed up with TQP and switched rigs to a SWL DSW-20 for 20 meters. **AB8FJ**—Excellent band conditions this evening for the contest. Used the SW rigs at 900mw on 80,40 and 20 meters. **AD1OS/3**—Hmmm...didn't work any Tennessee stations. **AD2A**—15 meters wasn't bad—stayed open right up to dusk here. Almost got KL7 with my 0.9 w and end-fed wire. **AD6GI**—Thanks to each fine operator for their good ears and great patience! I need to work harder to get the rate up where it makes sense. Plans are now formulated. **AL7OK**—First time I worked this contest, had fun. **KØEVZ**—First time ever using a computer for scoring (QRPDUPE). Rig performed excellently as always. Could not have been more pleased with its performance today. Who needs QRO[gg]? **K2JT**—Tried a CQ on 10 meters and AL7JK called me for my first 2xQRP to Alaska! **K3HX**—Another exercise in courtesy and considerate operating. What a contrast to typical contest behavior! **K4UK**—Great fun for my first

Holiday Spirits Sprint 2001

QTH	Call	Score	Pts	SPC	Bonus	Power	Bands	Time	Rig	Antenna
AK	KL7GN	75852	252	43	0	LT5	20,15,10	4	TS570D	TH6DXX @ 60'
	AL7OK	13160	68	12	5000	LT1		2	K1	Tribander @ 40'
AL	KS4L	100152	244	44	25000	LT5	80,40,20,15,10	3	K2	350' horizontal loop
	K4AGT	8920	56	10	5000	LT5	20	1.3	OHR100	GAP Titan
AZ	K7RE	245624	474	68	20000	LT5	40,20,15,10	4	K2	Yagi
CA	W6EU	85330	265	46	0	LT5	40,20,15,10	3	IC761	Tribanders & 40m yagi
	NK6A	85149	227	41	20000	LT5	40,20,15,10	2	K2	C4
	K6III	81234	249	38	15000	LT5	20,15,10	2.5	K2	C4
	AD6GI	48418	154	31	15000	LT5	20,15,10	4	K2	K2
	KN6YD	1911	39	7	0	LT5	10	1.5	FT920	R7 & rotary dipole
CO	W9KV	9312	56	11	5000	LT5	20	4	NorCal 20	136' dipole
CT	N1EI	62525	135	21	20000	LT250	80,40,20,15	4	OHR500	88' doublet
FL	N4BP	352906	602	79	20000	LT5	40,20,15,10	3.75	K2	TH7DXX @ 65'

QTH	Call	Score	Pts	SPC	Bonus	Power	Bands	Time	Rig	Antenna
	K4MF	207480	456	65	0	LT5	40,20,15,10	4		
GA	K4BAI	144774	383	54	0	LT5	40,20,15,10	4		
	W3IRZ	26300	60	15	20000	LT5	40,20,15,10	3	HB XCVR	
	W4JHR	21134	27	6	20000	LT5	80,40,20,15	3	K2	80 m dipole
	KO4WX	18970	69	13	10000	LT1		1.5	K2	80 m loop
	WB6BWZ	3640	52	10	0	LT5	40,20	2	FT817	73' Inv-L @ 40'
HP	HP1AC	665	19	5	0	LT5	15,10	0.2	IC706MKIIG	TA33jr
ID	K7TQ	261560	366	66	20000	LT1	40,20,15,10	4	K2	C4S
IL	AA9NF	49270	187	30	10000	LT5	40,20	4		
	N9RY	15864	97	16	5000	LT5	20	3	K1	Inverted vee in attic
	N9KO	5460	65	12	0	LT5	40,20,15	1		
IN	K9PX	74223	341	29	5000	LT5	40	4	K2	80 m loop
MD	KB3WK	112255	277	45	25000	LT5	80,40,20,15,10	4	K2	3 el yagi, dipole
	W3MWY	19964	124	23	0	LT5	20,15	4	ARGO 556	23' vert wire
ME	KØZK	145048	319	56	20000	LT5	40,20,15,10	4	K2	30' dipole in attic
MI	K8TDM	28715	93	17	5000	LT250	20	4	K2	High Sierra on roof
MO	WAØOTV	1376	86	16	0	GT5	15	1.5	TS530S	Indoor dipole @ 7'
NC	WA4DOU	79695	345	33	0	LT5	20	3.5	FT990	C3SS @ 53'
	WB2QAP	10313	69	11	5000	LT5	40	2	K1	Isotron 40 m @ 15'
ND	KØEVZ	288030	547	70	20000	LT5	40,20,15,10	4	K2	Bazooka on 20, loop on 40, Titan 10/15
NH	KN1H	117020	229	38	30000	LT1	160,80,40,20, 15,10	4		Homebrew 300' end-fed wire
	W1PID	16566	67	14	10000	LT5	40,20	2	DSW-20, -40	OCF dipole
	W1KRT	15948	92	17	5000	LT5		3.5	K1	OCF dipole @ 25'
NJ	W2AGN	137050	249	45	25000	LT1	80,40,20,15,10	4	K2	KT34A, 40 m dipole, 300' loop
	W2BVH	77143	191	39	25000	LT5	80,40,20,15,10	4	K2	80 m zepp @ 25'
	K2JT	50600	103	20	30000	LT1	160,80,40,20,15,10		1.5	Sierra Doublet, long wire
	AD2A	27300	82	15	15000	LT1	40,20,15	2	K2	W3EDP end fed wire
	W2JEK	22394	38	9	20000	LT5	80,40,20,15	1.5	OHR500	Dipole, gnd plane, hertz
	KF2EW	16170	110	21	0	LT5	40,20	2.5	IC746	Windom
NM	K5DI	25872	154	24	0	LT5	20,15,10	3	FT817	TH6DXX @ 60'
OH	WV9N	49388	134	26	25000	LT5	80,40,20,15,10	4	K2	A3S, 40 m dipole
	WB8ZWW	46840	104	21	25000	LT1	80,40,20,15,10	3.5	Sierra	Carolina windom
	AB8FJ	24000	75	12	15000	LT1	80,40,20	3	SW-80, 40,-20+	Random Wire
	NG8S	15551	61	13	10000	LT5	20,15	1.5	K2	G5RV
	N8RN	9639	81	17	0	LT5	40,20,15	1.25	TS570	Attic dipole, half square
OR	KI7Y	20300	116	25	0	LT5	20,15,10	2	FT817	A3S
PA	NA3V	48659	189	33	5000	LT5	80,40,20,15	3	IC756, NW80	130' doublet @ 65'
	N3AO	39992	136	21	20000	LT5	40,20,15,10	2		
	K3HX	18900	135	20	0	LT5	15	4		
	AD1OS/3	16128	128	18	0	LT5	40	4	FT890	G5RV @ 40'
	W3ZMN	11888	82	12	5000	LT5		2	K2	150' doublet
	N3CZB	1554	37	6	0	LT5	20	4	MFJ9020	Indoor loop
SC	W3RDF	114040	265	48	25000	LT5	80,40,20,15,10	4	K2	Quad, Inv vee, long wire
SK	VE5ZX	455700	700	93	0	LT5	40,20,15,10	4	IC736	C31XR, EF204
TN	KK4BE	35664	123	24	15000	LT5	40,20,15	3	K1	Zepp
TX	K5ZTY	72708	229	36	15000	LT5	20,15,10	2		
UT	WA7LNW	79676	254	42	5000	LT5	20,15,10	1.5	K2	272' loop @ 50'
VA	K4UK	115410	290	47	20000	LT5	40,20,15,10	3.75	K2	160 m dipole, trap dipole
WA	N7RVD	91960	257	40	20000	LT5	40,20,15,10	1.6	K2	Tribander & 80 m loop
WI	N9NE	375966	583	86	25000	LT5	80,40,20,15,10	4	K2	80 M CFZ, triband beam
	K9OSC	69232	296	31	5000	LT5	20	3	K2	D4 Rotary dipole @ 20'
WV	KC8GOJ	32048	184	21	5000	LT5	40	4	K1	Delta loop

