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April 1999 Volume XXXVII Number 2

The cover photo this month is from Mark Gilger, WB0IQK showing some fine homebrew construction (clockwise from bottom): (1) Small Wonder Labs Green Mountain 40m transceiver with built-in straight key, audio filter and battery, running 900 mW, (2) SWL Green Mountain 30m transceiver running 900 mW, and (3) LDG Auto Tuner.

The QRP ARCI is a non-profit organization dedicated to increasing world-wide enjoyment of QRP operation and experimentation, and to the formation and promotion of local and regional QRP Clubs throughout the world.

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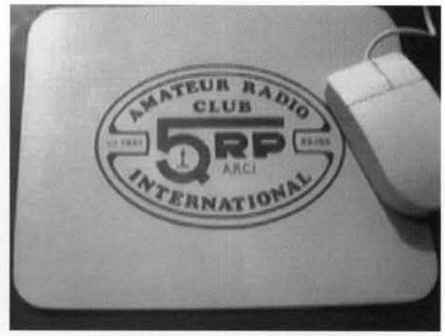
The QRP-ARCI TOY STORE



QRP-ARCI Coffee Mug

This is the **official** coffee mug used by top QRP Fox Hunters, contesters and casual operators found near the normal QRP Frequencies. Kelly Green on White and the Logo on both sides. (Coffee, tea or milk not included.)

New for 1999!

These new QRP-ARCI patches are fully stitched, black on white. They measure 3-9/16" wide X 2-1/2" high oval, and can either be ironed on, or sewn on the finest evening

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From the Editor

George Heron, N2APB

Well, everyone loved the larger January QQ issue so the editorial staff is pleased to bring yet another large issue chock full of QRP articles of reviews, construction project and operating topics. Major features this time include a homebrew Differential GPS Receiver – extremely useful when going QRP in the field – and part 5 of LB's excellent series on Link Tuners. This issue marks the return of WO3B's "Milliwatting" column, and a review of a wonderful new contest logging program from our friend WB2QAP. Elecraft's K2 transceiver references abound these days, and the April issue of QQ is keeping up with this hot topic.

Guest Editorial

This month we feature **Jay Miller, WA5WHN,** publicity officer for QRP ARCI. Jay is plugged into many varied issues in the QRP community – issues discussed on the QRP-L mail list, as well as those in club activities around the country. He offers some observations about code licensing, technology advances, modern homebrewing and more. And note Jay's final recommendation … good advice indeed!

"The 'L' & the Attitude" – Jay Miller, WA5WHN

I would guess that over 70% of the QRP-L group can either walk, bicycle {VE3JC} or mobile away from their home QTH with a complete VHF/HF station. In fact, I would also say that over 50% of the people on the QRP-L have built their own radios. I would bet that the majority of us, on the "L", belong to NorCal, ARCI, NJ-QRP, plus a multitude of other QRP organizations.

OK, where am I going with this? Look around, we have new people coming into this part of the hobby. KL7GU, an 80 year old youngster from Anchorage; and KD5DCN, who is upgrading his license because he was impressed with the independence of this group during FYBO. It's someone's mentoring that had brought them into the hobby. Look at the list subjects. QRP is growing.

I had recently worked KH6CC on 10 SSB qrp mobile {Uniden HR2510 & 6 feet whip.) He told me that if he hears someone say "QRP" or "Mobile" in the pile up, he stands by for them. FYI: within 45 minutes, I had worked KL7IFP in Ketchikan, AK, KH6CC, and CX8FP, all via QRP mobile 10 SSB. All of them had told me that they stand by for or give priority to QRP stations. I observe the same results when I am using QRP RTTY too.

Hmmmm, independence of this group? Look around you. At least once per week, if there is not a QRP category in a contest, or a major QRP contest taking place, someone or some group of people on the "L" are heading out to a remote location. Did anyone read the latest edition of "QST", with the crew from Kansas, who had set up camp in an igloo in the Colorado Rockies? Where is N4BP headed for this weekend's contest? How about the K1OJ crew?

Look at all of the new entrepreneurs in the QRP part of the hobby. That first step towards economic independence is a tough one. Why would they gamble their lively hoods on a hobby? How many of you can fix your own radios now?

Why would a small group of people spend their spare time, designing & sorting parts for new kits ? Why are Atlanticon, Pacificon, Ft. Tuthill & Dayton QRP events growing?

If I were to grep, cut & paste some of the gripes & complaints from the Microsoft MCSE/MCP/MSD certification publications, and deleted the subject line, you would think they were talking about Amateur Radio. The tests are too easy, too many people don't know anything that have their certifications. I have heard all of this before.

How many people build computers from kits today? I can remember when the computer hobby was in it's infancy. Most of the US hams were forbidden from using ASCII on the air, but quite a few had built their own computers from kits (IMSAI, ALTAIR), written very primitive logging programs, and in one case had written a piece of code to convert ASCII to morse code. This was 1975 and I had heard that CW was dead. Oh, the complaints about incentive licensing was raging then too. The Old Timers complaining that when they had taken their exams, they had to draw the schematics.

Why do people continue to learn Tewa or Hebrew? (These are two very ancient languages.) The descendants of the Tewa had become the "Code Talkers" from WWII. If you get a chance, visit the "Code Talkers" museum in NE Arizona.

The US Navy still signals ship to ship using semaphores, which is an ancient & secure form of communications that dates back to the Roman ships.

There is a large ancient basalt rock ("Mystery Stone") that was engraved in Phoenician/Greek/Hebrew that was inscribed over 2,500 years ago that resides ~.75 mile south of the Rio Puerco & Highway 6, ~ 12 miles west of Los Lunas, NM. If we had the attitude about those ancient languages that we currently see about "Morse Code", that rock would have been just another rock. I wonder if that is what our descendants will be thinking about Morse Code, IPV6, et al.

Relax, it's a hobby, enjoy yourself!

72,

Jay, WA5WHN Albuquerque, NM

e-mail: jaywa5whn@juno.com

Build a Differential GPS Receiver

by Jim Bixby *email: bix@san.rr.com*

Introduction

This document describes the hardware component of a differential DGPS beacon receiver. The receiver can receive DGPS beacon transmissions in the marine beacon band (285-325 kHz) and demodulate the transmission to extract the digital data stream with the DGPS information. A microprocessor takes that data, and outputs SC104-format digital data to a "DGPS-ready" GPS receiver at 4800 or 9600 baud. Receiver status and the decoded Station ID are displayed on a 16x2 LCD display.

Design Goals

- High performance: Low noise, High sensitivity, Excellent adjacent channel and image rejection
- Buildable from parts available to hobbyists (All of the components can be purchased from Digikey or Newark)
- Parts cost of less than $100 (somewhat exceeded this cost)

Specifications:

- Power: 10-16vdc, 35 ma, plus LCD backlight current (50 ma)
- Operation: Manual.
- Receiver: 285-325 khz, in 1 khz steps, controlled by UP and DOWN pushbutton switches. Receiver input noise: about 3 nv/root hz. Sensitivity: better than 10 uv. Output: SC104 serial data, selectable to be 4800 or 9600 baud
- Building this receiver is not for the inexperienced.

Block Diagram

The receiver block diagram is shown in **figure 1**. The receiver can use a loopstick antenna or a short vertical whip, and the input can be provided directly to the RF Amp block, or through an Active Antenna Preamp, which is almost identical in design to the RF Amp. Both are 3-pole filters with a small amount of gain, low input capacitance, low noise, and high input impedance.

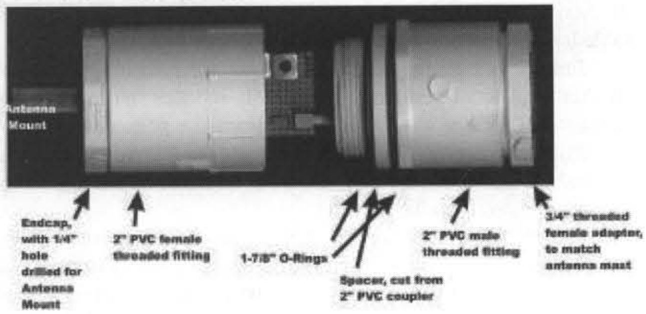
After bandpass filtering and gain, the signal is fed to dual-conversion FM receiver, with the first IF frequency at 122 kHz and the second IF at 3 kHz. A very low frequency was chosen for the second IF to facilitate achieving a narrow bandpass filter for the second IF filter, and to make the FSK deviation of the input signal relatively larger compared to the carrier frequency, at the input to the FM demodulator to ease demodulation. The 1st local oscillator is synthesized, and the 2nd local oscillator is obtained by dividing down the processor clock.

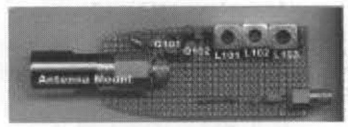
The output of the receiver's limiter is fed to an FM demodulator which locks onto and demodulates the FSK signal and converts it to a digital signal. The demodulated digital data stream is then supplied to the PIC 16F84 processor, which performs bit, word and frame synchronization, outputs data, and controls, monitors and displays receiver status on the LCD display.

Active Antenna Preamp

Figure 2 shows the schematic of the Active Antenna Preamp. The antenna input signal goes to a jfet-input cascode amplifier. The input noise is about 2-3 nv/root hz and input capacitance is about 3 pf. This preamp should be located right at the base of a whip antenna. The source impedance of an electrically short whip antenna (short compared to a wavelength) is equivalent to a low impedance source fed thru a series capacitor of about 10 pf per meter, so a voltage divider is formed between the antenna capacitance and the amplifier input capacitance. Thus, the longer (and larger in diameter) the whip, the larger the antenna capacitance, and thus the smaller is the signal loss due to the capacitive divider. In practice, a one-meter antenna should be fine for most uses. I selected a Radio Shack 8-foot whip for use on my boat.

Active Antenna Preamp





The antenna preamp is built on a small piece of vector board, and fits inside a housing made from 2" PCV pipe components. The preamp is held in place by a single 1/4-20 bolt which passes thru a right-angle brass plumbing fitting attached to the board, and out the top of the antenna housing. An antenna mount (Radio Shack 21-950) is screwed onto the bolt, and the mount provides a 3/8-24 threaded base for standard 3/8" whip antennas, such as a 102" fiberglass whip (Radio Shack 21-905) or a 39" stainless steel whip (Radio Shack 21-952). Large stainless steel washers are used above and below the top cap of the housing to increase strength.

The bottom cap of the antenna mount is a 3/4" female threaded adapter, which fits standard marine antenna mounts. The output cable is fed thru the bottom hole of the housing and thru the mast mount. After installation, RTV can be used to provide a weather seal.

The preamp is powered by 8vdc provided by the antenna cable from the receiver. The supply voltage is filtered by C106/C107, and supplied to the input cascode stage.

The filter in the preamp is a 3-pole design whose bandpass covers the marine beacon band. The nominal frequency response is shown in figure 5.1.

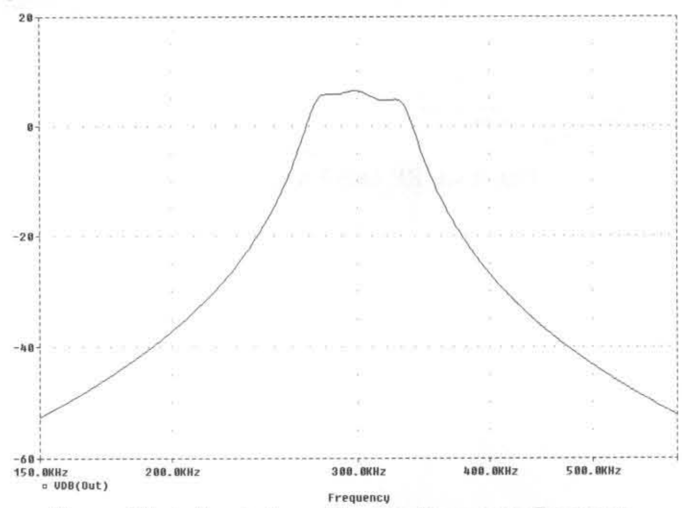


Figure 5.1 Active Antenna Preamp Frequency Response

Filter tuning for both the Active Antenna Preamp and the RF Amp (the designs are almost identical) is best done with a sweep generator, with the horizontal axis of an oscilloscope driven from the sweep output so that it represents frequency. Even better would be a spectrum analyzer with a tracking oscillator. Tune the filter for -3db points just outside of 285-325 khz, and a passband response which is reasonably flat.

RF Amp

The RF Amp (in **figure X**) is very similar to the Active Antenna Preamp. The antenna can be connected directly to this amplifier, and the Active Antenna Preamp eliminated altogether, as long as there is no cable length between the antenna and the receiver.

Jumper W1 on the schematic allows for providing 8vdc power to the Active Antenna Preamp. L4 greatly reduces the input impedance, so leave this jumper out if you are not using the preamp.

Jumper W2, when installed, increases the RF Amp gain by about 6 db, and is provided for use on weak signals, when the antenna is connected directly to the receiver.

Figure 6.1 shows the RF Amp frequency response. The upper trace shows the response when the jumper for C3 is in place, and the lower trace shows the reduced gain when the jumper is not present. Figure 6.2 shows the frequency response of the Active Antenna Preamp and the RF Amp combined. Because the receiver's image frequencies fall within the AM broadcast band, this filter response was chosen to insure that no broadcast band signals would interfere with the DGPS receiver.

The result is overkill, and to save a bit in component cost, two of the six inductors could be eliminated by using 2-pole filters in each section rather than 3-pole filters. To do this, remove the middle inductor-capacitor combination in each circuit and replace with a 1500 pf capacitor. For the RF Amp, replace R4 and R5 with 14k resistors instead of the values shown. Figure 6.3 shows the resulting combined frequency response of the Antenna Preamp followed by the RF Amp, when two coils are used for each rather than three.

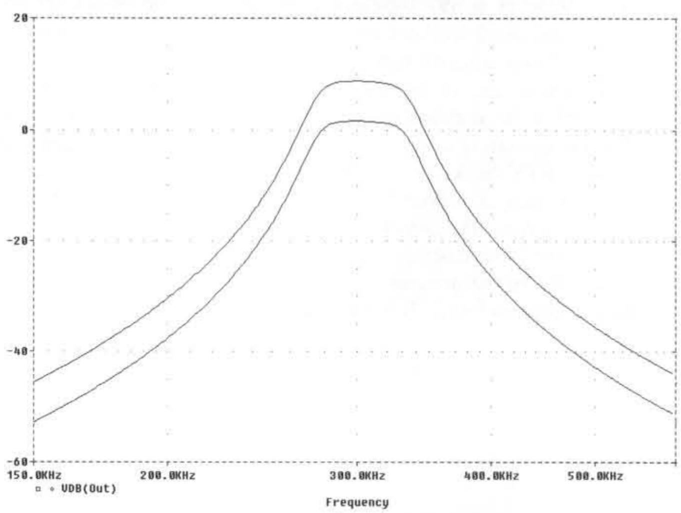


Figure 6.1 RF Amp Frequency Response

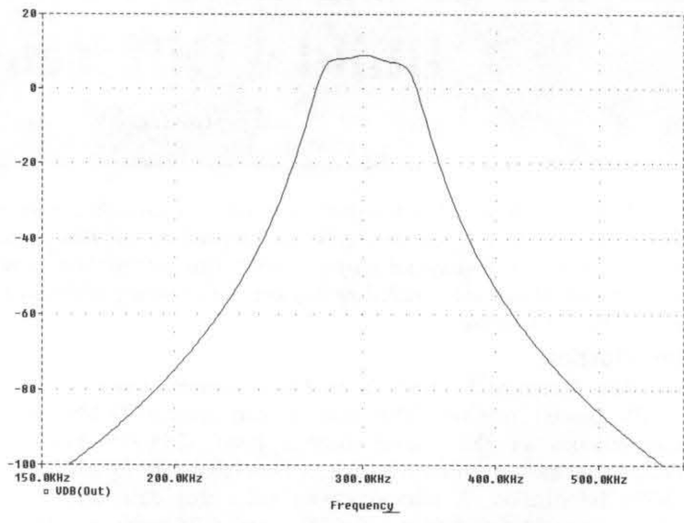


Figure 6.2 Combined Active Antenna Preamp and RF Amp Frequency Response

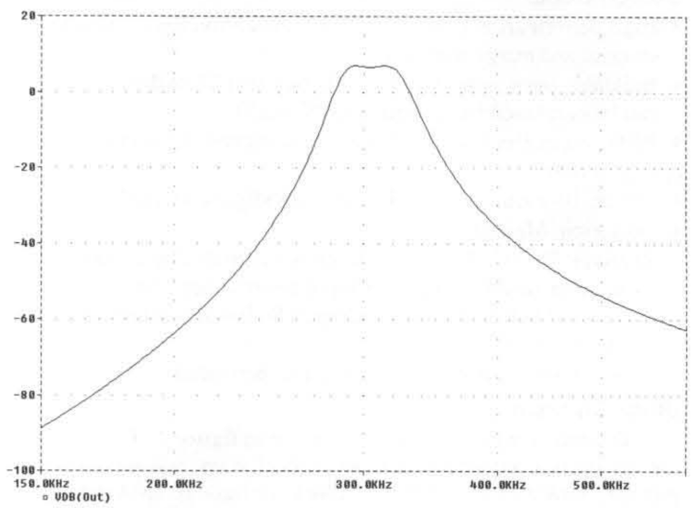


Figure 6.3 Combined Response, Two Coils per Amplifier

Receiver

As shown in **figure X**, this is a dual-conversion FM receiver based on a Motorola MC3362 receiver chip. The RF input is applied to the 1st mixer. The other mixer input is the 1st LO (local oscillator), which is on the MC3362 chip, and whose frequency is controlled by L5 and dual varactor diode D1. A frequency synthesizer chip on the Processor schematic phase locks the first local oscillator to the correct frequency, and U3A-U3B form the loop filter for the phase lock loop. Capacitors C12,C13, C15 and C16 provide attenuation of the 1khz PLL reference frequency. Tuning range for the first LO is 410-450 khz (ie, 125 khz above the receiver frequency).