QRP ARCI contest as a "new" member. A thrill to work KL7GN in the Sprint. **K5DI**—Was fun with Yaesu FT-817 and TH6DXX beam at 60 ft. Glad to work Randy both on 10 and then 20 meters. **K5ZTY**—Only got to work a couple of hours, but found lots of member numbers to work. Band conditions good, even worked some 10 meters. **K7RE**—Very few stations did not have an ARCI member number to offer. Looks like ARCI is getting the word out. Sure was a fast 4 hours! **K9OSC**—Good conditions and super operators. The sprints are the best contests around! **K9PX**—Strange conditions on 40 meters. This contest—only station I heard with a 5 in the call was VE5ZX. **KC8GOJ**—My first solo contest and I'm hooked! Looking forward to my next one. **KI7Y**—Logging problem caused an early end to test for me. **KK4BE**—Forgot about it and missed the first hour. **KL7GN**—Enjoyed the sprint but poor propagation on 20 meters...only 7 QSOs on 20 meters. **KN1H**—I used the SQRPions QRPdupe for the first time and it works OK. Hope it's OK. Contest was very good from our new QTH, worked my first KL7 in 15 years. **KO4WX**—First Homebrew Sprint—strong signals, but not a lot of them. I think an earlier or later time would work better. But love those ARCI contests! **KS4L**—Good contest. Ran into Tennessee QSO Party on 40 meters. **N1EI**—Lots of BC QRM and other noise on 40 meters. Other bands in nice shape. Got our contest manager, K7TQ, in the log for the first time. **N4BP**—Condx fairly good. Usual lack of activity on 10 & 15 meters. Fun sprint! **N7RVD**—Great contest. A real blast. Thanks to all. **N8RN**—I have built several homebrew rigs in the past but my vision impairment has made it difficult to continue homebrewing. I am setting up a special magnification system so that I can renew my homebrewing efforts in the near future. N9NE—One-watt stations from the west coast were S9 on 10 meters here in Wisconsin. I worked three KL7 stations in the first 11 minutes of the contest. **N9RY**—Need to spread out—several stations reply at same time—had great time in spite of 50 kW BC station 3/4 mile away. **NA3V**—Interesting contest. The Tennessee QSO Party had a lock on 40 meters, so most QRP activity was on 80, 20, and 15 meters. **NG8S**—First ARCI contest. Lots of fun. Looking forward to the next event. **NK6A**—That was fun. Working Alaska and Maine plus VE9DX. **W1KRT**—I don't do many contests, but the Sprints are FUN. Was going to use both K1 bands (40 & 20 meters), but 40 meters was busy with the TN QSO Party, so I stayed on 20 meters. Thanks for contest! **W1PID**—Lots of fun. Thanks. **W2AGN**—High Point was being called by KL7GN. Some VERY strong signals on 20 meters. VE9DX and KØEVZ often pinning S-meter with preamp off! Unable to scare up a 160 meter contact. **W3MWY**—As always, a nice contest. **W3RDF**—Great time. Sad there were no signals heard on 160 meters and the Tennessee contest on 40 meters offered a different kind of challenge. Hi, Hi! Good to see many of my old friends on the bands. **W4JHR**—Boy, I realized just how bad I am on CW. Still was a lot of fun. **W9KV**—Picked up contacts while doing other things and had fun. **WA4DOU**—Had fun but wish there was more activity. **WA7LNW**—Only 2 hours operating time when visitors arrived. Good conditions and fun event. **WB2QAP**—My first contest in a long time, even with compromise antenna. **WB6BWZ**—N4BP added Florida to my QRP WAS list. **WB8ZWW**—Heard some stations I couldn't raise, but with 900 mW & a wire antenna was happy to make contacts on 5 bands. **WV4N**—Great fun es tnx to all the patient ops. **WV9N**—Had lots of fun working intermittently. Very patient ops especially the OM that pulled me out for the 80 meter QSO. This is second test that have submitted entry (first was CW-SS).

Top Band Sprint 2001

This year was the inaugural running of the Top Band Sprint. A club member, WB5KYK, Larry Jones, sent me an e-mail in August suggesting a 160 meter contest. He said, "As you know the winter months are approaching, and with that comes the 160 meter season. Randy, there are some of us who play on 160 with QRP and some us really love a challenge and use SSB as well as CW! I know there are a lot sprints that the club puts on, and they are great and a lot of fun, BUT the hours they run are not conducive to 160 meter operation. Why not have a 160 meter sprint, during the week days at NIGHT for the 160 meter operators?"

After a couple of rounds of e-mail, the Top Band Sprint was born.

The 2001 Top Band Sprint was held on Wednesday, December 5th, from 8 PM to midnight local time. This was the first time we have had a contest on other than the weekend, and the first time we have had a mixed mode event. The date was chosen so that folks could check out their stations in advance of the ARRL contest on the weekend, and so we could get some QRO folks to participate as well. Reports indicate that we had success on both counts.

Top Band Sprint 2001
Top Three:

WA7LNW	16,758
W4DEC	16,254
W3TS	15,000

Category Winners:

<1 watt	K2JT	2,350
Mixed Modes	KIØII	2,856
SSB	WB5KYK	2,772

Larry and I started talking about the contest just after the deadline for the October *QRP Quarterly*, so there was not a written announcement of the contest. A total of thirty-three folks submitted logs. This is a sufficient number to have another event in 2002, and it is already scheduled for December 4, 2002. As of now, mid-February, the time has not been chosen. Some have suggested allowing any 4 hours between 6 pm and 6 am local time, while others want to keep the 8 pm to midnight local time slot. If you have a preference, please let me know.

Soapbox

AB8FJ—Wasn't able to match the random wire, so I did the best I could with 5 watts and a fairly high SWR. Managed to work one local station. Will do better for the next time. **AC7A**—Good sprint on a tough band. Noise and QSB the usual 160 meter foes. I lost a few Qs to them. **AE5X**—Had a good time in the contest. I will definitely work to improve my antenna on this band, maybe a horizontally polarized antenna would be better. **KØFRP**—I had my DSP on. With all filters in and DSP, noise was only S-5. My sloper is east for 65 feet, then south for the rest of the sloper. **K2JT**—Tough going, one contact the last half hour. **K3HX**—More great fun! Conditions improved late. I'm in QRN Central between Christmas

Top Band Sprint 2001

QTH	Call	Score	Pts	SPC	Power	Mode	Time	Rig	Antenna
AL	W4DEC	16254	129	18	LT5	CW	4		
	WB4HUX	168	12	2	LT5	CW	1		
AZ	AC7A	6650	95	10	LT5	CW	2	K2	45' top loaded vert
	W7ILW	420	20	3	LT5	CW	1.5	TS430S	Half wave @ 70'
CA	W6EU	4914	78	9	LT5	CW	2	IC761	Half sloper
	K6MDJ	2548	52	7	LT5	CW	3	QRP++	160 m Windom @ 45'
CO	KØFRP	12432	111	16	LT5	CW	3	TS850	1/4 wave sloper @ 70'
	KIØII	2856	51	8	LT5, LT10	Mixed	2	Omni VI	Carolina 160 special
FL	K4MF	945	27	5	LT5	CW	1.5	IC736	Inv-L
GA	W3IRZ	2205	35	9	LT5	CW	2		
HI	KH6B	14	2	1	LT5	CW	1	K2	40 m half wave @ 8'
ID	K7TQ	1092	39	4	LT5	CW	2	K2	Zepp
IL	WT9U	2240	32	10	LT5	CW	0.5	TS930	1/4 wave sloper
IN	W9CC	4081	53	11	LT5	CW	2	Scout 555	Inv vee
MD	W3ERU	1386	33	6	LT5	CW	1.5	TS850S	Inv-L
MI	W8RU	7980	95	12	LT5	CW	1.5	FT1000	Inv-L
MS	WB5KYK	2772	44	9	LT5	SSB	3	TS940S	CW160
NJ	W2AGN	3234	66	7	LT5	CW	2	K2	Inv-L
	K2JT	2350	47	5	LT1	CW	1.5	Sierra	132' long wire
	W2JEK	2058	49	6	LT5	CW	2.25	FT840	155 ' Marconi
	AE5X	1540	55	4	LT5	CW	1.5	FT840	Inv-L
OH	WB8ZWW	735	21	5	LT5	CW	2	Argonaut II	Carolina windom
	AB8FJ	14	2	1	LT5	CW	1	Argo II	Random wire
ON	VE3FAL	980	28	5	LT5	CW	3	FT817	660' long wire
PA	W3TS	15000	100	10	LT250	CW	2	HB superhet	1/8 wave wire tee
	K3HX	3465	45	11	LT5	CW	3.5		
TN	WS4S	14630	110	19	LT5	CW	4	K2	50' vert
	KW4JS	2961	47	9	LT5	CW	3	K2	Folded dipole
UT	WA7LNW	16758	171	14	LT5	CW	4	K2	Inv-vee @ 60'
VA	K4UK	6825	75	13	LT5	CW	2	Omni 6	
WA	W7AWA	3773	77	7	LT5	CW	3	K2	Slanted T @ 50'
	N7RVD	819	39	3	LT5	CW	1	K2	80 m loop @ 24'
WI	N9NE	9639	81	17	LT5	CW	2	K2	Inv-L

lights flashing and normal QRN, I'm also 2 air miles from 50kW K0KA. **K4MF**—Tested new antenna—before was hard to work anyone with 100W, so my 9 QSO's in 1.5 hours was a nice surprise. **K4UK**—Nothing seemed to be going on at the beginning (2000 EST), so I had a nice chat with a fellow FISTS member in WV. Then when I signed with him I found a few folks calling me? Hi! **K6MDJ**—Fun sprint. Some 3s, 4s, and 5s heard. Couldn't make the second hop. **KH6B**—Only NH7D came back to my CQ. That was 8:01 pm local time. Reports were 559/579 across town. Heard 3 mainland signals. Only K7CA was readable. **KIØII**—QRP ops have good ears. Worked most stations I heard, very unlike the ARRL 160 meter contest where it is more like one in four. Was fun and certainly an antenna challenging event. **N9NE**—Kept calling that there BCK station on 1811.5/1812.5 kHz but it was an alligator. **VE3FAL**—Had a great time, look forward to the next top band sprint. First half hour was on 40 meter dipole, no wonder no one heard me, then went to the longwire and voila. **W2AGN**—Fun Contest. Lots of QRN. Let's keep this one on the books, but make the time MAX 4 hours between 8PM and 8AM local. Will allow early birds to get the worm! **W3ERU**—Always fun. **W3TS**—Maybe next year the sprint could be run one week earlier or after the ARRL 160 meter contest. **W7AWA**—Great contest! **W7ILW**—Severe QSB—worked all stations I heard except one. High snow static at times. **W8RU**—Decent conditions, limited operating time, lots of fun! **W9CC**—Enjoyed the sprint. We should do this a couple of times during the winter! **WA7LNW**—Installed inverted vee antenna just before dark. Happy with band conditions and QRP turnout. Great event! **WB5KYK**—Great contest which promotes QRP on 160! Actually had QRO stations reduce power. **WB8ZWW**—Heard a few others I couldn't work. Listened a little later, but heard same stations. Short Windom works on 160 a little. **WS4S**—Band was OK here. QRM could have been much worse. Worked everything I had a chance to call. QRP operators are the absolute best there are. **WT9U**—First time in any ARCI contest. Heard a bunch of people calling CQ Test, and remembered seeing something about it on contesting.com.

CONTEST ANNOUNCEMENTS

2002 *Hootowl Sprint*

Date/Time: May 26, 2002; 8:00 pm to 12:00 pm Local Time. CW only.
Exchange: Members — RST, State/Province/Country, ARCI Number
Non-member — RST, State/Province/Country, Power Output.
QSO Points: Member = 5 points; Non-member, Different Continent = 4 points; Non-member, Same Continent = 2 points
Multipliers: SPC (State/Province/Country) total for all bands. The same station may be worked on more than one band for QSO points and SPC credit.
Power Multiplier:

0 - 250 mW = ×15
250 mW - 1 W = ×10
1 W - 5 W = ×7
Over 5 W = ×1

Suggested Frequencies:

160 m	1810 kHz
80 m	3560 kHz
40 m	7040 kHz
20 m	14060 kHz
15 m	21060 kHz
10 m	28060 kHz

Score: Points (total for all bands) × SPCs (total for all bands) × Power Multiplier.

Entry may be All-band, Single-, High-, or Low-Band. Entry includes a copy of logs and summary sheet. Include legible name, call, address, and ARCI number, if any. Entry must be received within 30 days of contest date. Highest power used will determine the power multiplier.

The final decision on all matters concerning the contest rests with the contest manager. Entries are welcome via e-mail to rfoltz@turbonet.com or by mail to

Randy Foltz
809 Leith St.
Moscow, ID 83843

After the contest, contest send your report by visiting http://personal.palouse.net/foltz/arci/form.htm. Check the web page at http://personal.palouse.net/rfoltz/arci/highclm.htm for 2 weeks after the contest to see what others have said and claimed as their scores.

Milliwatt Field Day 2002

NOTE: You do NOT have to run less than 1 watt to play in this contest! Usual QRP power levels are just fine. However, because this is a piggy-back contest on ARRL Field Day, you need to use their definition of SSB QRP, which is 5 W PEP.

Date/Time: June 22, 2002, 1800Z to June 23, 2100Z. CW, SSB, Digital
Exchange: Same as for the ARRL contest. See the May issue of *QST* for exchange details and full rules.
QSO Points: Same as ARRL rules. Phone counts one point/QSO. CW counts 2 points/QSO. Digital counts 2 points/QSO.
Power Multiplier: See ARRL rules. Multiplier based on transmitter power and power source.
Bonus Points: No special QRP ARCI bonus points. Just use the ARRL ones.
Score: Same as ARRL rules. Total number of QSO points times the power multiplier plus bonus points.
Entry Classes:

One watt or less, one operator
One watt or less,
two operators, one transmitter
Five watts max, one operator
Five watts max,
two operators, one transmitter
Club class

In short— use the ARRL rules and scoring then send me a summary sheet.