The output of the first mixer is bandpass filtered in the 1st IF Filter, at 122 kHz. Figure 7.1 shows the filter response of this filter, which is easier to tune than the RF filter: basically, just tune the filter for maximum response at 122 kHz. During development, I found that while trying to listen to the DGPS beacon transmitter on Point Loma, CA, at 302 khz, I had a problem with noise generated by my PC at 300 khz and about a factor of 20 larger than the beacon I was trying to receive. The design of the first IF filter is the successful result of a long effort to receive the desired signal even in the presence of such a strong, local interfering signal. It is probably more than is needed, and one could eliminate one or two of the filter stages with little impact on performance in most situations.

The first IF filter design uses CMOS inverters as analog gain blocks. Each inverter, if biased to it's linear region, has a gain of about -30, and thus these inverters are very useful as very low power, simple gain blocks. You can probably substitute a 74C04 for the MC14069, but do not try to substitute an HCMOS component such as the 74HC04. The gain is much to high and the bandwidth much too large, and they invariably oscillate.

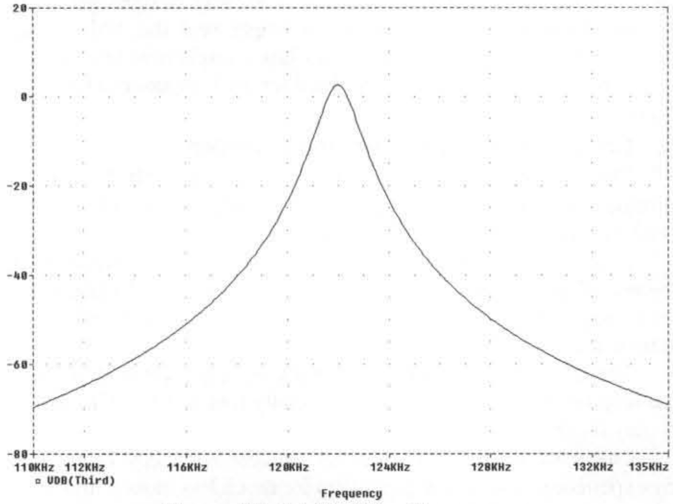


Figure 7.1 1st IF Filter Response

The output of this filter is fed to the second mixer, whose LO input is at 125 kHz, obtained by dividing the 4MHz processor clock. The output is bandpass filtered by an active filter tuned to 3 kHz. The capacitors marked 10 nf in this filter are critical, and capacitors with a tolerance of 2% or better should be used (available from Digikey). The frequency response of the second IF filter is shown on figure 7.2.

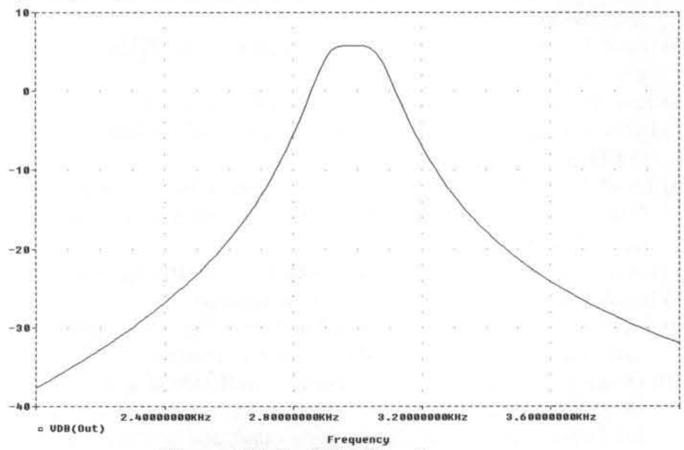


Figure 7.2 2nd IF Filter Response

The output of the second IF filter is fed to a limiter on the MC3362, which amplifies it to a 4v p-p square wave at the Detector Out pin. The MC3362 has circuitry to determine the signal level based on which limiter stage goes into saturation, which is used to determine if an input signal is present or not. Resistor R6 controls the detection threshold -- adjust it so that the receiver shows no input signal when tuned to empty channels, and shows the presence of a signal when tuned to a beacon receiver. The resulting signal CarrDetect is fed to the processor for display on the LCD.

PLL Detector

The schematic for the FM demodulator is shown in **figure X**. The DGPS signal is a very narrow band FSK signal, with deviation proportional to the bit rate. This circuit accepts the 3khz limited carrier signal from the Receiver, and phase-locks a 3khz oscillator to it. The voltage used to control the PLL oscillator is the demodulated signal. To convert this analog voltage to a digital signal, the top and bottom peaks are found by U5D and U5C respectively. From this, the voltage corresponding to the mid-amplitude point is found (resistors R43-R44) and that is used by U5B operating as a comparator with a small amount of hysteresis. U3C is present simply as a buffer, to provide the data signal to the processor.

At 100 bits per second, the signal at U5A output (pin 1) will be about 1/2 volt peak to peak. At 200 bps it will be about 1 volt, and at 50 bps it will be about 250 mv.

Resistors R41 and R42 limit the charging current for the peak detectors so that the peak is determined by averaging several peaks together, and the discharge resistor (R43 plus R44) sets the decay time constant to tens of bits.

PLL adjustment is accomplished by adjusting R34 so that the VCOout pin on U4 is at 3 khz when the VCOin pin is held at 2.5 volts.

Processor

Processor.wmf shows the processor block, which contains the actual processor, the local oscillator synthesizer, and the LCD interface. The processor chosen is a PIC16F84. The processor clock (4 MHz) is generated by an oscillator block on U6, the frequency synthesizer. Jumper W5 allows disconnecting the clock to the processor to allow in-circuit emulation.

Operation is controlled by switches S1 and S2, the UP and DOWN pushbuttons. A single press moves the frequency up or down in 1 kHz steps. The frequency and synchronization/data quality status is displayed on an LCD, which has two rows of characters, with 16 characters per row. I chose an Optrex 16x2 display with LED backlighting, but any LCD display based on the Hitachi HD44780 controller of size 16x2 or larger would work fine.

There is provision for a third switch in the hardware and software, named MODE. This switch is not implemented in this design.

The first local oscillator for the receiver is controlled by U6, a dual PLL chip of which only one section is used, so a single PLL chip could be used instead. The synthesizer in turn is serially programmed by the processor. See the MC145162 data sheet for more programming information.

The second local oscillator is generated by dividing down the 4MHz crystal oscillator. U6 provides an output which divided by four, at 1 MHz. This is divided by 8 by U7 to create the 125 khz second LO.

Jumper W4 allows selection of the output baud rate. At power-up, the processor reads this jumper, and uses that to set the output bit rate at 4800 or 9600 baud. It is read only at power up, so to change baud rates, it is necessary to power down and back up, or press Reset.

To provide parallel data to the LCD, PORTB on the processor does double duty. It is configured as an input port to listen to the receiver status and switches, and then turned into an output port to drive data to the LCD. Because the LCD has internal pullup resistors, it was necessary to add U8 so that the LCD data would be received by a high-impedance circuit. If a processor such at the PIC 16C63 is used instead with more I/O pins, U8 can be eliminated, as well as many of the resistors on the schematic near U9.

A typical LCD display when the receiver is locked is shown below:

```
302k  ID SICBWFP
102b 262 +++++++
```

302k	designates the receiver frequency as 302 khz	
100b	indicates the input signal is at 100 bits per second	
ID	is a label for Station ID, which appears below it (262 is the Station ID for Point Loma, CA)	
S..P	Labels:	
S:	Synthesizer Lock Status.	+:Synth is locked
I:	Input signal detected	+:Signal detected
C:	Carrier Lock	+:FM Demod is locked
B:	Bit Sync	+:Processor is in bit sync
W:	Word Sync	+:Processor is in word sync
F:	Frame Sync	+:Processor is in frame sync
P:	Parity	+:Last parity bit checked was good

10. PLL Design Information

The receiver employs two PLLs: two for the first LO synthesizer, and one for the FM demodulator. The phase detector gains (Kd), VCO gains (Kv) and additional loop gains (A) for each are given below:

PLL	Kd	Kv	A	N	f-ref	Type
1st LO	0.4	63.7k	15	410-450	1 kHz	Active
FM Demod	1.6	730	20	4	3 kHz	Passive

(Kd in volts/radian, Kv in Hz/volt)

In both cases, additional poles are added to the loop filters to filter out the phase comparator sampling frequency, so the loop time constants have been adjusted from those which are computed by a PLL design program to compensate for the presence of the additional pole(s).

N is the value of any divider which divides down the VCO output, ahead of the phase comparator input which is at the reference frequency f-ref. Kv values shown are at the VCO Output which is at N times f-ref.

11. Comments on Antennas

As noted in the description above, this receiver will work with a short whip antenna or with a loopstick antenna. The whip antenna has been adequately covered above, and is nothing more than a length of wire. If buying a whip, do not buy antennas which are base loaded, spiral wound, or which contains words like 'trap' or 'coil' in their descriptions. You just want a simple whip antenna.

The loopstick antenna can be a very attractive choice for backpackers and similar applications. It is small and efficient. And loopsticks have excellent rejection of electrostatic noise from any nearby electrical equipment, which the whip antenna does not. The primary disadvantages of the loopstick are that it is more difficult to build, and it has a null in its pattern which cannot be avoided. Hence, a loopstick is not a good choice for fixed mounting on a boat.

To build a loopstick for a single frequency, determine the frequency of the beacon you wish to receive. Buy a ferrite rod (Amidon is a good source) -- buy the biggest rod you want to afford. Amidon sells a ferrite rod which is about 7" long and 1/2" in diameter for about $15. Next, wind the entire rod with a single layer of small magnet wire, like 32 or 34 guage wire. Now you need to find a capacitor to place across the loopstick to form a resonant circuit. Start with any value, like 100 pf. Get an oscillator, and take the output into a loop of wire near your loopstick, and tune the oscillator to find the frequency of maximum output from the loopstick. If this is above the desired frequency, add capacitance until the desired frequency is achieved. If below, reduce capacitance or remove turns of wire to achieve the desired result. Once you get within the marine beacon band, final tuning should be done with the antenna in its final physical configuration, and wired to the receiver, so that receiver input capacitance is being accounted for.

Comments on Design Modifications

A few variations on the design have already been mentioned above, such as reducing the number of inductors in the front-end amplifiers or in the first IF filter.

Below are some further comments on modifications:

Processor: If you use one of the 28- or 40-pin PIC processors, the extra I/O pins would allow the LCD data to be driven from a dedicated port, eliminating U8. Also eliminated would be most of the resistors near the processors which are there to provide for multiplexing of the use of PORTB. If a 16C73 were chosen, the built-in A/D converters would allow measurement of the maximum and minimum values of the input data (top of C31 and top of C32) -- the difference tells you the FM signal amplitude and hence the bit rate. This would be a good way to determine bit rate, rather than the hunting process used by the current design in software.

Also, a larger PIC with a UART would allow a NMEA control signal to be received from the GPS receiver, so that the GPS could control the frequency of the DGPS receiver. Finally, a larger PIC with more program memory would allow implementation of the MODE switch, so that the receiver could, for instance, automatically hunt for a beacon transmission.

For the very experienced builder, a much better and cheaper first IF amplifier can be built. If the first IF frequency is moved to 200 khz, then 200 khz ceramic resonators can be used as filter elements. These resonators have very high Q, and must be individually adjusted with a shunt capacitor. I found the resonators from Digikey could be tuned with 300-400 pf of capacitance. Thus, a filter at the first IF frequency could be built with sufficient selectivity to eliminate the need for the second IF filter. However, such a design would be very difficult to duplicate, which is why I chose conventional tuned circuits for this design.

A similar approach would be to move the first IF frequency very high, like to 6 MHz, and design a crystal filter for the first IF. In that case, the RF Amp and Active Antenna Preamp designs get simpler because the image frequencies are no longer near the AM broadcast band, and the second IF filter becomes just a single pole lowpass filter. Again: better and cheaper, but very hard for the inexperienced builder to duplicate.

13. Comments on Parts Cost and Selection

The file PartsList.xls is an Excel spreadsheet with detailed parts information, including order numbers and single-quantity prices. Note: I make no claim as to the accuracy of this list!

If you have a well-stocked junk box, you can of course save a fair amount of the project cost, especially for resistors and capacitors. I have called out 1% resistors for the project, but most can be 5%, or even some nearby value.

The LCD in PartsList has LED backlighting. If you shop around, and drop the backlighting, you can generally find a 16x2 LCD character display for about $6-$7.

I included the cost of front panel switches in the cost estimate -- in my experience these can be purchased for much less money from a local electronics surplus outlet, like Gateway or others.

Initial Debugging and Tuning

This section describes a sequence for initially checking out your receiver after you have built it.

1) With no ICs installed, verify that the voltage regulators are producing +5v and +8v
2) Install U2, and verify that this active filter has the correct frequency response and gain
3) Install U3, and tune the IF filter for max output at 122khz. Verify the gain to be about 1.
4) Tune the RF Amp to achieve the correct frequency response.
5) Install U4, and with 2.5 volts applied to pin 9, adjust R34 so that pin4 (VCOout) is at 3 KHz
6) Install U1. Apply 2.5 volts to pin 23, and adjust L5 so the 1st LO Out pin (pin 20) is at about 430 khz, corresponding to a channel frequency of 308 khz.
7) Install U6. Verify that the crystal oscillator is operating, at 4 MHz.
8) Install U5, U7, U9, U8, and connect the front panel.
9) Verify that the LCD comes up, and that the up and down pushbuttons move the LCD display up and down in 1 khz steps.
10) Observe that there are pulses, spaced 1 millisecond apart, at U6 pin 13. (Indicates the LO Synthesizer is working properly). Press UP and DOWN to move the frequency around, and observe that the LO 1 frequency is correct (122 khz above the displayed frequency).
11) Observe that U7 pin 9 is a 125 khz square wave.
12) Observe that U3 Pin 2 has very little noise, and moves up and down with switch presses in small steps.
13) At this point, the receiver should be working. Connect an antenna to the receiver. If you are in a metal building, tape a wire to a window. You should be able to tune the receiver to your local beacon transmitter, and the LCD display should in short order stabilize on the bit rate display, achieve bit sync and word sync, then show good parity, and finally after 5-10 seconds show frame sync. A few seconds after that, the station ID should appear on the display (sometimes this process can take a long time, up to minutes, depending on signal quality).
14) Adjust R6 so that the incoming signal indicator ('I' on the LCD shows a minus on frequencies with no signal, and a '+' for frequencies with a signal. Note: there may be noise present which causes a signal indication on some 'empty' channels -- this is unavoidable.