Entry must be received within 30 days of contest date.

The final decision on all matters concerning the piggy-back contest rests with the contest manager. Entries are welcome via e-mail to rfoltz@turbonet.com or by mail to

Randy Foltz
809 Leith St.
Moscow, ID 83843

After the contest send your Claimed Score by visiting http://personal.palouse.net/rfoltz/arci/arcisum.htm. Check the web page for 10 days after the contest to see what others have said and claimed as their scores.

QRP CONTESTS ARE FUN!

2002 Summer Homebrew Sprint

Date/Time: July 14, 2002; 2000Z to 2400Z. CW HF only
Exchange: Member — RST, State/Province/Country, ARCI Number; Non-member — RST, State/Province/Country, Power Output.
QSO Points: Member = 5 points; Non-member, Different Continent = 4 points; *Non-member, Same Continent = 2 points*
Multipliers: SPC (State/Province/Country) total for all bands. The same station may be worked on more than one band for QSO points and SPC credit.
Power Multiplier:

0 - 250 mW = ×15
250 mW - 1 W = ×10
1 W - 5 W = ×7
Over 5 W = ×1

Bonus Points: For homebrew gear (per band): Add 2,000 points for using HB transmitter; add 3,000 points for using HB receiver; or add 5,000 points for using HB transceiver.
Suggested Frequencies:

160 m	1810 kHz
80 m	3560 kHz
40 m	7040 kHz
20 m	14060 kHz
15 m	21060 kHz
10 m	28060 kHz

Score: Points (total for all bands) × SPCs (total for all bands) × Power Multiplier + Bonus Points.

Entry may be All-band, Single-, High-, or Low-Band. Entry includes a copy of logs and summary sheet. Include legible name, call, address, and ARCI number, if any. Entry must be received within 30 days of contest date. Highest power used will determine the power multiplier.

The final decision on all matters concerning the contest rests with the contest manager. Entries are welcome via e-mail to rfoltz@turbonet.com or by mail to

Randy Foltz
809 Leith St.
Moscow, ID 83843

After the contest send your Claimed Score by visiting http://personal.palouse.net/rfoltz/arci/arcisum.htm. Check the web page for 10 days after the contest to see what others have said and claimed as their scores. ●●

Milliwatting Without a Beam Antenna

Jim Hale—KJ5TF
kj5tf@madisoncounty.net

Last time the ARRL CW DX contest came around, I took to heart some of the tips and suggestions I received from some of the QRP contest veterans. I worked hard at it, ran up a decent score, and had a blast. That was the 2001 ARRL CW DX contest, and having a 2-element quad on a 70 ft tower added quite a punch to my 750 mW CW signal.

But then 2002 arrived, and another of our famous Arkansas Ozark ice storms has left me without my little beam. My 20M half square was the only high band antenna that survived the weather, although the 40 and 80M verticals made it through okay. The problem here is the same one most everyone has—a lack of spare time simply doesn't allow me to have much in the way of antennas this time around.

For 10 and 15 meters, I still have my mobile antennas mounted on an 8 foot ladder with the 4 raised radials. Using this emergency antenna on 15 meters has resulted in mixed results. Sometimes with 750 mW I can't make a contact, while using 5 watts gets me through, even though most times it takes several tries, and sometimes the full 5 watts won't make it either. My procedure was to always try the 750 milliwatts several times in the clear, with no other callers. If that failed, I'd power the K2 up to 5 watts and try again.

But there is some good news too. Using just 700 to 750 mW and the make do antenna, I was still able to get some new DXCC countries! On 10 meters, LA9VDA, and ES6Q were both worked, and on 15 meters, TS3M fell to my milliwatt signal using just the mobile antenna mounted on the 8 foot ladder.

Notable recent additions to my logs also include KL7Y, J37ZA, SQ0HQ, DL6RAI, S50C, G4BUO, S56M, 9A1A, ZF2NT, MD/DL5AXX, EA8FT, RZ3AA, KH7R, DK3GI, TI7/N4MO, and SP5GRM —all worked with 750 milliwatts and the simple portable antenna described above. G4TSH/P across the pond was a special pleasure to work, and I did it with just 700mW on 10 meters.

On Sunday I drove my XYL to the city, so unfortunately I missed operating the contest from home. But as I waited for her in the pickup truck, I set my QRP+ for 700 mW and made several contacts on 10M, again using the same mobile antenna. It took some effort, but I worked 7L1AAI, and for some reason (their superior antennas?) JH7XGN, and JA7NVF were much easier to log.

So for me the lesson here is that yes, the beam really helps. But if I can do it, almost anyone can make milliwatt contacts with a poor antenna.

—Jim, KJ5TF

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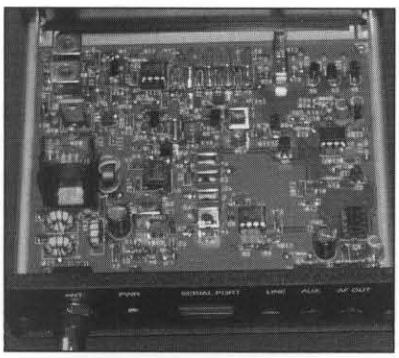
Small Wonder Labs PSK-10

Dave Benson, the driving force behind Small Wonder Labs, has a new kit out, and if it's anything like the rest of his kit line-up, it should be an instant best seller.

This kit is a variation of his highly successful PSK series, and it's aimed at those who want to try PSK on ten meters.

Even though we are not at the peak of the sunspot cycle, ten meters is still plenty hot and it's easy to work DX with low power and minimal antennas. This particular kit should help a lot of New Technicians (and others who want to try their hands at building) enter the digital modes.

Here is the official Small Wonder Labs press release:



This announcement for Small Wonder Labs' new PSK-10 transceiver. This variant of the popular PSK-20 transceiver features several significant changes with respect to the series.

The transmitter strip has been revised to use considerably hotter driver and PA devices. Output power is rated at 3W PEP, and all three development versions built to date have shown a maximum output at 4W PEP. The final amplifier device is a 2SC1971, a 7W/175 MHz device. The receiver has been streamlined with respect to the PSK-20 to cut cost and complexity. It uses an SA612 1st mixer and two front-end tuned circuits.

The serial-port interface has been deleted and replaced with 'VOX' (audio-based) switching, thus eliminating the need for that interconnect to a computer. The interface to the computer consists of two sound card signals: Microphone and Line Out.

This project grows out of the desire to provide an economical means for Tech+ operators to try their hand at HF. The PSK-10 operates on 28.120-28.124 Mhz, compatible with that license class's privileges.

This project is being released in Beta form as of April 6, '02, and near-term quantities are limited. The manual is fairly mature, but will be further augmented with illustrations to better assist newer builders. The manual may now be viewed online at

http://smallwonderlabs.com/PSK10_Manual.pdf

Following feedback from beta builders, the PSK-10 will be introduced into production concurrent with the Dayton 2002 Hamvention.