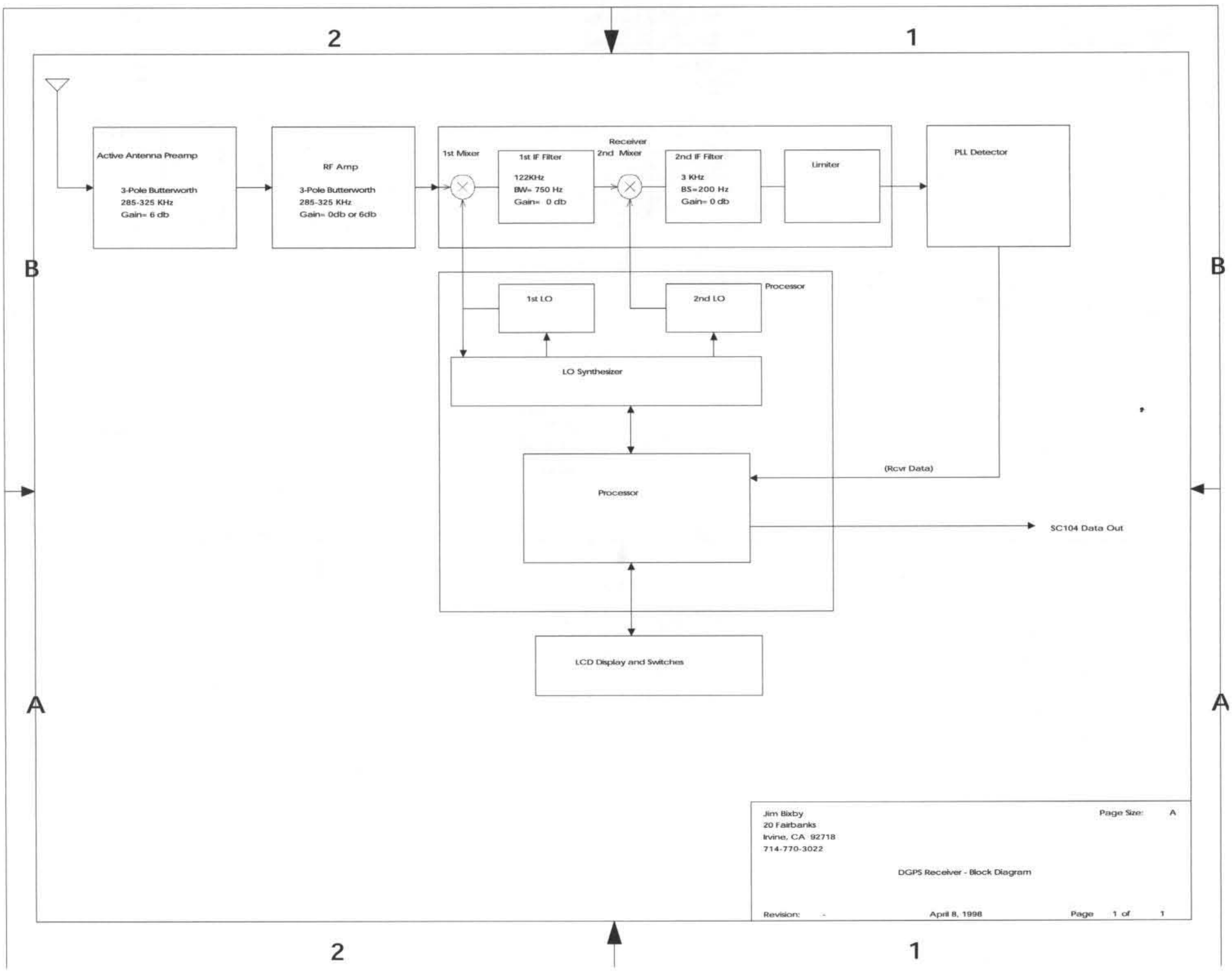
15) Verify that there is serial data at the SC104 output which your GPS receiver can read. Note that this output is generated irrespective of the receivers notion about being in sync, so your GPS receiver may determine the station ID well ahead of this receiver.

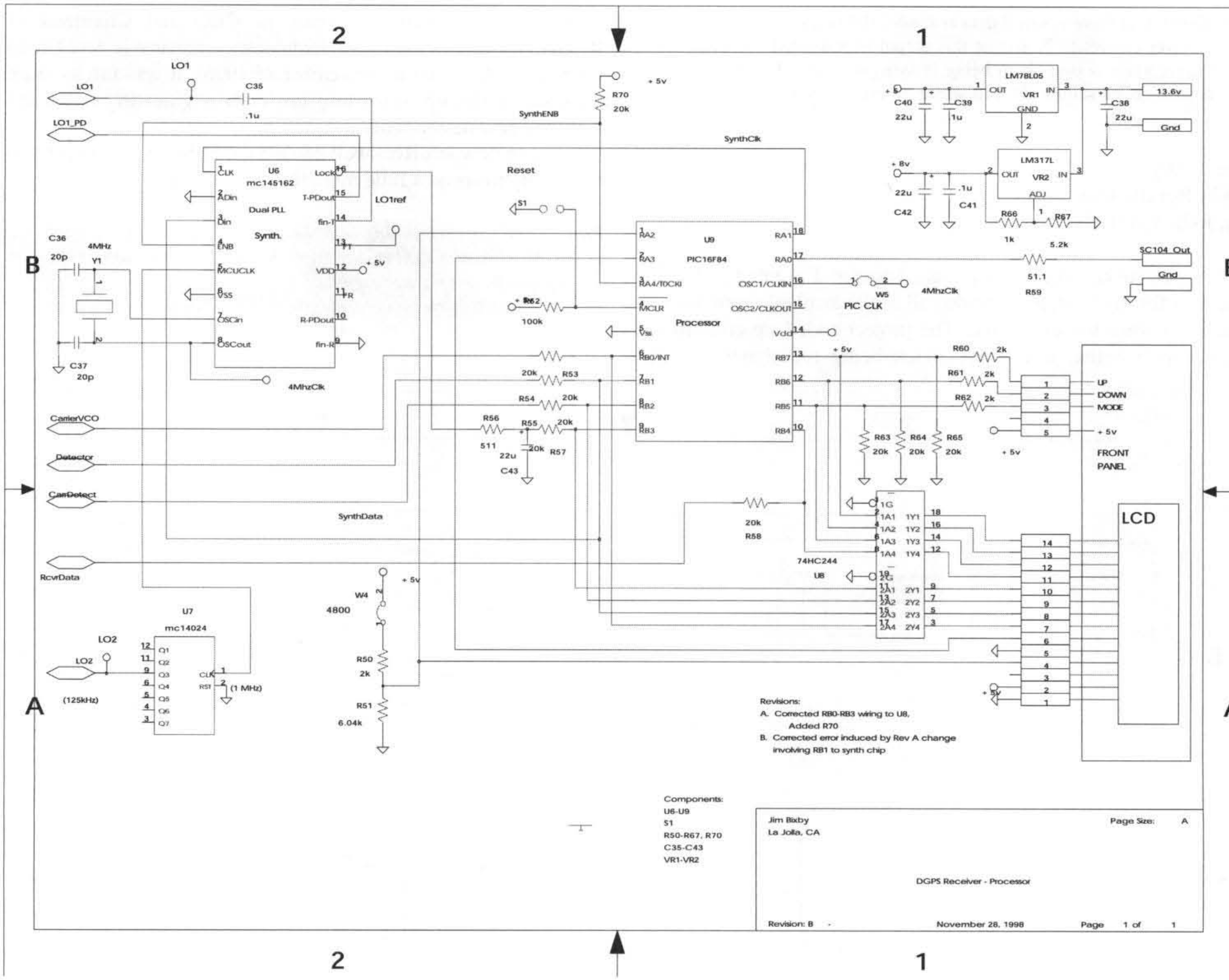
Jim Bixby
7878 Revelle Drive
La Jolla, CA 92037

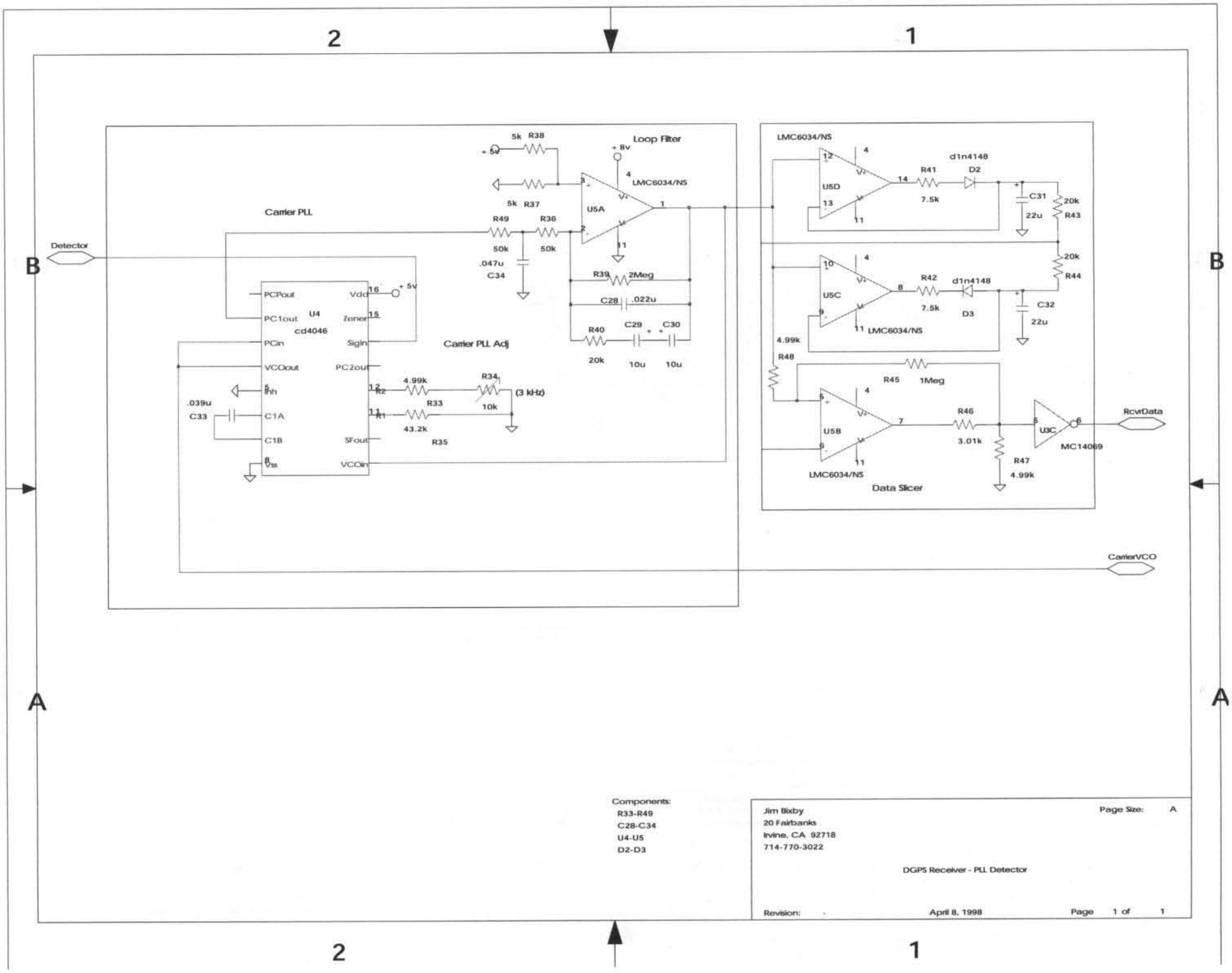
I got sucked into this project because I wanted a DPGS receiver for my boat, and decided all of the available commercial receivers were too expensive. The project ended up consuming about six months, with every block being redesigned several times. After spending 13 years as CEO and Chairman of Brooktree Corporation (a semiconductor company in San Diego we sold to Rockwell in September of 1996), it was fun to reach back and dredge up all my long neglected engineering skills, and learn the new design tools.

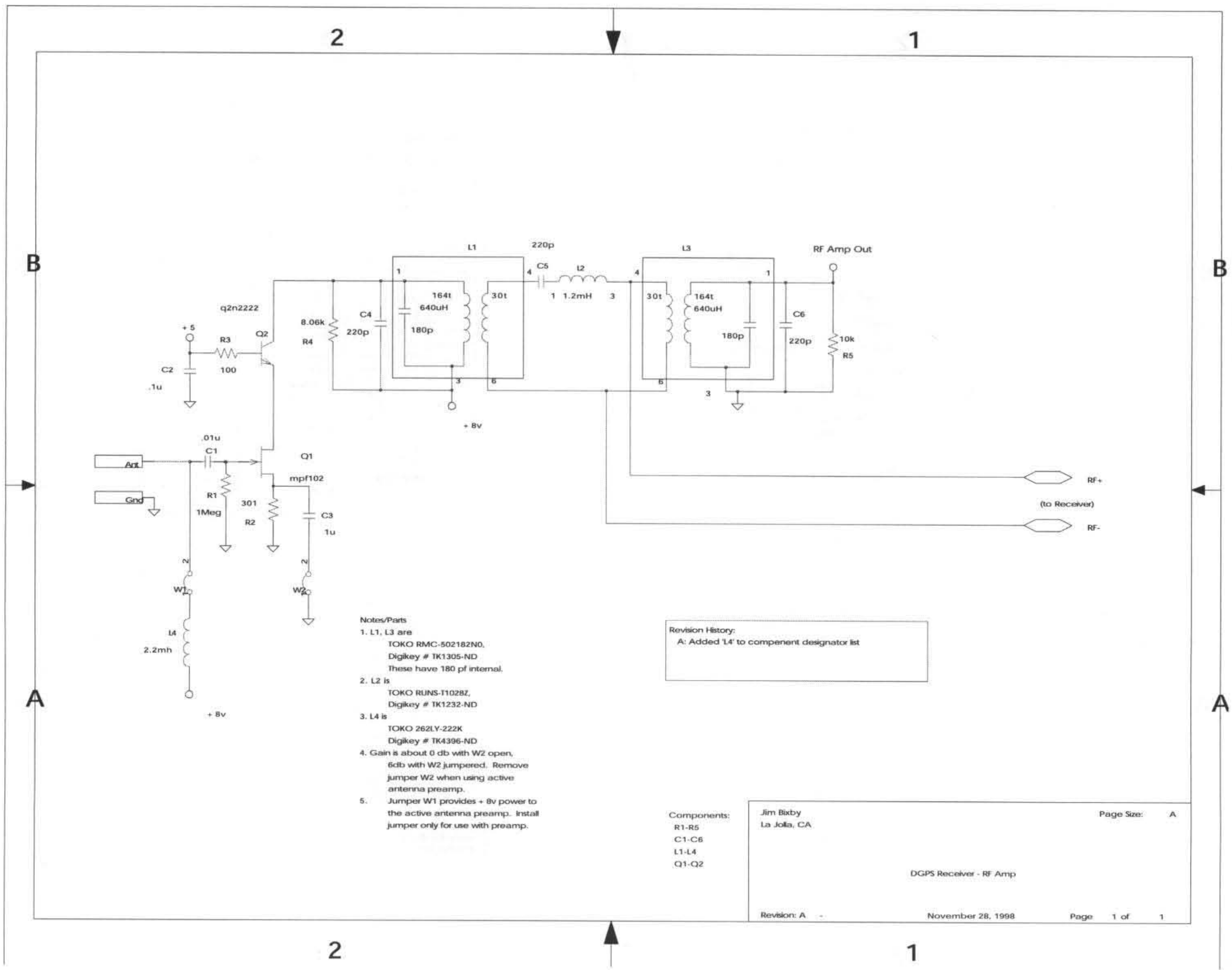
I have now left Rockwell and am exploring new things to do and trying to spend a little more time on the boat.