—73, Dave

Dave Benson, K1SWL
dave@smallwonderlabs.com
http://smallwonderlabs.com
Phone/fax 860-537-8031

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150 QRPers Enjoy Atlanticon

George Heron—N2APB n2apb@amsat.org

Well folks, the fourth year of doing Atlanticon is now history. Man, what a blow-out time it was this time!

About 150 QRPers from all across North America attended—from Gody Siason AC6UV in CA, to Brien Pepperdine VE3VAW in Toronto, Canada! Here's most of the happenings—speaker presentations, special awards, new kit announcements, contests and winners... and everything in between. Read on and enjoy!

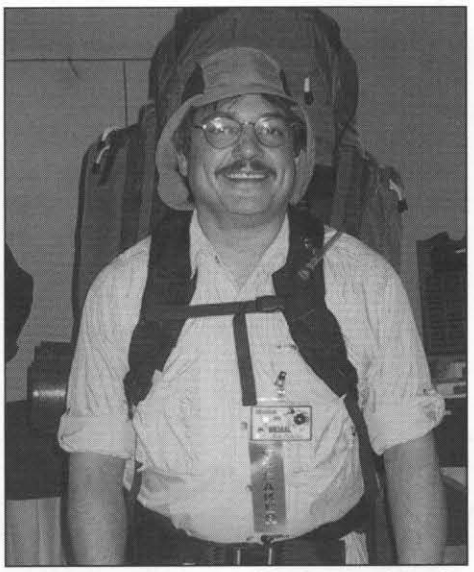
Presentations

Clearly the highlight of the weekend was the full day of presentations delivered on Saturday by the absolutely outstanding staff of QRP speakers: N2CX, NF0R, K8IQY, NA5N, WB3AAL and K1SWL. Many, many, attendees commented that this year's content and value exceeded their best expectations. Rich Arland, K7SZ, did the master of ceremonies duty again this year and kept us all on track with his lively and gracious attitude.

Joe Everhart, N2CX lead off the day with a detailed review of circuit simulation using WinSpice, giving a very practical example with circuits used in his recent designs and kits. Per usual, Joe pulled a quickie on the audience with a clever slide that had everyone holding their breath until the punch line came—whereupon I personally heaved a great sigh of relief. (We'll have to ask Joe to post something on QRP-L about that one.) N2CX's presentation and paper in the Proceedings provide an excellent cookbook recipe of references and examples for anyone wishing to get into simulating circuits to save bench prototyping time and provide more robust designs.

Dave Gauding, NFØR made his first-ever QRP trip east to visit us, and what a presentation he did! In Dave's inimitable style of self-effacing modesty and unsurpassed "QRP operator in the field" knowledge, NFØR dazzled the audience with a detailed review and show of his trailside QRP station—a modified DSW-40 transceiver and St. Louis Quickie portable vertical antenna. I personally have built everything this true QRP gentleman has described since my first meeting him some 4 years ago, and I'm sure that about 150 QRPers will now also be trying out Dave's suggestions and operating techniques.

Jim Kortge, K8IQY returned for his third speaking engagement at Atlanticon, and this guy just keeps getting better and better! Jim wowed the audience with a project he recently designed to help him measure and sort the massive number of crystals he was working on for his 2N2-40 Build Group—over 120 QRPers on Yahoo mail list are building his 2N2-40 Transceiver project step-by-step under his coaching and guidance. Jim's detailed the theory, design and usage of his "Precision VXO" project, and gave a live demonstration of the PVXO in action for the entire audience to see (with the video camera assist of one of the attending QRPers, me!). Each one of us deals with crystals on a frequent basis, and K8IQY's usual technically thorough and understandable discussion of this topic was very well received. (See the "Kit Announcements" section for some great news about this project)



WB3AAL "The Mule" in full backbacking regalia. (There's a QRP rig and antenna in there somewhere.)

Paul Harden, NA5N, returned for his second Atlanticon gig with us and the reception was just superb! Paul delivered a wonderfully down-to-earth presentation about transmitter design, talking about impedance matching between stages, signal levels throughout the transmit chain, MOSFET transistors used in the output stage, and more. He provided some really beautiful diagrams and technical artwork in his printed paper (in the Proceedings) that support and detail all of his discussion. Despite feeling a bit under the weather, NA5N's presentation brought about many rave reviews throughout the day.

Ron Polityka, WB3AAL, aka "The Ninja QRPer," aka "El Presidente" (of the EPAQRP Club), aka "The Mule"...we learned the background of the many nicknames of this high-spirited, enthusiastic and talented field operator. Ron delivered an energetic and show 'n tell-based overview of his adventures of hiking and camping throughout his 20 year QRP history. He provided us all with expert advice and humor, with his comrade and co-conspirator Ed Brenseiser,

WA3WSJ handled the slides of Ron's presentation while Ron trotted in with full hiking garb wearing his 52-pound backpack! Ron had us simultaneously in stitches over his real life hiking experiences and in awe over the beauty one can see while operating on mountaintops along the Appalachian Trail. WB3AAL wrapped by describing the AT Awards he and the EPAQRP group sponsor for all who also enjoy these experiences.

Dave Benson, K1SWL, is the very good and close friend of the NJQRP, and he too returned for a third Atlanticon speaking engagement this year. Dave presented a very useful and eye-opening overview of antennas, their modeling with EZNEC, and clear descriptions of what really happens when you shorten antennas or otherwise compromise on the basic formula of "make it big and put it high." We all have dealt with these compromising situations before, and it was delightful to have it all explained by this master designer in our hobby. Throughout the ensuing evening's activities, conference attendees were commenting to me on the usefulness of Dave's guidance and the value of his paper in the Proceedings—we couldn't agree more!

Each speaker received a nicely engraved plaque from the NJQRP Club in appreciation for their graciously contributed presentation and written paper in the Proceedings. Additionally, each speaker received a spe-

cial navy blue hat embroidered with "Atlanticon 2002" and their name/callsign, courtesy of Pat Arland, XYL of K7SZ. (Any other QRPer may order similarly personalized hats from the Arlands.)

Prizes—Door, Contest and Grand

Those attending Atlanticon this year were blessed with the generosity of many individuals, clubs and companies who donated an absolutely stunning array of prizes. We had so many that multiple drawings were done in between each speaker presentation so that we could share this generosity among all attendees throughout the day. We sincerely thank the following list of donors...**EPA QRP Club** (calendars, R8 antenna, 6m beam, 2m beam), **Ft Smith QRP Club** (Tuna Tin 2 kits, Marker Generator kits), **NoVaQRP Club** (PK-3 Keyer kit, WM-2 Power Meter kit), **NorCal QRP Club** (Capacitor Kit, Toroid Kit, BLT Tuner Kit, QRPp subscription), **QRP ARCI** (*QQ* back issues), **NJQRP Club** (PSK31 Beacon Kit, Tip Tapper Paddle, Rainbow Tuner Kit, Islander Amps & Pad Cutters, QRP Homebrewer subscription, Manhattan Starter Kit, K8IQY Precision VXO Kit), **Graham Firth G3MFJ** (Peak Atlas Component Analyzer), **Small Wonder Labs** (PSK-10 Kit), **Mike Czuhajewski WA8MCQ** (*QRP Quarterly* subscription), **Gil Kost/American QRP Mfg Co** (paddles), **Greg Lawrence W2JWM/QRP Books** (ARRL Antenna books), **Larry Pryzborowski K3PEG** (solder roll), and **Elecraft** (price reduced K1-4).