Part 2 of this article, dealing with the software design, will be published in the July issue of QRP Quarterly. For more timely information on Jim's project, visit his website at: http://home.san.rr.com/bix/DGPS_Project.htm

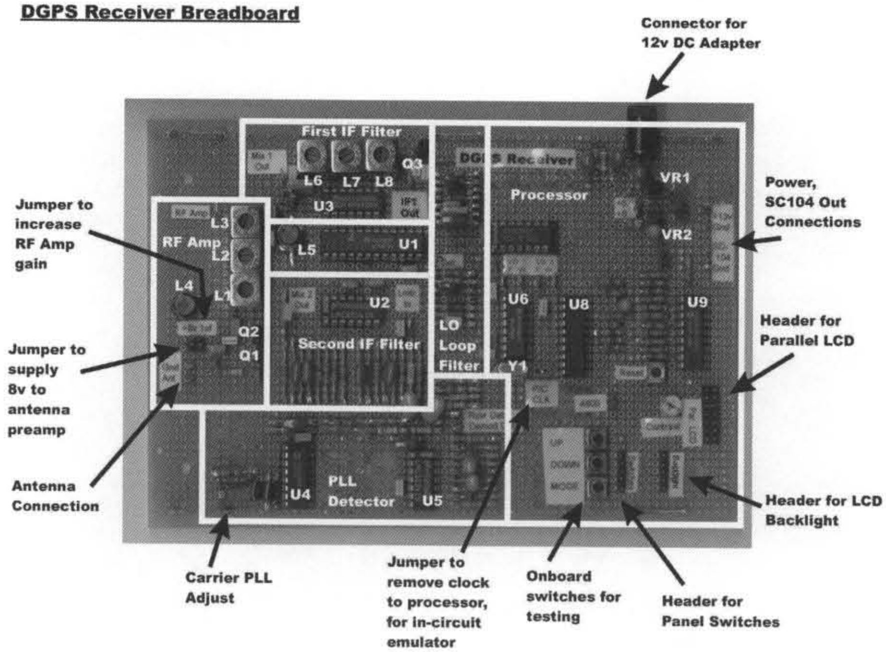


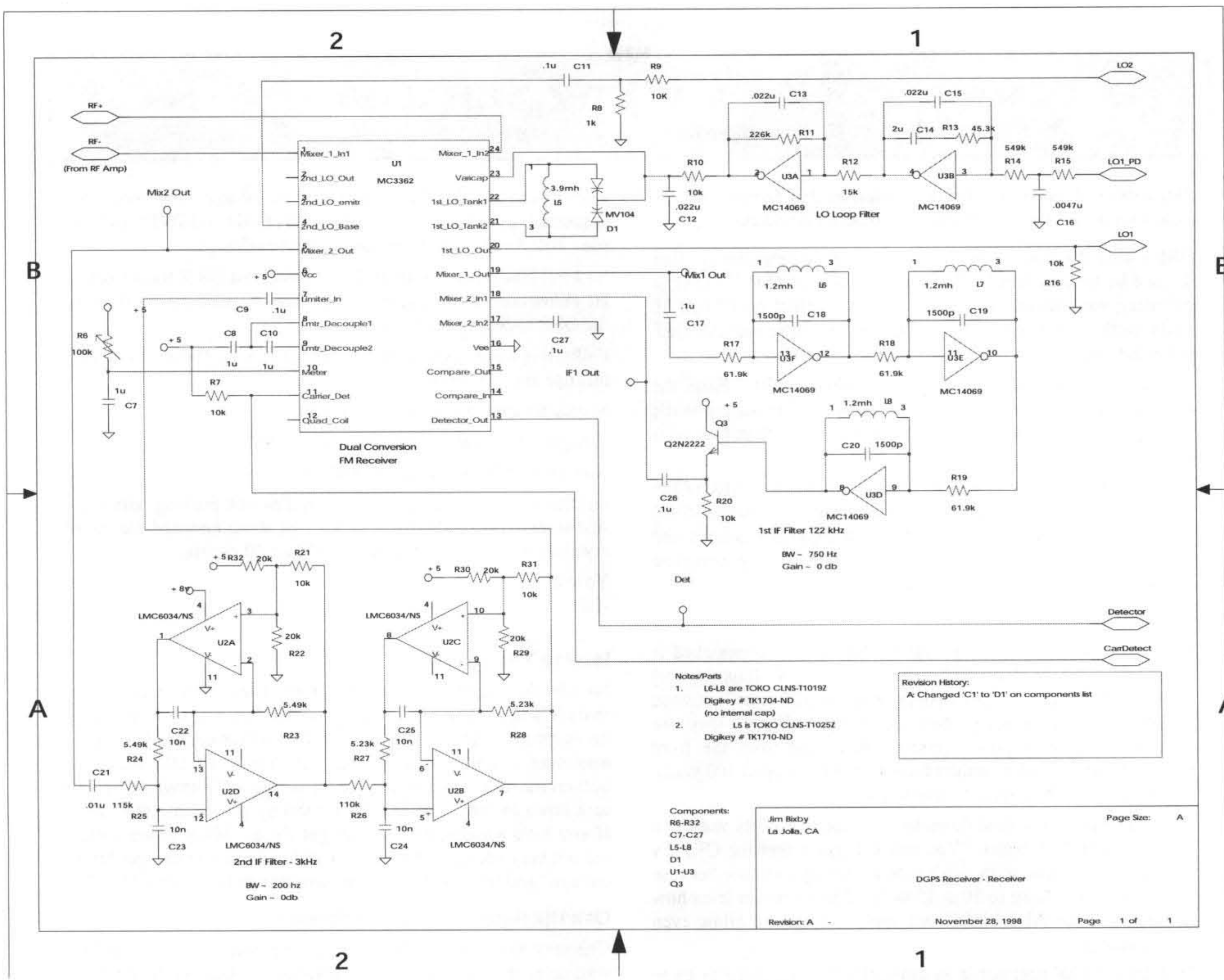

Jim Bixby
La Jolla, CA
DGPS Receiver - Processor
Revision: B
November 28, 1998
Revisions:
A. Corrected RB0-RB3 wiring to U8, Added R70
B. Corrected error induced by Rev A change involving RB1 to synth chip
Components:
U6-U9
S1
R50-R67, R70
C35-C43
VR1-VR2
FRONT PANEL
LCD


Loop Filter
Carrier PLL
Carrier PLL Adj
Detector
CarrierVCO
RcvrData
Data Slicer
LMC6034/NS
cd4046
MC14069
Components:
R33-R49
C28-C34
U4-U5
D2-D3
Jim Bixby
20 Fairbanks
Irvine, CA 92718
714-770-3022
DGPS Receiver - PLL Detector
Page Size: A
Revision: -
April 8, 1998
Page 1 of 1



DGPS Receiver Breadboard




RF+
RF-
(From RF Amp)
U1
MC3362
Mixer_1_In1
2nd_LO_Out
2nd_LO_emitr
2nd_LO_Base
Mixer_2_Out
Vcc
Limiter_In
Lmtr_Decouple1
Lmtr_Decouple2
Meter
Carrier_Det
Quad_Coil
Mixer_1_In2
Varicap
1st_LO_Tank1
1st_LO_Tank2
1st_LO_Out
Mixer_1_Out
Mixer_2_In1
Mixer_2_In2
Vee
Compare_Out
Compare_In
Detector_Out
Dual Conversion
FM Receiver
Mix2 Out
Mix1 Out
IF1 Out
LO2
LO1_PD
LO1
LO Loop Filter
MC14069
MV104
D1
3.9mh
L5
Q3
Q2N2222
1st IF Filter 122 kHz
BW ~ 750 Hz
Gain ~ 0 db
Det
Detector
CarrDetect
LMC6034/NS
2nd IF Filter - 3kHz
BW ~ 200 hz
Gain ~ 0db
Notes/Parts
1. L6-L8 are TOKO CLNS-T1019Z
Digikey # TK1704-ND
(no internal cap)
2. L5 is TOKO CLNS-T1025Z
Digikey # TK1710-ND
Revision History:
A: Changed 'C1' to 'D1' on components list
Components:
R6-R32
C7-C27
L5-L8
D1
U1-U3
Q3
Jim Bixby
La Jolla, CA
Page Size: A
DGPS Receiver - Receiver
Revision: A
November 28, 1998
Page 1 of 1

QRP – Getting Started

By Jim Larsen, AL7FS

This article is reprinted with permission by Jim Larsen, AL7FS, from Anchorage Amatuer Radio Club (AARC) newsletter

QRP essentially means you reduce power. As a definition, further defined by the Amateur Radio Club International (ARCI), QRP is operating your station at less than 5 watts output on CW or 10 watts peak power on SSB. (ARCI is the International QRP organization)

I have been involved with QRP since about 1970. From the beginning it has always been fun to work another station while running 5 watts or 2 watts or 50 milliwatts. More than fun…it is exciting!

At the April 1999 Anchorage Amateur Radio Club (AARC) Club meeting I will be presenting a comprehensive program titled "Why QRP?". The program, along with copious handouts and examples to touch and feel, will give you a very complete overview of QRP operating and equipment.

Simple QRP

One simple aspect of QRP operating that is often overlooked is that it can often be done with your existing QRO (high power) radio. In my case, I largely operate with my 100 watt Kenwood TS450S. One nice thing about Kenwood radios is they are capable of reducing power (going QRP) right from the front panel. My power can be reduced down to zero or up to 100 watts. I most often run from three to five watts.

Some radios will not tune down to less than five watts and often bottom out at 7-10 watts. You can still get a feel for QRP by running at these levels so don't pass up the opportunity because you can only get down to 10 or 15 watts. Later you can learn how to enter into the ALC circuit and apply voltages to allow even lower settings.

QRP for the CW operator is an especially friendly place to go to improve Morse code. Many of the QRP operators prefer more modest speeds and are very willing to slow down to whatever is needed. As you improve, there are also high-speed operators who will move up in speed with you. I often operate from 15-18 wpm and feel no pressure to move up to high speed.

QRP Works

An example of what can be done was recently described by WE6W in his email to the QRP-L mail reflector[1], a major hangout for the QRP crowd. (More than 2500 QRP operators are subscribed and regularly communicate on this mail reflector.)

Subject: Pixie2:Nor-Cal to Acworth, GA at 400mW!
Date: Thu, 31 Dec 1998 03:43:39 EST
From: we6w@juno.com (Ed Loranger)
To: "Low Power Amateur Radio Discussion" <qrp-l@Lehigh.EDU>

Oh my Goodness!! Was tiddling around playing with bias levels on the Pixie2 oscillator and heard KE4GBE calling CQ dead on 7040. As I listen to my soldering iron cycle between temps I thought, don't hear many '4' calls, so I called him!

Kaboom! WE6W? de KE4GBE ur 339 etc....

First code out the door was: WOW 400 mW, pwr 400mW
QTH Santa Rosa, Name Ed, RST 579 KB4GBE de WE6W/QRPp KN.

Then he came back with a monologue and 'WI6W'. Oh heck, QSB is gonna lose him for me..... But he adds Call? WI6W??? call agn pse. BK And he got it right on the next exchange.

So I tell him it is a full transceiver, basic unit has 2 transistors..... He either fainted straight away, measured himself on the floor, or the QSB ended the excitement.

Folks, this wasn't over saltwater, we are talking 400 milliwatts for this one and over land!

Maybe we need a warning on these rigs:

"Frequent use causes increased excitability."

Non-users subject to fainting spells :)

Disclaimer: My pixie is homebrew, I'm not pushing kits here. Just sharing late-night joy of radio! Just about knocked me out of my chair to catch Georgia on 400 mW on 40 meters.

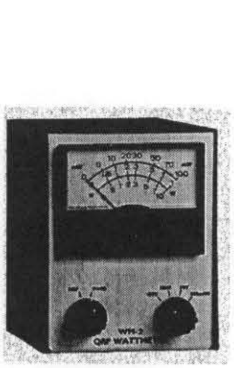
Yowsa!
-Ed

How to Know QRP

So how do you know if you are QRP? I feel QRP is largely an attitude and a sincere effort to get under five watts. If you have no wattmeter then guess by turning your power control to near the minimum power output setting. A Yaesu FT-990 seems to bottom out at 7-10 watts at the zero setting. A Kenwood rig will turn down to zero so tweak the control up just a little from zero. If you have a wattmeter you can get close. Many power meters are not very accurate at the five watt level but you can get "close enough" and feel justified you are working to the intent of QRP.

Oak Hill Research QRP Wattmeter

One very nice method of knowing your power output is to build a wattmeter designed for QRP operation. Oak Hills Research (OHR) provides a wonderful QRP wattmeter kit. It has 10 watt, one watt, and 100 mw scales and is designed to be accurate to 5 percent of full scale. I have built this wattmeter and use it in almost all of my QRP operating to assure I am under five watts. I used it to assure I was 900 mw when I worked W5JAY in Arkansas QRPp 2-way (QRPp = less than one watt) last month.

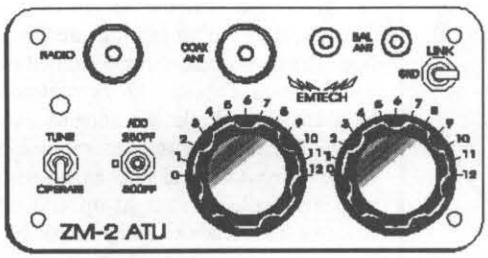


The Oak Hills Research WM-2 was designed specifically for the QRP operator. The unit operates from 300 KHz to 54 MHz. It will measure forward and reflected power at QRP levels down to 5mW. You can select from three full scale power ranges of 10W, 1W or 100mW with an accuracy of 5% of full scale. A rear panel switch allows you to select the internal 9V battery or external power jack for the operating voltage. The WM-2 now uses a very high quality American-made 3" meter movement with a large easy to read scale. The meter circuit current drain is typically 1mA, making it great for portable use. The wattmeter can be left in-line permanently with very little loss. The kit is supplied with high quality Amphenol SO-239 connectors. The WM-2 is easy to build and align. The alignment consists of setting three voltages with your digital voltmeter. A source of RF is not required for alignment. The completed wattmeter measures (HWD) 4 1/2" x 3 1/2" x 4" and weighs 16 oz. The kit is complete with cabinet, high quality silkscreened and masked PCB, all components and instructions (less 9V battery).

OHR can be contacted at 20879 Madison Street - Big Rapids - MI - 49307; Phone: (616) 796-0920 - 24 hr. Fax: (616) 796-6633 qrp@ohr.com

EMTECH Tuner and LED SWR Indicator

One other QRP accessory that enhances operation is an effective QRP antenna tuner. One such unit that can be used both at home and in the field is the EMTECH ZM-2 Z-Match Antenna Tuner. Good for up to 15 watts, this kit also incorporates a unique LED SER Indicator designed by N7VE. This LED SWR system can also be built as a stand-alone unit from parts around the workbench or from Radio Shack (Frigid North). (http://www.extremezone.com/~ki7mn/n7veswr.htm)



** Visual SWR Indicator ** Tunes wire antennas such as -- Random, Long, Short ** Tunes balance fed antennas such as, Loops, Deltas, Dipoles, Verticals, V's. ** Tunes (from field reports) gutters, window frames, swing sets, and -- bed springs? ** Tunes out coax fed antenna mismatches to make the radio happy. ** Does all the above at 80-10 meters, and usually much faster than other ATUs.

** 15 WATTS MAX! This is an evening project for many, maybe two evenings for others. It is very easy construction, via pictorial drawings. All parts are furnished, including a stick-on panel layout as shown. The big knobs are provided for vernier tuning because the ZM-2 tunes so sharp. One large toroid to wind using a unique method that is fast and extremely easy. One small toroid to wind. Wire is furnished. Kit is complete, no other parts to try to find. Size is 5-1/16" x 2-5/8" x 1-5/8".

EMTECH can be contacted at: EMTECH; 1127 Poindexter Ave W; Bremerton, WA 98312

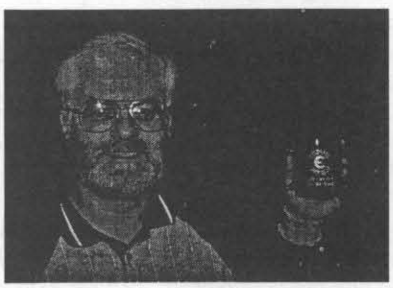
Send mail to KC7MAS: emtech@steadynet.com

QRP Wrap Up

In this first of several QRP articles I have discussed very basic concepts of QRP and QRP techniques that you can try with your current rig. As you move further into QRP you may wish to build your own monoband or multiband QRP rig, many of which are available as kits. Future articles will address more details of QRP and QRP kits. The program in April will fill in even more information.

If you are in a hurry for more please check the following Internet URL (addresses) or have a friend look them up for you.

[1]QRP-L ... http://qrp.cc.nd.edu/QRP-L/
QRP-L Message Archives ... http://listserv.lehigh.edu/lists/Archives/qrp-l/
Oak Hills Research ... http://www.ohr.com/
EMTECH ... http://emtech.steadynet.com/
New Jersey QRP ... http://www.njqrp.org/
KI7MN ... http://www.extremezone.com/~ki7mn/
ARCI ... http://www.qrparci.org/



AL7FS

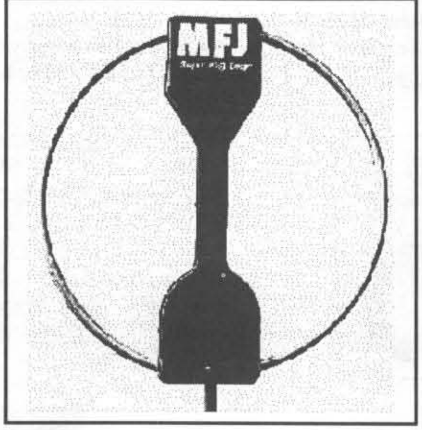
AL7FS was originally licensed as WN0LPK in March 1965 (WA0LPK from 1965-1985). Jim is a member of AARC and SCRC and he has participated in HF from 160-10 meters (CW and SSB), packet, satellite, 6 meter, UHF, VHF, ATV, EME (2 meter WAS #36), DX and QRP. QRP has lasted the longest and the strongest - 1970 to 1999.

(The mug was a recent gift from the Colorado QRP Club (CQC) and it reads, "Life is too short for $800 finals.)

Review: The MFJ 1788 Super Hi-Q Loop Antenna

T. J. "Skip" Arey, N2EI *PO Box 236, Beverly, NJ 08010* *email: tjarey@home.com*

This is probably as much a story about camping as it is about an antenna. Historically, it seems, QRP and camping activities go hand in hand. Many fine articles have been written about backpackers climbing to dizzying, often frigid heights carrying rigs that weigh mere ounces feeding all manner of wire configurations. Still, there are other campers. Folks that can be found in any of hundreds of campgrounds on any given weekend. I'm talking about people like me. Pop-up Tent and light trailer campers. I've done my share of adventurous deprivation backpacking throughout my college years. I'm more settled now and don't mind pulling a bit of weight behind my mini-van in search of a woodland weekend. While this commitment to trailer camping allows me to carry radio gear of less modest size (and a decent sized battery to keep me in QSOs for a long weekend) it does have other limitations. Family campground culture has its own set of rules. The first obstacle to serious radio fun is that many campsites formally prohibit stringing wires in the trees, no matter how carefully they are placed. Campground culture frowns on things that bring the possibility of "clotheslining" someone on the way to the "two holer" in the night. So tree tossed dipoles are often out of the picture. Then there are vertical antennas. Then again, even the fewest number of radials needed to begin to get a few electrons to leave the surface of a traditional vertical could also come under scrutiny in a family campground. What else can a campground camper use to keep the temporary neighbors from complaining? Enter the **MFJ Super HI-Q Loop Antenna**. Measuring just 36 inches in diameter and requiring no additional ground wires, the antenna attracts no more attention at a campground than any of the dozens of portable TV antennas and satellite dishes that sprout from various trailers. Let's take a look at the antenna specifications and then I'll give you a run down on how this set up works in the semi-wilderness of campground camping.



The MFJ Super High Q-Loop is currently available in two models, the MFJ-1786 that covers 10 MHz through 30 MHz and the MFJ -1788 that covers 7 MHz through 21 MHz. Since the majority of my field QRP efforts these days are accomplished on 20, 30 and 40 meters, I opted for the 1788. Other than frequency coverage, most specifications are identical for both antennas.

Small loop antenna theory has been discussed in these pages by folks with far more engineering background than I have. The short version is that an antenna of this type functions primarily because of its ability (some would say need) to be finely tuned to any particular operating frequency within its design range. This is accomplished by an air variable capacitor mounted right at the radiating element. Accurate adjustment of this capacitor to bring the antenna into resonance is critical and could be described as the biggest liability to such a design. Well, Maurice Ju and his folks down in Mississippi have got this problem licked. In their design, the capacitor is tuned by way of a motor drive connected to a control head that also allows for monitoring of SWR. This remote control unit in and of it self is larger, weighs more than any of the transceivers I hook to it. At 6mA standby and 20-55 mA of active current, it could be considered a bloated power hog by many of our backpacking compatriots. Ah, but as a campground camper, I am not constrained by what I can carry in my Kelty. If I want to get really lazy I can even hook up the supplied "wallwart" power supply to (shudder) line current. In my case this is not often a problem. My various home brew rigs are rather miserly and my gel cell is rather generous so the current needs to keep the 1788 happy are not out of line with my regular radio practices.

The 36-inch loop and capacitor/motordrive come as a single unit that can be clamped to the mast material of your choice allowing for a diameter of 1 through 1.5 inches. This radiating unit is well designed using welded construction that should hold up under just about any practical application. The capacitor/motordrive and the entire center mounting section is covered with a high impact plastic. This is not only aesthetically pleasing but prevents those accidental bumps up against the surprisingly substantial RF present at those points. (Do the math and you'll choose to keep the covers on during operation.) The radiator unit can be mounted in either a vertical or horizontal polarization position. Your decisions in this area will require a bit of time with the instruction manual, as they are critical to loop efficiency. For example, horizontal polarization of the loop will yield an omnidirectional pattern that will sacrifice some skywave effectiveness but produces a null directly below the antenna that will reduce interference to other electrical devices. TVI is an important consideration in campgrounds too. The tradeoff here is that you need to get the antenna at least 20 feet above any metal roof or other ground plane. This can best be accomplished in a campground environment by any one of the various nested masts that are available commercially or can be creatively homebrewed out of hardware store materials. Most folks who chose to use this antenna in a nomadic setting will probably go with vertical polarization of the loop element. This introduces some directionality but given the portable nature of the installation, adjustment by the "armstrong" method should do just fine. The Instruction manual pointed out something I hadn't thought about with vertical polarization of a loop antenna: While the antenna exhibits the low angle of radiation of any vertical, unlike a traditional single element vertical antenna, a vertically polarized loop also radiates straight up and down from the antenna. This leads to a high angle of radiation that can be used very effectively to cover shorter distances by way of skywave propagation. If you check over your logs, this probably reflects a good chunk of your casual communication. When I'm camping, I'm relaxing and, while I won't turn down a DX QSO, I'm just as happy to ragchew with some folks in the region. If you feel obliged to reduce this "up and down" radiation component, the manual has a few suggestions. I've never felt obliged to take those steps as the antenna meets my needs without such measures. Incidentally, the folks at MFJ take pride in their equipment being designed "by hams for hams." In this spirit, the instruction manual goes into a great detail about the subjects of practical propagation and use of this product in real world conditions. Also, the MFJ folks have respect for amateur radio operator skills and they are not afraid to tell you to occasionally "lift the lid" and make a few reasonable adjustments to improve overall performance. This attitude is very refreshing and is reflected in several entries throughout the Instruction manual.

Primary installation instructions lean toward a permanent installation, either outdoors or in a restricted space environment such as an attic. Given that my uses and needs were slightly different, I still found the information useful in planning how I would adapt the 1788 to courteous campground use. If you are going with a more permanent installation, give some thought to sealing the radiating unit a bit more. The plastic cover does leave a few small openings that could make attractive entry points for the various insects and arachnids that are so often seeking shelter and nesting places. Any plastic friendly, RF transparent sealant would solve this problem in short order. However, the manual does warn that you to leave adequate drainage for condensation so make the same kind of balance of choices in this area that you would apply to such things as beam traps.

relatively important, as it is remotely possible to do things wrong enough to cause damage to the control head. However, a session or two tuning this antenna up will turn most of the effort into second nature. The control panel of the unit gives the user a great deal of information. LED's monitor the movement of the motor drive and a twin needle SWR meter helps the users to bring the loop into tune. This meter is calibrated in 300/30 Watts forward, 60/6 Watts reflected. On the surface this would seem to be a bit too generous for QRP work, however, since you are tuning for minimum SWR in all cases, the 6 Watt reflected scale gives adequate deflection in all but the most minute QRPp power levels. The manual recommends 1 Watt of tuning energy minimum. For many of us, that is running full tilt. If you have been known to resort to QRO power levels, the 1788 can handle up to 150 Watts by design.

The Super High-Q Loop comes with everything you need except coaxial cable and masting suitable to your application. As with most any antenna application, high quality coax with the lowest practical losses is the most desirable. The radiating unit weighs in the neighborhood of 12 lbs. according to my bathroom scale so the manual's recommendation of galvanized steel or thick walled aluminum masts is a good one. The manual also give very specific directions concerning guying such masts to assure antenna efficiency. If your application requires guy wires, you will want to study this information carefully. My personal preferences are for a pair of 10-ft. steel mast sections with vertical mounting of the radiating unit. I secure the masts along the side of the camper. Since I can take the unit down when not in use or in high wind conditions, I do not worry myself with guying as the mast is extending only about 10 feet above the camper. This season I may consider trying to get high enough to utilize horizontal polarization but that will require more thought.

Okay, so how does the thing work on the air? Well, lacking a proper antenna measuring range and adequate test equipment to give true information here, I must resort to the highly subjective but fairly practical "fun" meter. The folks at MFJ claim performance just slight below that of a dipole hung under similar conditions. Well, given the campground environment which is full of nearby metallic surfaces, electromagnetic noise and overall antenna heights well below optimum, I would still have to say that this antenna works "good enough". My goals are simple when I am on a family camping excursion. A couple of hours of friendly ragchewing are all that I ask. I really don't care if the person I am in QSO with is on the other side of the world or on the other side of the campground. Subjectively compared to dipoles I have used under similar conditions, I find the loop design much quieter in terms of received QRN. As I have said, campgrounds can be very electrically noisy places.

As with most MFJ products there is a one year "No Matter What" unconditional warranty and a 30 day trial with full refund policy. Arguably one of the better deals in the hobby.

Given the antenna's $429.95 price, this does not represent a casual purchase. Many of you are probably saying you can get a beam for less and you would be right. However, many folks find themselves in the unenviable position of needing to put up an antenna on minimal real estate and with the lowest "eyesore" quotient possible. Folks subject to such limitations could spend many hours and dollars trying to come up with solutions that will allow them to continue to enjoy the radio hobby under less than ideal conditions.

I've found this to be an excellent antenna for use in the campground world. I've even had some fellow campers compliment me on my neat "TV" antenna. Little do they know!!!

The MFJ Super HI-Q Loop Antenna is available from dealers or directly from MFJ:

MFJ Enterprises, Inc., P.O. Box 494,
Mississippi State, MS 39762.
Phone: (800) 647-1800 (orders)
(601) 323-0549 (tech info)
Email: techinfo@mfjenterprises.com

Edited by W1HUE

IDEA EXCHANGE

Technical tidbits for the QRPer

Mike Czuhajewski, WA8MCQ 7945 Citadel Drive, Severn, MD 21144 wa8mcq@erols.com

IN THIS EDITION OF THE IDEA EXCHANGE:

NEW E-MAIL FOR WA8MCQ

This is the last time this will be mentioned. I changed my e-mail address some months back, and the old address of wa8mcq@abs.net has been closed for some time. Please note that my new e-mail address is wa8mcq@erols.com.

A WIDE RANGE VARIABLE CRYSTAL OSCILLATOR

Homebrewing and engineering legend and member of the QRP Hall of Fame **Wes Hayward, W7ZOI**, *wrote a technical column for the QRP Quarterly called "Experimenters Corner" for about a year, circa 1985. With all the interest in VXOs lately, I asked if he'd mind if I reran his treatise on a very wide range VXO, and here it is, from the April 1985 issue--*

This paper will attack a problem of the mainstay of the QRP experimenter, the Variable Crystal Oscillator, or VXO. This is a crystal oscillator capable of a small amount of tuning.

A VXO exhibits the stability of a simple crystal oscillator but much of the flexibility of a good VFO. The circuit is not without problems, the most common being a severely restricted tuning range. Tuning is often very nonlinear. If you try to pull the crystal too far, the VXO is subject to mode jumps, ie, oscillation occurs at an undesired frequency. Crystal characteristics will have a dramatic effect on performance, making it difficult to duplicate published circuits exactly.

Figures 1 and 2 show two common VXO circuits. Figure 1 is a Colpitts crystal oscillator, modified with the addition of series L and C. The inductor value must be determined experimentally: if it's too small, the tuning range will be correspondingly small; if L is too large, the circuit will change modes, may be unstable and may oscillate at a frequency unrelated to the crystal. Still, the circuit is very simple. This circuit was used at 14 MHz (with a frequency doubler) in a very successful little 10 meter CW rig. The tuning range at 14 MHz was about 25 kHz, using crystals from International Crystal (GP type). Tuning was very nonlinear. (See QST, May 1979, page 28.)

Figure 2 shows another "standard" VXO circuit. This one provides rather constant output, a result of the AGC provided by the diode and capacitor in series with the gate. A dual section variable capacitor is required. The diode should be either a germanium or hot-carrier silicon type to prevent conduction in the FET gate diode. (See

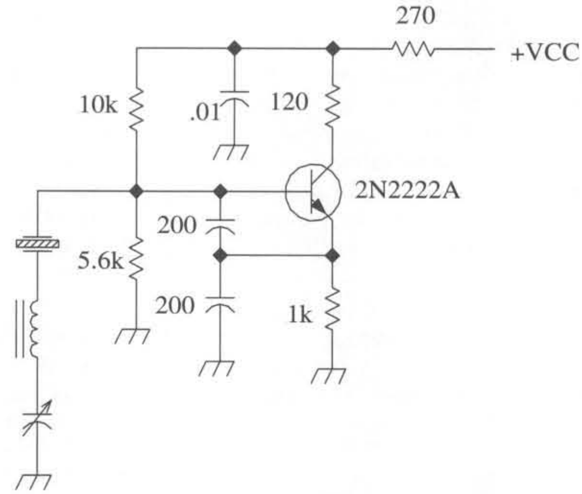


Figure 1—A simple and conventional VXO circuit

DeMaw's paper on this circuit in QST, May 1972.) Tuning is again quite nonlinear, and empirical component selection is required.

The consequences of nonlinear tuning can be significant for the builder. A fixed capacitance change will produce very different

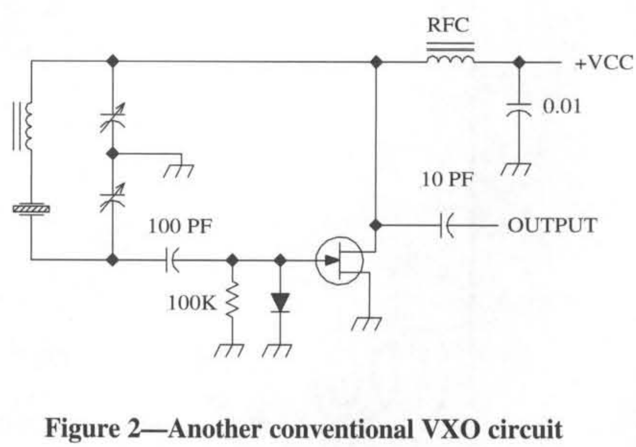


Figure 2—Another conventional VXO circuit

frequency shifts at the extremes of the tuning range, making the circuit very difficult to use in a direct conversion transceiver. The offset that would be included, then, is not constant.

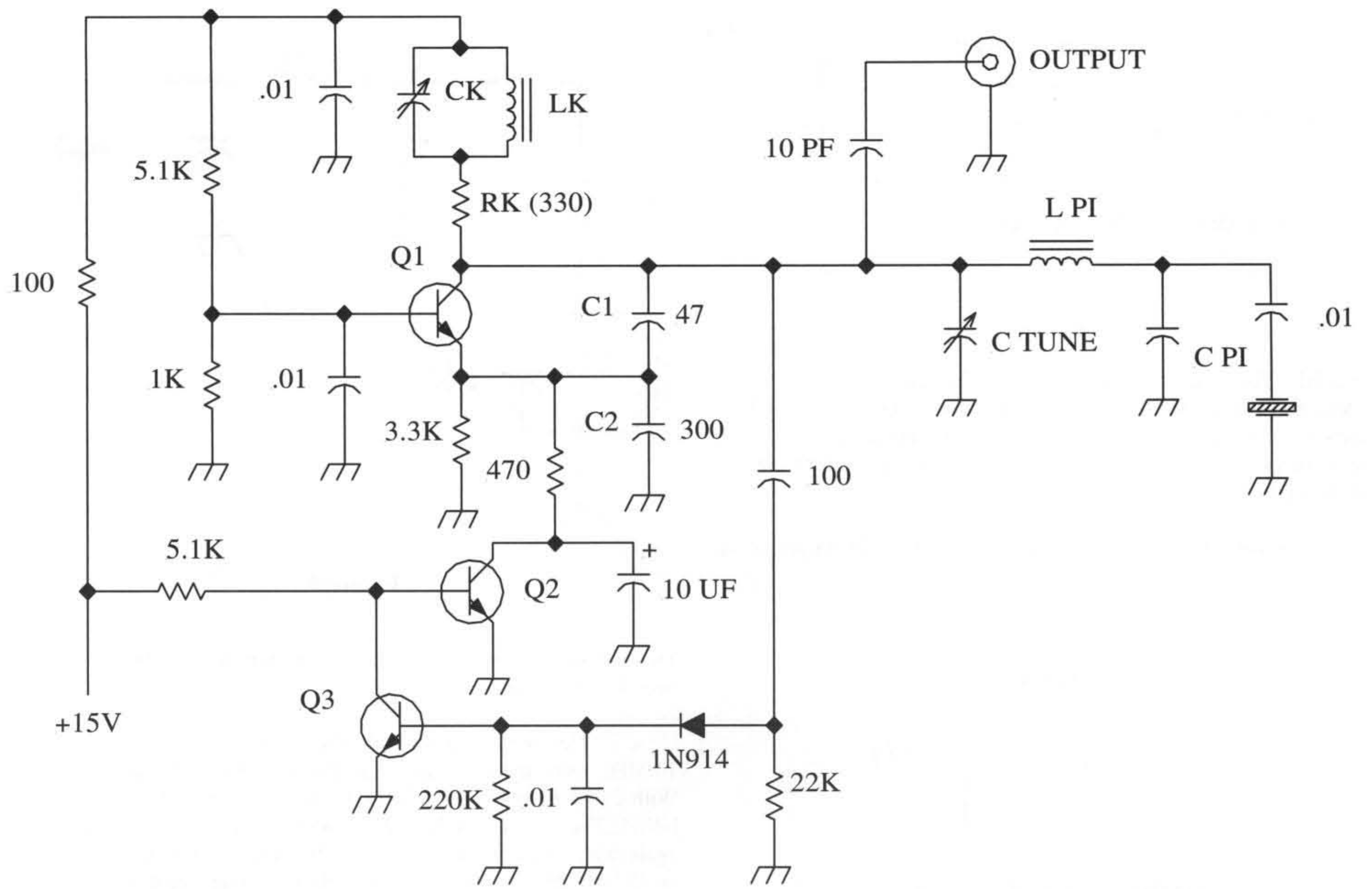


Figure 3—A very wide range variable crystal oscillator. All transistors are2N3904, but any general purpose NPN should work OK (such as 2N2222A). Q2 and Q3 provide AGC action (together with the diode detector) to give constant output as the frequency is changed.