John Sielke, W2AGN was the lucky winner of the fully-loaded 4-band Elecraft K1 Transceiver kit.

Special Awards

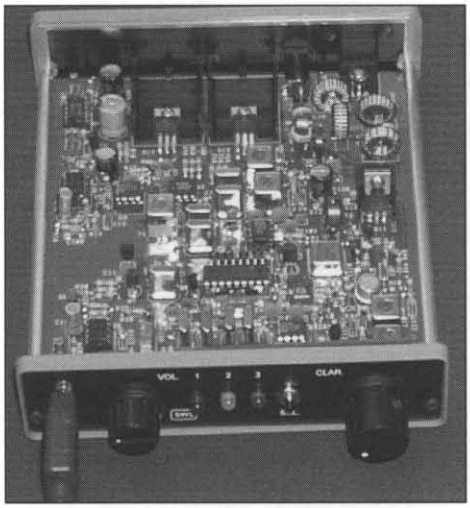
As is characteristically done at this time of year, the climax of the NJQRP Club's efforts during the preceding 12 months, is the two prestigious awards presented to very deserved individuals.

The "Most Significant Contribution to QRP" award plaque was presented to Jim Kortge, K8IQY [see the story on page 31].

The "NJQRP Lifetime Achievement" award plaque was presented to Tony Colaguori, W2GUM. At an age of more than 82 years, Tony "The Gummer" W2GUM continues to play a more active role in the NJQRP than most of it other members combined. Tony provides a steady stream of innovative mechanical and electronic ideas, antennas and activities to the club membership that serve as inspiration and models for club projects. W2GUM is an inveterate tinkerer and machinist. Even during the winter months at his Florida-based home he is constantly thinking up new gadgets and working them out in his personal machine shop in the trailer park. Tony and his absolutely lovely wife, Clara, live in Long Branch, NJ, and together they drive the 1.5 hours to nearly every monthly meeting the club has in order to "be with the boys." The NJQRP membership is very pleased to present W2GUM with a beautifully-engraved plaque and a generous gift certificate to Harbor Freight, his favorite "toy store." Thank you for being there for us Tony!

Kit Announcements:

Small Wonder Labs—During the lunch break, while the Atlanticon attendees sat around munching on sandwiches, chips and sodas, Dave Benson, K1SWL, gave a delightful overview of things going on in his workshop over at Small Wonder Labs. We'll let Dave elaborate more on the detail himself, but in summary, he described (1) the "Son of DSW Transceiver" (that's not the real name, of course, but because of crazy parts shortages in the industry he's redesigned this very popular small portable monobander); (2) a new 75m SSB transceiver based on a specialized "Villager Radio" project he has going on for a third-world country; and (3) his now-officially introduced PSK-10 Transceiver for operating PSK31 on 10m during the extended solar cycle. Great stuff continues to pour out of the labs of SWL for us all. Thanks Dave!!

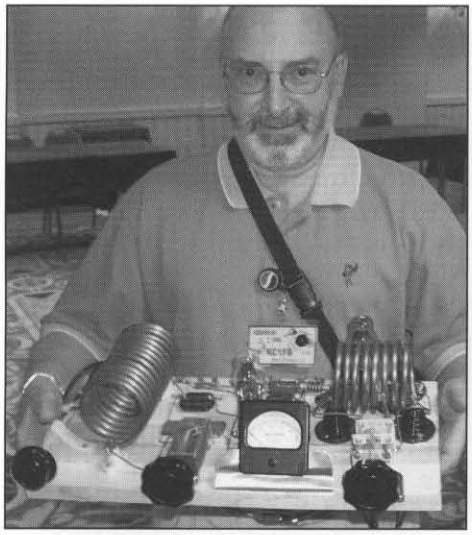


Here's a look inside the Villager, a 75M SSB transceiver from SWL.

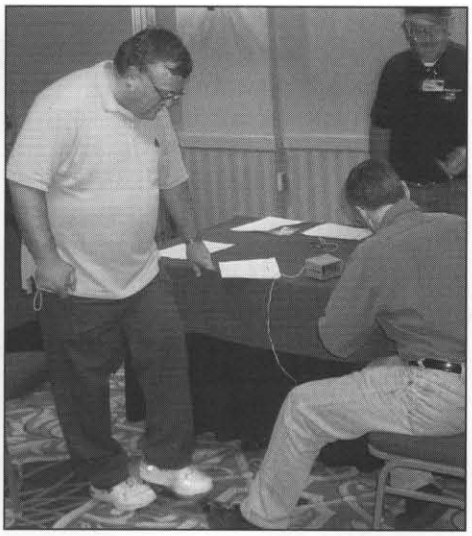
Precision VXO kit—Jim Kortge, K8IQY, graciously agreed to collaborate with the NJQRP in turning his specialized crystal measurement equipment (i.e., the subject of his presentation) into a full-blown and reproducible design called the Precision VXO. The NJQRP helped fund that productization and is now providing a kit of all parts, a gorgeous red pc board, all board-mounted controls, a Ten-Tec enclosure, and a very comprehensive construction and operating manual all, at a very attractive price. This kit is useful in crystal measurement and sorting, as an extremely precise crystal oscillator, as a way to bend a given crystal to place it directly on the desired frequency, as a local oscillator in a radio, or as a direct conversion transmitter unto itself! We had approximately twenty-three kits all prepared for sale at this weekend, and they were quickly sold out on Saturday evening. We're awaiting more of the controls hardware so we can begin shipments. Starting on Monday April 8, see the NJ web page http://www.njqrp.org/pvxo for more details. (Note: Enough interest was shown in the companion "crystal test fixture" that Jim used to sort the crystals for the 2N2-40 Group, and the NJQRP will also be kitting that project in the very near future in order to further enhance the usefulness of this K8IQY-designed test equipment.) Thanks Jim!

Low power balun kit—The NJQRP has the pleasure of working with an ever-growing base of designers from all over the country, and has recently coupled with Chas Greene, W1CG, to productize his low power balun design.

Not your everyday balun, this one has been meticulously optimized and tested to ensure top performance at QRP power levels. Chas is an excellent engineer and has described the theory, design considerations and construction detail in the companion manual that will be of great value to all who build and use the balun. In another day's time you can see photos and technical detail on the NJQRP website at http://www.njqrp.org/balun. Chas also authored an article concerning this project in the next issue of QRP Homebrewer, coming to subscribers this month. Many of the Low Power Balun Kits were sold on Saturday evening at Atlanticon, and we have plenty of stock for new incoming



Jim, KC1FB shows off his winning entry in the Bulding Contest, a fine example of the "art" of homebrewing