The maximum tuning range available from the simple VXO circuits is approximately 0.1 percent. It's usually easier to build a functioning VXO at the higher frequencies. (For example, a 14 MHz VXO is more practical than one for 7 MHz.) Tuning is usually from the

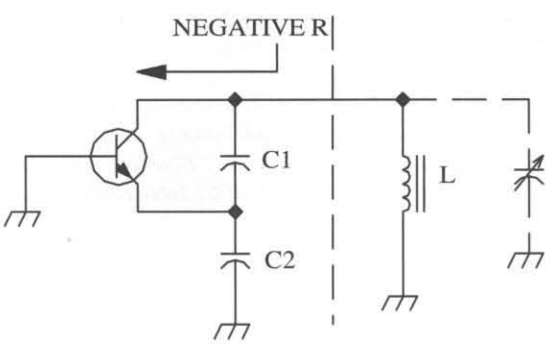


Figure 4

marked crystal frequency downward, with the circuits of figures 1 and 2. Crystals operate best on their fundamental modes in VXO applications.

Figure 3 shows a more elaborate VXO circuit capable of a very wide tuning range, and often, reasonable tuning linearity. It is especially useful for voltage tuning applications, a VCXO. Circuit operation is analyzed with the information in Figures 4 through 9. Figure 4 shows a basic Colpitts oscillator in "small signal" form with transistor biasing details omitted. The combination of capacitors C1 and C2 and the transistor form a network with a negative resistance. This R is

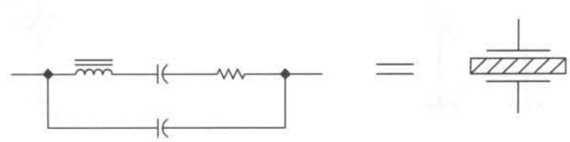


Figure 5

paralleled by a capacitance, the series combination of C1 and C2. The circuitry to the right of the dotted line may be an inductor or a parallel tuned circuit. The circuit will oscillate if the negative resistance dominates the inductor losses.

A parallel resonator is needed for the circuit of Figure 4. A crystal has the equivalent circuit of Figure 5, a series tuned circuit, modified slightly by a parallel capacitance. A series resonance may be transformed to behave like a parallel resonance with a quarter wavelength of transmission line (figure 6). Such a "transformer" is often used in antenna matching.

A quarter wave line is not the most convenient component for

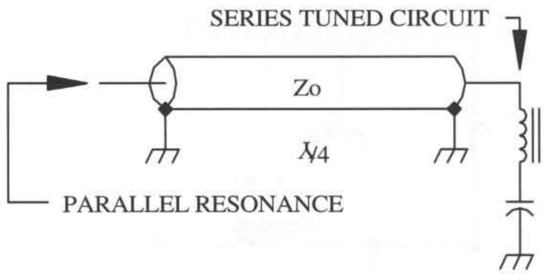


Figure 6

use at HF. The behavior of a line is easily simulated with the symmetrical pi network shown in Figure 7. The simulation is exact and includes all of the transforming effects of a real transmission line. The composite parallel tuned circuit is presented in Figure 8, with the frequency adjusted with the variable capacitor.

A synthetic transmission line section is not without problems.

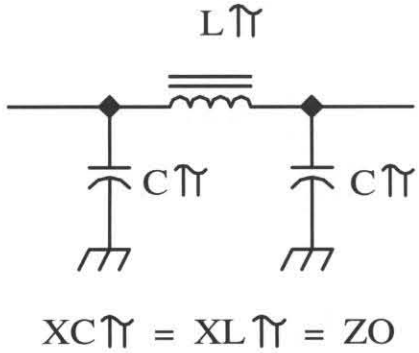


Figure 7

It's exactly like the actual transmission line only at one design frequency. Behavior is complicated at other frequencies by other resonances. They can be very close to the desired resonance if the characteristic impedance of the line is chosen to be too high (Zo of figure 6).

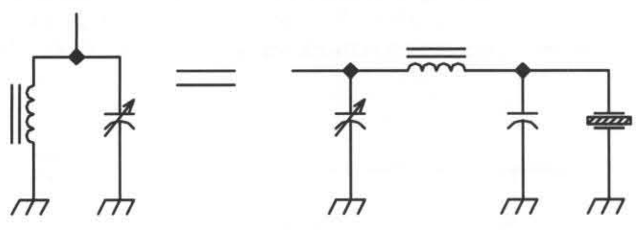


Figure 8

We can "kill" the Q of the stray resonance with the addition of a resistor, RK, and a parallel tuned circuit, LK and CK This is shown in Figure 9. The "killer" tuned circuit is resonant at the desired operating frequency.

The VXO of Figure 3 should now begin to make some sense. The "killer" network also serves the role of biasing the transistor collector. Output is obtained directly from the collector through a small value capacitor, to a 50 ohm termination. The synthetic transmission line is designed for Zo of 150 to 250 ohms. The "killer" inductor, LK, should have a reactance from 50 to 100 ohms at the oscillation frequency, with CK chosen for resonance. The circuit also contains a gain control loop to maintain oscillation and to ensure a constant output.

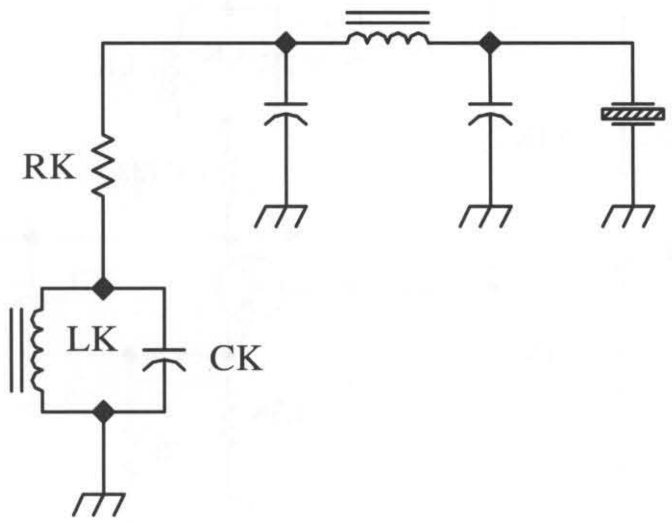


Figure 9

This is required, owing to a tank impedance that varies dramatically over the tuning range.

How well does it play? The circuit of Figure 3 was built for 14 MHz, using the same crystal used in the circuits of Figures 1 and 2. With CT of 10 to 400 pF, a 200 kHz range was obtained with good stability! The circuit was then rebuilt and aligned for 7 MHz operation, again with an available crystal from International Crystal, type GP in an HC-6 holder. More than 100 kHz of tuning range was obtained. The linearity was suitable for direct conversion transceiver applications.

The range may be controlled to a surprising extent through adjustment of the pi network capacitor at the crystal end. This behavior has been confirmed with computer modeling.

A word of warning: This is not one of those easily applied "cookbook" circuits we like to garner from the publications. Rather, it's a subtle circuit that depends upon the crystal characteristics, careful design and proper adjustment. However, it can provide rather spectacular performance. This circuit is not new, and is often found in commercial instrumentation. (See the book on Frequency synthesizers by Manassewitsch, Wiley Interscience, 1976.)

WA8MCQ note—Further information on wide range VXOs using this principle can be found in the January 1982 issue of Ham Radio magazine, on page 66. The title is "Phantom-coil VXO", by Frank Noble, W3MT. (Page 8 of the July 1982 Ham Radio contained a correction to a drawing in the article.)

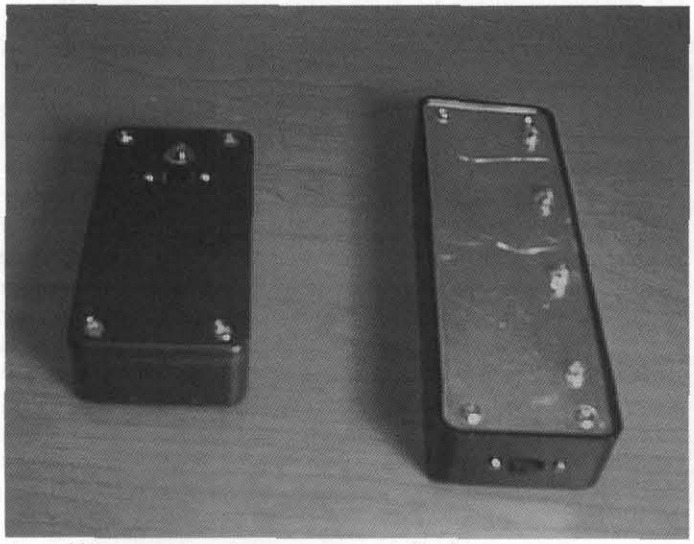
—DE W7ZOI

A QRP LIGHT FOR FIELD USE

*Number 29 in his unending series of Technical Quickies, this comes from **Joe Everhart, N2CX** of Brooklawn, NJ, one of the guiding lights (no pun intended) of the NJ QRP group—*

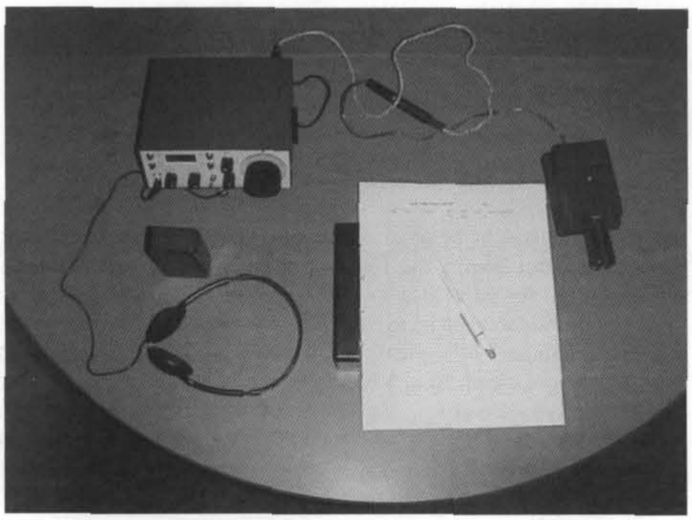
Lots of bright ideas are discussed on QRP-L, the Internet QRP e-mail reflector (see Mike C's standard info at the end of the IX for details). One that really piqued my interest dealt with modern high-intensity LED's. For the longest time they were just OK, but lately great strides forward have resulted in inexpensive LED's that rival small incandescent bulbs and feature lower current drain.

Several folks on the list discussed the idea of using these ultrabright LEDs as a QRP night light for portable operation. None of the ideas presented was exactly what I wanted. So I set about coming up with my own portable night light. The very first decision was to use yellow LEDs rather than the more common red ones. Maybe it's just personal, but the yellow light is just easier to see with than red and furthermore for outdoor use, yellow is a good choice since supposedly it will not attract insects. Of course if I were an aviator or astronomer,



red would be mandatory to preserve my night vision.

Second, I discounted commercial products 'cause it's more fun to roll my own and by homebrewing I could tailor the light just the way I want it.



Actually it ended up being two lights instead of just one. This really is a matter of the relatively low total light output from even the ultrabright LEDs. One light provides illumination for the front panel of my Sierra while the second lights up the log sheets. The first photo shows the two lights. As the second photo shows, the smaller one is used on end to light the Sierra while the longer one is place alongside log sheets so they can be seen in the dark.

The schematic diagram of both is shown in Figure 10. They differ only in the number of LEDs. Separate current limiting resistors are needed for each LED for proper current sharing. Each LED has a

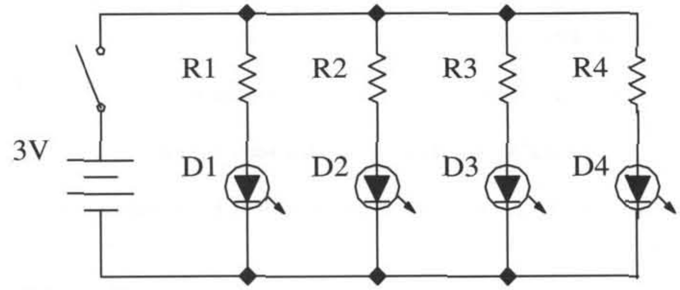


Figure 10—N2CX QRP Light. Resistors are 82 ohms, LED's are ultrabright yellow type. Battery consists of a pair of AAA cells (see text). Use D1/R1 for single light, and additional components for multiple lights.

forward drop of about 1.8 to 1.9 volts so the operating current is about 13 ma with fresh batteries. I think that the LEDs are rated for 20 ma operation so a 56 ohm resistor will likely give a more usable light output though battery life will suffer. I used AAA batteries rather than the more common AA's since the enclosures I had on hand were too small for the latter. I used slide switches since they are not subject to accidental turn-off. I always have trouble making a good rectangular hole for them in metal panels, but the plastic cases are very easy to "machine" with nothing more exotic than an Exacto knife.

The cases were not necessarily optimum, just what I had on hand. The part numbers will be listed later, but read on and you may decide to pick different sizes. The smaller case was sized so that when stood on end, the LED would be at the same height as the Sierra frequency display. When placed about 6 inches or so away, it adequately lights the LCD readout and provides enough light that the front panel switches can be seen.

The larger case is used to side-light the log sheets. Ideally the case would be long enough to space the LEDs equally from top to bottom on an 8-1/2 by 11 inch standard log sheet. The box I had was only 6 inches long so it was too small. Decide for yourself what works for you!

The smaller one is a Radio Shack RSU 11907680 4X2X1" plastic box with a plastic lid. When I bought his one, it was a standard item carried at all "Shacks" but now it is a special order item. A suitable replacement is the metal front RS 270-1802 which, as of this writing "is" commonly available. The large case is a RS 270-1804 6x2x1" plastic case with a metal front panel.

The LEDs I used were similarly just what I had on hand. The single one in the front panel illuminator is a Radio Shack RS 276-205 jumbo yellow LED. It is quite good for the application, though rather pricey at $2.99 each. I had bought some smaller yellow ultrabrights from Alltronics (see URL at end). Their SE5034H lists for .69 each though the light output is less than the R/S unit. Other surplus outfits such as Halted and Hosfelt have similar units in the same price range.

Now for the bottom line - how good were they? I have to admit that the results were mixed. The single light did an excellent job of lighting the Sierra front panel. But the illumination from the log illuminator did not reach much farther than the log sheet I was using. I had hoped that it would reach far enough to light up a "dupe" sheet to the right of the log sheet but it did not. So I had to move the dupe sheet over to the light in order to read it. More work is needed to position it for use. Perhaps some sort of fixture mounted above the sheets would be more suitable.

For more info on ultrabright LEDs and lights using them, check out the following web sites:

1. A super site for more info on the LEDs themselves is

http://www.netaxs.com/~klipstei/led.html

It has a wealth of information on ultrabright LED characteristics and sources.

2. The premier keychain light using ultrabrights is the "Photon Micro-Light." They are sold at various stores that specialize in unusual pricey gadgets (I found one at the local Eastern Mountain Sales). And the lights are often sold at larger hamfests. The lights feature a choice of red, green, yellow, blue and even white LEDs. They definitely carry premium prices.

As a sidenote, Walmart also carries a less bright "Ladybug" keychain light for about $3.00 and even Fry's recently had a special deal on a similar keychain light for $.99.

The Photon URL is:
http://www.photonlight.com

3. Ham manufacturer Whiterook has their own ultrabright LED products including both small ones useful for lighting keyholes as well as others that would be useful for lighting up a night-time portable rig.

You can find their website at:

http:/www.west.net/~wpc

4. Alltronics - **http:/www.alltronics.com**

5. Halted - **http://www.halted.com**

6. Hosfelt - **http://hosfelt.com**

—DE N2CX

BURNISHING PADDLE AND BUG CONTACTS

Open frame relays, which we don't use much anymore, have something in common with bugs and paddles--they all use contacts which can get dirty and cause improper operation. How to clean them was discussed recently on the QRP e-mail reflector QRP-L (see the end of the Idea Exchange for information on subscribing).

It started with **Larry Brandon, K1ZW** (ex-AC5EZ) reporting that he obtained some used paddles that didn't work correctly--dashes but no dots. The contacts on that side were a bit dirty and he cleaned them with white notebook paper. He then asked what the best things are to clean these contacts. Here are some of the replies, most of which were along those lines.

Alan Kaul, W6RCL, seconded the call for a good solution, saying he has used fine sandpaper to file down pits on contacts but wasn't sure if that's the best way. If you do have pits in the contacts, that's "probably" OK, but I wouldn't use sandpaper or a file if the contacts are merely dirty and appear to be otherwise in good condition.

From **Monte Stark, KU7Y**: "I just use paper. After once using a file or sand paper, the coating is gone and from then on you will have trouble. Pitting came from (usually) the old tube days when there was enough current being keyed to have some good arcs! If you feel that you MUST use something more than paper, use a burnishing tool. They are like very fine files and are made for relay contact cleaning. Most any supply house will have them."

When I was in the Air Force in an electronics maintenance career field, I always had one of those in my toolbox and saw a gazillion of them. They're still available since relays with big contacts are going to be around for a long time. The burnishing tool I'm familiar with is shown in figure 11. It looks like a pen with a cap on it; pull off the cap, and it exposes the chuck in the end which holds a removable burnishing blade or rod. These are stored in the other end of the tool, under a removable cover. They are made of some springy metal, and appear to be coated with a very fine abrasive of some sort, possibly diamond dust (just a guess). **Frank West, KE6VHM**, described the working end of the burnishing tool as being similar to a fingernail file but much finer; it's also much thinner.

I never had to buy one, so had no idea what they cost. A little research shows that the cost varies quite a bit. I checked the latest Newark catalog, and they are close to $40 or more! That does include several blades, and replacement blades were under $2 each in a package of 25 blades but not available individually. The Allied catalog had what appeared to be the same thing (same manufacturer) but about $27.

Finally, Techni-Tool (where we get a lot of tools at work) has

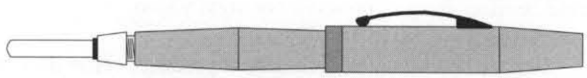


Figure 11—Contact burnishing tool

what again appears to be the same item but for $14.95. You can write for a catalog at 5 Apollo Road, PO Box 368, Plymouth Meeting, PA 19462-0368 or e-mail sales@techni-tool.com. You can also find their web page at

www.techni-tool.com

You might be able to find them locally at electrical supply houses, too. But even at the Techni-Tool price you might consider it a bit expensive for home use, considering how often it would be used. You might want to keep an eye out for a used one at a hamfest; even an old one should still have plenty of life left in the blades for occasional use. I later got e-mail from **VE1VQ, Dave Marling**, who presented a less expensive alternative. It's a basically the same thing but a single blade without the holder, from General Cement (GC) which has a well known and widely available line of chemicals and other things for electronics. He give me the URL for a catalog which contains these contact burnishing tools, and they are:

GC 9337 Fineline (0.120" wide) $2.05 CDN [Canadian]
GC 9338 Standard (0.250" wide) $2.09 CDN

The catalog describes them as "stainless steel strips with ultra-fine surface; remove oxide and corrosion from contact points made of platinum, paladium, molydenum, gold, tungsten and silver." If you have a source of GC products, this would be worth looking into.

Bill Stietenroth, K5ZTY said, "Spray some contact cleaner on a piece of paper and slide it back and forth between the contacts while holding as much pressure on the contacts as will allow the paper to slip. Then slide a dry piece of the paper between them in the same manner. NEVER sand the contacts. The silver plating is very thin. You only want to remove the oxidation." (Keeping in mind that if the contacts already have pits from past abuse, there may well not be much plating left!)

Harvey Laidman, W8DX, said he prefers a product called DeOxit for the cleaner.

How about using a dollar bill? That was suggested by **Tom McCuen, AA2VK**, told to him by his Elmer. That was a method taught to me very early in my Air Force career, and works quite well. Equally effective is pulling a strip of paper cut from a grocery bag, wetted with alcohol, through the closed contacts, followed up with a dry strip. That was suggested by VE1VQ (who uses the burnishing tool when this doesn't work), and **Bob Morgenstern, WA2EAW**, also recommended that type of paper. **George Baker, W5YR**, says he uses plain white bond paper with good results.

Finally, a safety note. If you are cleaning contacts on a paddle or bug used with a solid state rig or keyer, you have no problems. However, if it's something that is plugged into a tube type rig or keyer, be sure to turn off the power first so you don't get zapped, and preferably unplug the paddle or bug as well. And if you need to clean contacts on some large relay, be sure to disconnect it from power first, discharge anything that may still have voltage on it, and follow all of the standard safety precautions.

CAUTION ON GATES CYCLON CELLS

That's Cyclon, not Cyclone, and it's a line of sealed, lead acid batteries that shows up frequenty at hamfests around here. There was some discussion about them on QRP-L a while back, and here's the two cents worth I threw in. I mentioned this some time back in the Idea Exchange, but it's worth a reminder.

Maryland Radio Center was a local ham store until it closed in 1998. They used to have a "public junk box" which was a corner of the store set aside for junk. If the wife made you clean out the basement and you didn't want to toss the electronics in the trash, you could bring it there, or take home anything that looked good, all free. We got all sorts of electronics goodies from the public junk box over the years, as well as dropping off a huge quantity from our own houses.

One thing that started appearing there was a large quantity of Gates Cyclon batteries, mostly in the size that's the same as a standard D cell. These are 2 volt cells, rated at 2.5 amp hours. We also started seeing larger sizes show up at hamfests, and they still do. The Cyclon series are sealed lead acid cells and made to have very low internal resistance. This means that they can supply rather staggering amounts of current--briefly!--to a short circuit. I looked up the Cyclon cells in a catalog at the time, and seems to me the lowly D size Cyclon could deliver 200 amps to a short circuit. Maybe my memory is faulty, or perhaps they improved the design, since the Cyclon application guide I just read says the D cell can supply 400 amps. That's four hundred amperes to a short circuit directly at the terminals. Hint: do not attempt this at home. That's based on an internal resistance of 5 milliohms (per the data sheet) at 2 volts for a fully charged cell.

The owner of Md Radio Center once accidentally shorted the wires on one of the cell packs--most of them came shrink-wrapped in a set of 3 with wire leads on them, to form a 6 volt battery. He reported that the wires vaporized and the cells were destroyed, but not before spitting out molten chunks of lead along with sulfuric acid. Fortunately no injury resulted, although the cement floor did require some cleaning!

Some of the other Cyclon cells available, by type, amp hour capacity and short circuit current are:

DT, 4.65 AH, 400 amps
X, 5 AH, 570 amps
E, 8 AH, 665 amps
J, 12 AH, 800 amps
BC, 25 AH, 1335 amps

All of these are physically larger than a standard D cell.

I still see Cyclon batteries at hamfests in this area, and I presume they are available around the country. They make attractive power sources and have great capabilities, but the potential for nastiness is equally great. If you are going to be using these--or any relatively large cell or battery of any type--it would be wise to place a fuse as close as possible to the battery, and to keep the terminals well protected and insulated so that nothing can short them directly.

Of course, if you have a short several inches away from one of those D cells, it won't draw anywhere near 400 amps due to the resistance of the wire. On the other hand, it probably will draw enough current through those wires to make you wish you'd had a fuse there.

Let's try an example. Assume #18 wire is used, and a short occurs one foot from the battery. That's two feet of #18 wire. According to the wire tables in the ARRL handbook, #18 has a resistance of 6.51 ohms per 1000 feet, so 2 feet has a resistance of 0.013 ohm. Add that to the 0.005 ohms internal resistance of the fully charged battery, or 0.018 ohms total, at 2 volts, or about 111 amps. The handbook says that #18 has a current carrying capacity of 2.32 amps, a specification which I believe is based on a specified, "acceptable" temperature rise. I'm not an expert in this area, but I rather suspect that 111 amps would result in an unacceptable temperature rise! (That could include things like melting the insulation, perhaps melting the wire itself, and there's always the possibility of a fire.)

Again, the moral is to make sure that you have a fuse as close as possible to the terminals of a rechargeable battery, and make sure the terminals are protected so they can't be accidentally shorted.

(I mentioned some of this in the Idea Exchange several years ago, although I didn't give the information on the larger sizes of cells or the #18 wire example.)

—DE WA8MCQ

FIX ANTENNA TRAPS WITH A BOTTLE

QRP ARCI Board of Directors member ***Cam Bailey, KT3A****, sent this tip along*—Need to replace those cracked plastic trap covers on your vertical? I have a HyGain 18AVQ-BW and it has seen better days. I am going to use it again as a stealth antenna. But, when I went to clean it up and reassemble it, I discovered that the traps have plastic covers over the top to prevent water and critters from going into the trap and that they were severely cracked. This plastic piece connects two different size aluminum tubings; one is the vertical itself and the other is the trap body.

What I am doing is taking plastic 20 ounce juice bottles made from an injection process. The brand I drink is the Fruitopia type. I cut the top off the bottle and then cut the body off. What you have left is a piece that resembles a funnel. I slide the funnel over the trap and use a heat gun (such as those for paint stripping) to "shrink" the funnel over the trap and vertical. I am going to then seal it with a water repelling silicone. I don't know how long the plastic will last with the UV rays, but it will get me by for the time being until I buy another antenna.

—DE KT3A

LADDER SAFETY

This isn't electronics at all, but certainly related to QRP. Most of us have the luxury of being allowed to put up outside antennas, and that almost always involves ladders in some way. Even those who are limited to using inside antennas may still find themselves using ladders, since it's hard to get to an attic access hatch by standing on a chair and pulling yourself up! Here are some items from QRP-L on the subject.

*First, **Roy Lincoln, WA4DOU** (wa4dou@usa.net) shared his experience--*

I was on the roof, tuning radials on a ground plane and when I went to remount the ladder it came apart, slid out from under me, and needless to say I fell to the ground. It was a new extension ladder made of aluminum, a 16 footer, considered a light duty ladder for up to 200 pounds of weight. I weigh about 180. The next day I had a sore back and leg, but survived without serious injury. As a kid, I remember tumbling off the roof occasionally while working on antennas. As a 51 year old, I don't think I need to be doing that anymore.

The lower section of the ladder collapsed sideways in an arc. I bought it recently at a home building center for $55 - $60. I should have bought a 20 footer of better construction. I hope this experience serves to illustrate that inexpensive ladders can be very costly in other areas.

When I asked Roy for permission to quote his QRP-L posting, he replied with these additional comments—I talked to the manager of the home improvement center where I got the cheap ladder. Even though it was damaged because the lower section was permanently bowed in an arc of about 30 degrees, he invited me to return it for a full refund. I took it and bought a $180 class II commercial 20 ft. fiberglass extension ladder, and a roof stabilizer for good measure! Those cheap aluminum ladders are just plain dangerous. The more folks that know that, the better.

***Monte Stark, KU7Y,** replied*--Back in my younger days I worked off ladders a lot. Here are some things I learned. NEVER use a light, cheap ladder. NEVER! Not if you like your body. When using any extension ladder, remember that there must be at least a 4' overlap on the two sections. In other words, if you have a 16' ladder you can only use it extended to 12'.

When you put a ladder up to a roof, it must extend above the roof about 3 to 4'. This means that 16' extension ladder will only let you get onto an 8' roof safely. And that's not allowing for the angle of the ladder. And don't put the base of the ladder too far out from the wall. Feel free to stop by your local fire department and ask them how to use a ladder. They will be more than happy to show you. They would much rather do that then come pick you up later!

To show that I really do believe in this, I bought a ladder 3 years ago. It's a Werner 20' fiberglass extension ladder that cost a little over $300. It's heavy. It's expensive. It doesn't "bow" out while you are on it. I feel safe when using it. It's cheaper than a fall might be. I have quit jobs over cheap ladders!

*Finally, **Adam Taylor, N7YA** (n7ya@aol.com) had this to say*--I work in the construction business, namely I've been working as a framer and pick-up carpenter. Ladders are part of the job, usually ascending them with heavy or bulky items (sheets of plywood, nail guns and hose, boxes of nails, etc). I can't stress safety enough, especially if you are not accustomed to working on ladders.

First of all, don't go beyond your limitations. If you think its too high, it probably is. Never, never use a cheap ladder--it could mean injury or death! For me, it would mean great pain and that I could no longer feed my family, so it is very important to have good equipment. Werner makes what I consider to be the best ladders (there are others if you want to shop around). They are not cheap, but neither is your life.

Don't over-extend your ladder ever, and set it up at a safe angle. As soon as it's set, make sure all 4 points of the ladder are secure and won't kick out from under you or fall to the side. My biggest fear is falling off a high ladder. (Most framing companies have a policy that says "if you fall, you're fired before you hit the ground!")

Make sure you know what you're putting your ladder up against. It must be solid. And the safety precautions on the label on the side of the ladder aren't for decoration--read them. I think that there should be a law against selling cheap, flimsy extension ladders. If you plan on doing any work on a ladder higher than 6 feet, dig down and shell out the $$$ and get a good, HEAVY ladder....its worth it! Oh yeah, watch those power lines, too!

For those out there who already know this, bear with me; not everyone knows about ladder safety and it's something that every ham should know. It's important that this info reaches anyone who plans on going up. The proper knowledge can mean a quick, safe trip up, back down, then getting on the air--instead of laying there dazed, broken and thinking "why didn't I spend more time making sure it was safe to do this...ouch!" (Or worse!)

*Final **WA8MCQ** comments.* One of the tips for climbing towers is to leave your tools and supplies on the ground, and just carry one end of a small rope up with you. When you get to working height, you pull up the rope--the other end is tied to a bucket with your tools and such. This way, you have both hands free to climb and don't have the tools weighing you down or getting in the way. I do the same when going up on the roof with a ladder if I have a lot of things to take with me. Falling off a ladder may do less damage to your body than falling from a tower, but it's still considerable.

CONNECTORS ON "WIRELESS" RADIOS

*From me, **WA8MCQ**, based on my post to QRP-L*—A while back, my daughter told me that her Casio music keyboard quit working; it wouldn't power up at all. I checked the voltage on the plug from the wall mounted power supply and it was putting out about 12VDC. From years of experience, I knew instantly what the problem was. I opened the thing up (27 screws!) and sure enough it was a broken trace on the PCB right at the power socket.

The thing uses the ubiquitous coaxial power connectors, and like a lot of electronic devices there is no strain relief whatsoever. The socket is held on the PCB by the solder on the lugs, and nothing else,

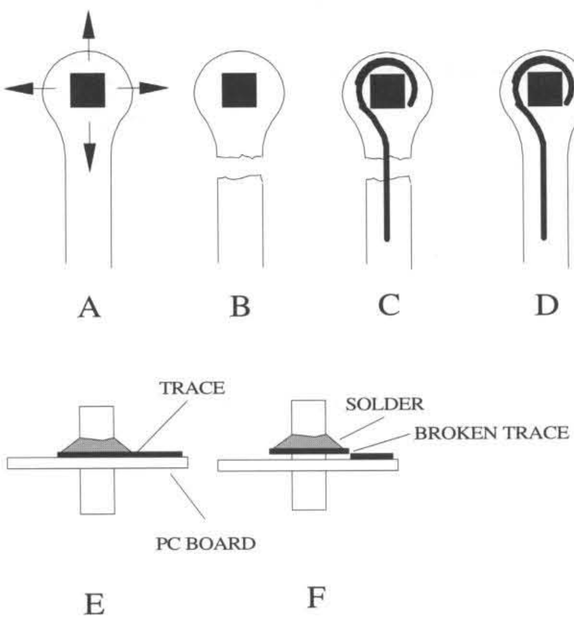


Figure 12—PCB pad can break from stress on pins and lugs imparted by unsupported connector (A). The gap at B and C is exaggerated; in the real world, it will probably be very small. Side view at E and F shows how the pad can lift and break.

so that whenever it's plugged or unplugged, or someone tugs on the power cord, force is transmitted to the solder joints (Figure 12A). Over time the pad around the contact can lift from the board due to the repeated stress and then move with respect to the trace. Result: the PCB trace broke very close to the lug (12B). The fix was simple--I bridged the broken trace with a piece of wire (12C), and to preclude further trouble I also bridged the unbroken trace on the other hot conductor as insurance in case it breaks later (12D).