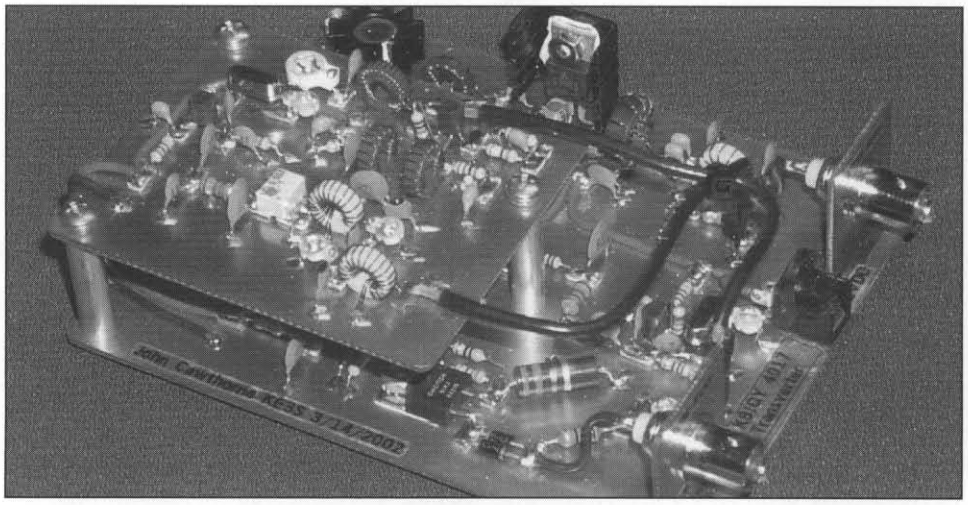


"It's all in the ankle," says Mike, WA8MCQ, and Charlie NU3N, winners of the QLF Contest.

orders. Again, see the club website for ordering details tomorrow. Thanks Chas!

Serial sender kit—Another designer who has graciously agreed to team up with the NJQRP in productizing his design is David Ek, NKØE. Dave is the developer of a contest logger program called "GOLog" for the Palm PDA, and he recently designed a PIC-based serial interface to allow the GOlog program to connect to one's transceiver in order to automate the CW contest exchange. Additionally, the user can plug in a paddle to manually transmit the exchange. We've designed a small pc board and kitted the design, providing all parts, enclosure and a construction/operating manual. The kitting was not quite complete by the time of Atlanticon, and we didn't have any kits on hand that weekend. Kits will be ready to ship soon, and orders can be placed now. See the club website for al the details http://www.njqrp.org/serialsender. Thanks Dave!

Badger infrared add-on kit—As all Atlanticon attendees now know, we designed an "expansion port" into the Badger smartbadge project. On the lower part of the Badger pc board, there is a 7-position row of pads that will allow a small board to be plugged into a pin header used at these pads. This 1" ˜ .75" board contains two surface mount chips: an EEROM memory IC and an infrared transceiver IC (The IR XCVR chip has an infrared LED and detector, similar to what is used in television remote controls). When the add-on board is plugged into the Badger, and when the correct software is loaded (v2.x), the smartbadge will send its callsign via the piezo and visible LED per normal, *and* via the infrared LED. If the Badger "sees" another Badger's callsign with its IR detector, it logs it into the EEROM memory. Thus two people wearing Badgers that electronically exchange callsigns in this manner have record of the "eyeball QSO." Later on, for a more permanent record of the eyeball QSOs, the owner of the smartbadge may download the accumulated callsigns in memory to a laptop of Palm PDA similarly outfitted with an IR port (as many computers are these days). This simple and low-cost project can be great fun at a club gathering, hamfest, etc. Allan Owen, WA3OWT, had been working fervently on the project leading up to Atlanticon, however we ran out of time to complete the project in time for the weekend. We expect to have the kit available in May, and full details, including pics of the prototype IR-AOK, are at the club website http://www.njqrp.org/ir-aok .



Another homebrew work of art is this "4017" transverter built by John, KE3S.

QLF Contest

During Friday's "QRP social" evening part of the weekend, Joe Everhart, N2CX, conducted a fun "QLF Activity," wherein pairs of QRPers teamed up to send CW on a large, makeshift key and code practice oscillator...using their left foot! One guy transmitted a crazy message, with all sorts of "handicaps" thrown in, while the other received. Then the roles reversed. The copy was graded and winners were announced: Mike Czuhajewski, WA8MCQ, and Charlie Powers, NU3N. What a riot! Each guy won a N2CAU Tip Tapper paddle.

Building Contest

There were so many great entries of homebrewed equipment and customized Badgers! I can't recall them all, but photos are posted on the website so everyone can view the craftsmanship displayed. The grand winner of the Building Contest, as judged by N2CX and K1SWL, was Jim Francoeur, KC1FB. Jim's winning entry was a homebrew tube transmitter with some gorgeous copper coils in the output tank circuit. Runner-up winners were John Cawthorne, KE3S, Dave Gauding, NFØR, and John Stratton, AA3SL. Each of these fine homebrewers received a prize for their achievement.

Badger Contest

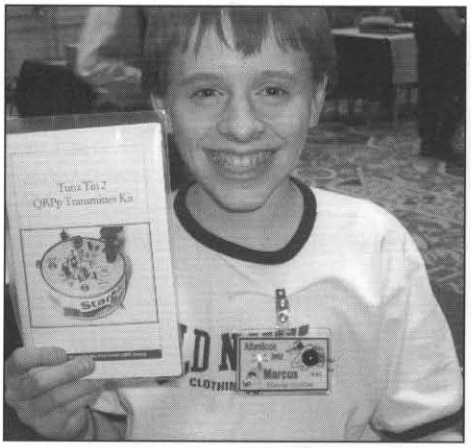
In a manner only we can achieve at

Atlanticon, the Badger contest was the wild and crazy event of the weekend! This contest was based on the fact that everyone had a "special mode" built into the program running in their smartbadge that could only be turned on by a secret combination of mode settings. We informed everyone how to turn on this special mode (select mode D then immediately select mode J) and all the Badgers then began sending the respective callsign and a special 2, 3 or 4 character code, over and over. The special code represented the position in a paragraph of text, followed by a character (letter or number) that belongs at that text position. For example, my code was "N2APB 182O" which indicated that the letter O should be placed at position 182 in the paragraph of text. A worksheet was passed out containing blanks at many of the character positions in that paragraph, and for the next 20 minutes, with over 150 Badgers repeatedly sounding callsigns and codes, the QRPers wandered around putting the other persons' badger to their eye and copying the code letter onto their worksheet. Man, if you can imagine being out in a field during the late summer evening hours and hearing how loud hundreds and hundreds of crickets can be, you'd have a good idea of how the room sounded for those 20 minutes... wild!

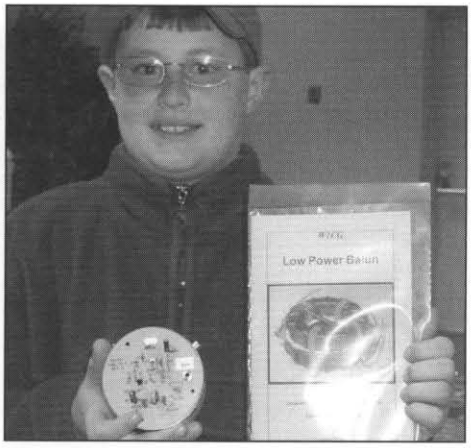
The winners of the contest were: Joe Stratton, W3JBS, Gerry Jurrens, N2GJ, John Straton, AA3SL, Dave Gwillim, KB2TQX, and Marcus Gwillim (not yet a ham!). Each of the winners received a prize. (The Straton and Gwillim father/son teams were really quite amazing!)

Proceedings

The Atlanticon Proceedings (an expertly written collection of author papers), were attractively printed, spiral bound and presented to each QRPer in attendance of the Atlanticon weekend. Only those who attended were entitled to receive the Proceedings; however others unable to make it to Atlanticon this year have the opportunity to purchase the extra copies we still have on hand for $15. Copies are limited, there will be no more printings of this material, and the articles will not appear anytime soon in other QRP magazines. We sincerely thank the speaker/authors for the opportunity to present their material for others to enjoy. (Note: The Proceedings were provided as a benefit to those who made the effort to attend Atlanticon. Those who pre-registered, but unable to attend, are not entitled to receive free copies of the Proceedings—they have already received the reduced price Badger kit without having attended Atlanticon.)



Marcus Gwillim placed 5th in the Badger "Special Code" contest—and he's not yet a ham!



Benjamin Williams holds his prize from the Building Contest—a TT2 that was the kit award from last year.

Atlanticon Staff

The effort to put on an event such as the Atlanticon weekend extends far beyond what one or two individuals can do by themselves. Joe and I are very proud and appreciative to have had the active participation of ten club volunteers who took care of all the logistics for the weekend completely freeing us up to be the club ambassadors and event sponsors. These volunteers who made Atlanticon happen are: Frank Novicki, K2PG, John Cawthorne, KE3S, John DeGood, NU3E, Mike Korejwo, KB3HMR, Allan Owen, WA3OWT, Bryan Williams, AA3WM, Jan Medley, N0QT, Ed Lyon, N4LRR and Michael Bower, N3NMR. There were countless times when we needed something done immediately and I'd tap one of these folks on the shoulder and they'd hop to make it happen. These are the real behind-the-scenes heroes for events such as this. Additionally, and even more personally, I wish to thank Dave Porter, AA3UR, for being the Staff Captain for the whole Atlanticon team. Dave has been my right arm during the months leading up to Atlanticon, taking care of kitting, planning out the details of all the logistics, and then making it all come together during the weekend itself. Without Dave, Joe and I wouldn't be nearly as effective in making the Atlanticon weekend happen, nor would we be able to accomplish what we do for the NJQRP. A sincere thank you Dave!

Mark Your Calendars for Atlanticon 2003— March 28-29

It's never too early to plan on having the time of your QRP life! God willing, next year's Atlanticon will be held on March 28-29, 2003.

—72/73, George Heron, N2APB

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The Atlanticon staff, looking justifiably proud of their work. From the left: AA3UR (captain), WA3OWT, NU3E, KB3HMR, N2CQ, KE3S, N2APB, N2CX, N4LRR, Benjamin Williams, K2PQ, AA3WM and N3NMR.

QRP ARCI is now taking membership applications and renewals via credit card—*online*—using the **PayPal** system. In fact, we prefer it—this is true for all applicants—worldwide! Simply go to the club website: **http://www.qrparci.org/us2signup.html** and follow the instructions. Be sure to select the appropriate button for the area of the world you reside in (per box below).

PayPal replaces all previous methods of payments for non-US hams, except that you may always send your payment directly to Mark Milburn, our Treasurer. ***Funds must be drawn on a U.S. bank and be in U.S. dollars.*** Make checks out to: QRP ARCI.

If mailing your application (if renewing, it helps to send in the mailing label from your *QQ*), send it to:

QRP ARCI—Mark Milburn, KQØI
117 E. Philip St.
Des Moines, IA 50315-4114

TIPS: Use the Online Member Lookup feature to keep track of your membership status—check: **http://www.qrparci.org/lookup.html.** Update your member data at: **http://www.qrparci.org/**

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(THE FOLLOWING IS OPTIONAL AND IS NOT RELEASED TO OTHERS)

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COMMENTS _____

_____

THE LAST WORD

The *QRP Quarterly* invites readers to submit original technical and feature articles as a service to fellow QRP enthusiasts. Although the *QRP Quarterly* cannot pay for submissions accepted for publication, it will acknowledge, with thanks, authorship of all published articles.

Due to space limitations, articles should be concise. Where appropriate, they should be illustrated with publishable photos and/or drawings.

Full articles should go to any of the volunteer editors for review. Information for columns should be sent directly to the column editor. See the page 3 for addresses. Submit technical and feature articles with a printed copy and a copy on disk, if possible. ASCII text is preferred. Photos and drawings should be camera-ready or in TIFF or JPEG format. Other formats can be used with prior approval.

Technical and feature articles should be original and not be under consideration by any other publication at the time of submission to *QRP Quarterly* or while the *QRP Quarterly* is reviewing the article. If you contemplate simultaneous submission to another publication, please explain the situation in a cover letter.

Material for possible use in *QRP Quarterly* should be sent to only one of the editorial volunteers, not to several at the same time. The *QRP Quarterly* editors and columnists will transmit the submission to others on the staff if it better fits another category. Material cannot be returned unless accompanied by sufficient postage.

Accepting advertisements for publication in *QRP Quarterly* does not constitute endorsement of either the product or the advertiser.

The act of mailing a manuscript constitutes the author's certification of the originality of the material.

Opinions express are those of the authors and do not necessarily represent those of the QRP ARCI, it's officers, Board of Directors, staff or advertisers.

The *QRP Quarterly* will occasionally consider reprinting articles previously published elsewhere if the information is especially useful to members of QRP ARCI. If your article has been published, include the name of the publication and the issue it appeared in. In all such cases, the *QRP Quarterly* will obtain permission to reprint from both the author and the original publication, and will acknowledge the source of the material.

The *QRP Quarterly* will occasionally print information first appearing on QRP-L after obtaining the author's permission and ascertaining that the information is not scheduled to appear in another publication.

 ●●

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Our K1 transceiver just became a 4-bander! With its small size, low current drain, and 5-watt+ output, the dual-band K1 was already a great rig for home or field operation. But we've taken the K1 to a new level with our KFL1-4 option, which covers 40, 30, 20, and your choice of 17 or 15 meters–all on a single plug-in module. Adding the internal auto-tuner (KAT1), internal AA battery pack (KBT1), and wide-range tilt-stand (KTS1) makes the K1 a truly "trail-friendly" radio. For more details on the K1, as well as on the K2 all-band, 15-watt SSB/CW transceiver, please visit our web site.

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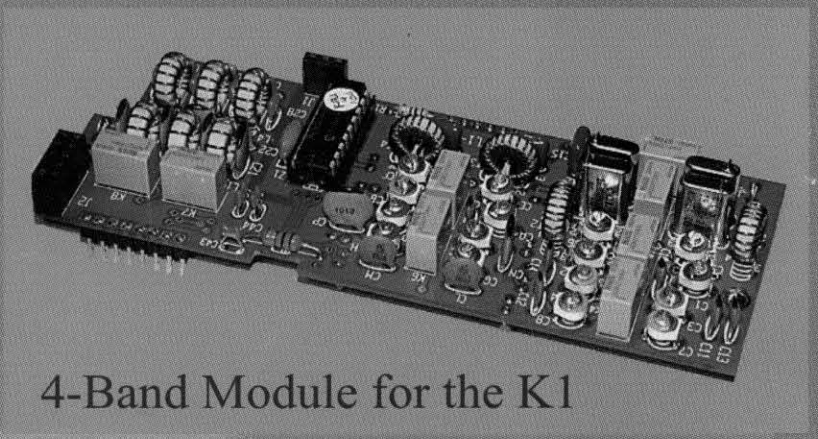

4-Band Module for the K1

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