I worked part time in a ham radio store from 1987 to 1994 and fixed a lot of bad HT's and HF rigs in that time. Most of the newer rigs made heavy use of connectors like the one on the music keyboard--supported solely by the solder connection on the lugs, with no mechanical strain relief on the body. It was rather common to see HT's which had intermittent push-to-talk or audio when using the remote microphones, or which would not charge when the charger was plugged in. In a very large number of cases the problem was PCB traces broken right next to the connector.

(Another common problem seen on both HTs and HF rigs was an open antenna connection. There would be a short piece of wire going from the center contact of the BNC (HTs) or SO-239 UHF socket (HF rigs) to the PCB. Even though the body of the connector was firmly mounted to the chassis, every time the antenna was connected or disconnected there was a little bit of movement of the center contact, transmitting force to the little piece of wire. Sure enough, the wire would sometimes break, either at the PCB end or the connector end. When I repaired those I tried to make the replacement wire a little bit longer to reduce the stress on it.)

The relation to QRP should be obvious. There are a number of radio designs and accessories in the QRP world that use this type of connector; some call them "wireless radios" since no wires are required between the PCB-mounted connector and the board itself. This simplifies construction considerably, but can introduce the same problem if the connector is not supported in some other way. I've seen a number of "wireless radios" in which PCB-mounted connectors are secured to a panel with a nut (Figure 13A), and these should last for quite some time. However, not all PCB connectors are designed to be held by nuts; if the only thing holding the connector in place is the solder on the lugs, as shown at B in Figure 13, they may fail eventually. This could be inconvenient if it happens at home, but if you're out backpacking it could put you off the air for the remainder of the trip, or even prevent an emergency call for help.

It might not be a bad idea to put a couple of "bandages of anticipation" (a W7ZOI phrase) in the radio like I did on the Casio

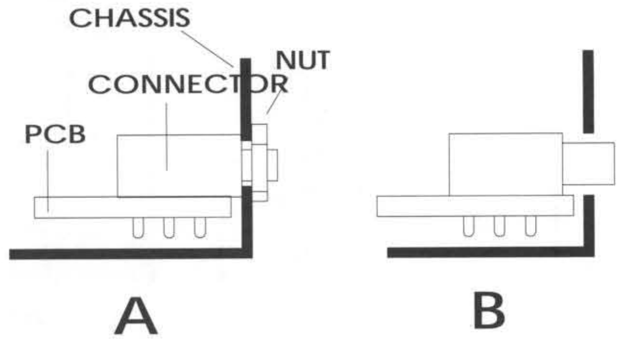


Figure 13— At A, connector is held to the chassis by a nut, relieving stress on the lugs and pads. Connector at B is held only by lugs on PCB. When plug is moved, stress is transferred to pads and may cause traces to break eventually.

keyboard. It won't prevent the traces from breaking next to the connector, but will keep the circuits intact when/if it happens. Simply connect a piece of wire from the pad of each connector lug to somewhere further along the PC trace (Figure 12D).

I could retire today if I had charged an extra dime for each time I saw this problem at the ham store!

—DE WA8MCQ

RF KEYING MONITOR

*The February 1999 issue of The Peanut Whistle, journal of the St. Louis QRP Society, had a nifty little circuit by **David Anthony, W5NOE**. It's a simple direct conversion receiver used to monitor your own signal, either as a substitute for a sidetone oscillator or to listen to the quality of the signal. It's not the first time I've seen the basic concept in print—SPRAT had an 80 meter tunable version a few years ago and the February 1999 issue of Worldradio also had one, crystal controlled on 40M, but this is the first time I've seen a bandswitching version. And since it's used as a monitor receiver and not listening to the bands, you don't have to worry if it drifts a bit or the sensitivity is a bit low. (SLQS was founded as a local QRP and homebrew group in 1987. They feel now, as then, that the QRP world is well-served by QRP-ARCI, NorCal, Michigan QRP, etc, and choose not to compete. They do not accept members from outside their area or accept outside subscribers to the Peanut Whistle. But they do allow me to share some of their technical goodies with the rest of the QRP community.)*

An RF keying monitor is useful for checking for key clicks and chirp on the transmitted CW note. I scoured the junk box and put together the unit shown in Figure 14. You may have a little direct conversion receiver board from ten years ago collecting dust; use it again this way. If it's a Neophyte, though, be sure and avoid the internal IC oscillator—build a separate VFO.

[WA8MCQ note—since the Neophyte is now 11 years old, there are probably a lot of folks who don't know what it is. Described in a February 1988 QST article by John Dillon, WA3RNC, it's a sim-

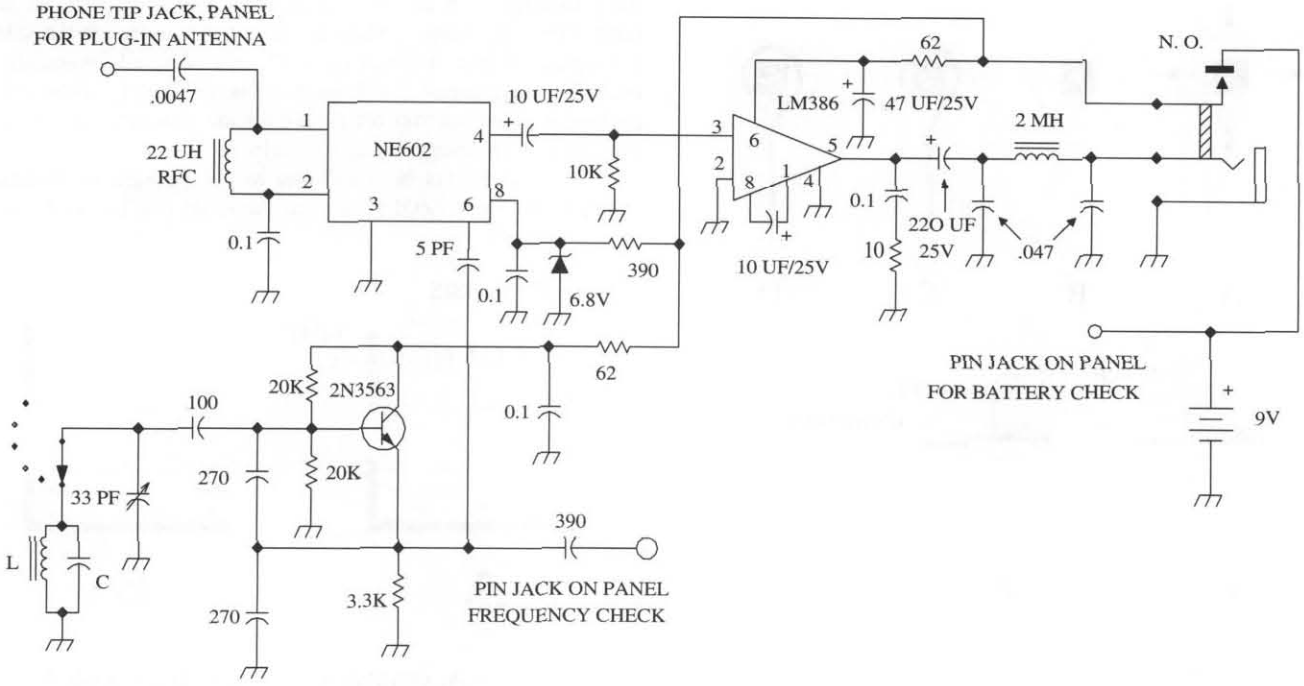


Figure 14—RF keying monitor. The phone jack with independent contact can be replaced with a regular jack and a separate power switch if desired. Test jacks for battery voltage and frequency measurement may be omitted.

ple direct conversion receiver using an NE602 and LM386, along the lines of this circuit. It really helped fuel the popularity of the NE602 in the QRP world. You may occasionally hear about the Sudden Receiver; that's the G3RJV equivalent of the Neophyte, described years ago in SPRAT, journal of the GQRP Club.]

The board and associated components are in a cast aluminum box. Any metal box will do; the tighter the RF seal, the better. My enclosure means I need a small plug-in antenna if monitoring a milliwatt rig.

Band switching a Colpitts oscillator is easy with a single pole rotary switch. I found an old two-decker, with the second deck providing useful tie points for the inductors. The C and L values in Figure 15 are simply those that matched the variable capacitor available. Inductances are mostly small encapsulated chokes—but any kind of reasonably high Q coil will work well.

Few of the component parameters are critical, so don't hesitate to substitute. Any general purpose NPN will probably do well in

BAND	15	17	20	30	40	80
C PF	18	—	56	—	82	—
L UH	0.68	1.0	1.0	3.3	3.3	22

Figure 15—Inductance and capacitance values for the RF monitor. (Sorry—no toroid winding information was given.)

place of the 2N3563. The NE602N will be happy with Vcc supplied from an 78L06 or 78L08 regulator. A phone jack with isolated, normally open contacts, if you can locate one, is handy to act as power switch. Know that sinking feeling when you realize the on/off toggle switch has been left "on" and the battery drained?

—DE W5NOE

QRP-L ARCHIVES NOW ON CD ROM

Chuck Adams, the founder and overseer of QRP-L, the Internet discussion forum, has put all of the archives (quite a few years worth) onto CD ROM. At the time of writing, it is available only by sending a blank writable CD ROM with a return mailer and postage. It will have the info copied onto it and returned. He has several people helping him out with this, so you send your blank disk to the one nearest you. If interested in getting a copy, send me e-mail (wa8mcq@erols.com) and I'll give you the current information from Chuck. (Note—do NOT send any blank CD ROMs to me since I am not part of the project.)

QRP-L, THE "QRP DAILY"

Started by Chuck Adams, K5FO in 1993, the Internet QRP discussion forum (mail reflector) is still going strong, with several dozen QRP postings every day (that is NO exaggeration, as anyone on QRP-L knows!) and over 2500 subscribers. Although it's not a traditional club in the sense of a group of people who meet physically, it has become the largest, most active QRP "club" in the US. If interested in details of subscribing to it (which is free, of course), ask me via e-mail (wa8mcq@erols.com) and I'll tell all, including some alternate ways of reading it that DON'T clutter up your inbox with 50 to 100 additional messages each day. (The Daily Digest is a big help, but the HTML Archives are an absolute lifesaver!) By the way, since it is a mail reflector, you do NOT have to have full blown Internet access; just an e-mail account, such as juno.com, will do.

THE FINE PRINT

Got something you'd like to share with the rest of us? Send it in! Floppy disk, e-mail, handwritten on notebook paper, whatever—just get it to Severn and I'll handle the rest!

—qrp—

To VE or Not to VE: QRPing the RAC Contests

Jim Gooch, NA3V 2475 Miller Avenue, Huntingdon, PA 16652 email: Gooch@Juniata.edu

QRPers in the U.S. spend most of their time working each other on east-west paths, or else chasing exotic DX. Twice a year, though, we should point our earphones north to be in on the action. The Radio Amateurs of Canada (RAC) organization sponsors two 24-hour contests: The Canada Day contest on July 1, celebrating the anniversary of Canada's Confederation, and the Canada Winter Contest on a weekend near Christmas. Both contests operate CW and SSB with high power, low power, and QRP categories. Contacts with Canadians are worth 10 points; with official RAC stations, 20 points; with U.S. and DX stations, 2 points. Canadians give RST and province or territory in the exchange and all others give RST and serial number. Multipliers are the 12 Canadian provinces and territories on each mode/band. On April 1, 1999 the North West Territory (NWT) will be divided and Nunavut, VY0, will become the13th multiplier in RAC contests.

Canadian multipliers are clustered in the small Atlantic Maritime Provinces: NB (VE9), NS (VE1), PE (VY2), and the bigger NF (VO1, including Labrador, VO2). The other provinces are widely spaced, double-Texas-sized chunks of real estate. The eastern pair, QC (VA2, VE2) and ON, (VA3, VE3) are poor in multipliers but rich in ham operators and point potential. Stretching westward are MB (VE4), SK (VE5), AB (VE6), and BC (VE7). Russ Carpenter, AA7QU, coined the term "Coyote Factor" in The Adventure Society's online newsletter *The Sojourner* – if your signal lands in a region more populated by coyotes than by people, you won't make many contacts. West of ON, Canada is semi-coyote country. Nonetheless, there are pockets of lively contest activity, and you will catch plenty of QSOs and multipliers when you skip your high-band signals across the prairies and the Rockies. Real coyote country – polar bear country is more like it – is the Yukon Territory (VY1) and the Northwest Territories (VE8) in Canada's frozen far north. Contest signals from there are scarce; you'll know them by the gargantuan pileups.

Shortly after Christmas, 1998, sleepy and stuffed full of turkey, I read the notice of the RAC Canada Winter Contest in QST. A long contest after all that turkey? Forget it! On the other hand, it was a chance to sew up the Canadian QRP Award. So, 0000 UTC of Dec. 27 found me at my TS-570, power set to 5 Watts, listening on 40M CW. Right away VY2SS's CQ came booming in from teeny little PE and I bagged him. Then I picked off VE9RAC from NB – a twenty pointer! Uh-oh, here we go again. The bleat of VE signals began to sound like meat on the hoof to a hungry predator! Forgetting the QRP award, I was hot on the trail of contest points.

Well, not so hot. I was a lowly 5-Watter on a wire antenna and worth two puny points to boot. After some fruitless CQing, I switched to search-and-pounce. That is what I did for 14 of the next 24 hours, netting 127 QSOs and 35 multipliers. That's a sluggish 9 contacts per hour – some predator! Even so, the RAC contest was a ball, and I look forward to the summer version.

When you're a little plink in the Anvil Chorus, you have to plot tactics. As an easterner, I realized my best bet was to work the low bands hard. Part of ON angles down between NY and MI, making it a short hop from my PA QTH to all those juicy VE3s. Likewise, the Maritime Provinces and QC were within nighttime reach on 160, 80, and 40M.

Scratch 160M. The Stew Perry contest was wall-to-wall on 160 CW and my SSB signal died over Lake Erie. Eighty meters was better – 6 to 10 VEs were CQing on the CW portion and about the same number on SSB. The callers were busy – folks were flitting from caller to caller, handing out points, like in stateside QSO parties. Every couple of hours the callers gave way to a new batch, making it possible to work the band again and again.

Eighty-meter SSB was good fun. Many of the VEs there sounded like pudgy old guys living it up with their friends. Every one of the 24 I called came back to my QRP whisper with patience, good humor, and best wishes for the New Year.

Forty meter CW was a repeat of 80M, except the skip was longer – I got out as far as SK and AB. SSB, though, was a desert, no CQers, no coyotes even. As Peter Larsen, VE6YC, who had 163 40M SSB QSOs in the contest, later reminded me, 7050 to 7100 MHz is allocated to SSB in Canada, and Canadian hams hang out down there away from the broadcast QRM, and there isn't much split-frequency activity. U.S. QRPers will have to kiss goodbye to those points.

The higher frequencies opened up on the second day of the contest. I worked the Maritimes on 20M CW and rolled up VE4, VE5, VE6, and VE7 in the other direction. Fifteen and 10M netted me VO1 and VO2 and most of the western provinces, but the Maritimes were inside my skip zone. I managed a few SSB QSOs on the higher bands, though QRPers need a gain antenna to muscle into that spectrum. There was a big pileup on VY1RAC and smaller ones on other RAC stations. Brian Kassell, W5VBO, who totaled 113 QRP QSOs in the contest from his AZ QTH, has good advice here: He marked the frequencies of the rare VEs and returned to them after the pileups had dwindled.

I began to hear more and more U.S. stations calling "CQ TEST." At first I turned up my nose at the locals. That was a mistake. When Canadian bacon gets scarce, go for U.S. ham – those 2 pointers add up. So I started chasing U.S. stations, but it was too late, too late... On a happier note, some DX showed up and I worked HA, LZ, EA, IZ, and OM. QRPer Bill Stietenroth, K5ZTY, in TX, also worked DX, mainly European on 15M among his 101 QSOs. A DL station gave Bill's one Watt a report of "559 gud sig."

Why are the RAC contests good ones for QRPers to mark on their calendar? Because they generate contest pressure, but not too much; the exchanges are easy to handle; the geography of multipliers isn't hard to figure out; and they don't kill the whole weekend. Finally, they are friendly contests – K5ZTY, W5VBO, and VE6YC, whom I thank for providing me input on their contest experiences, were unanimous on that score. Dave Goodwin, VE2ZP, former RAC HF Contest Manager, says that QRPers are more than welcome in the contest.

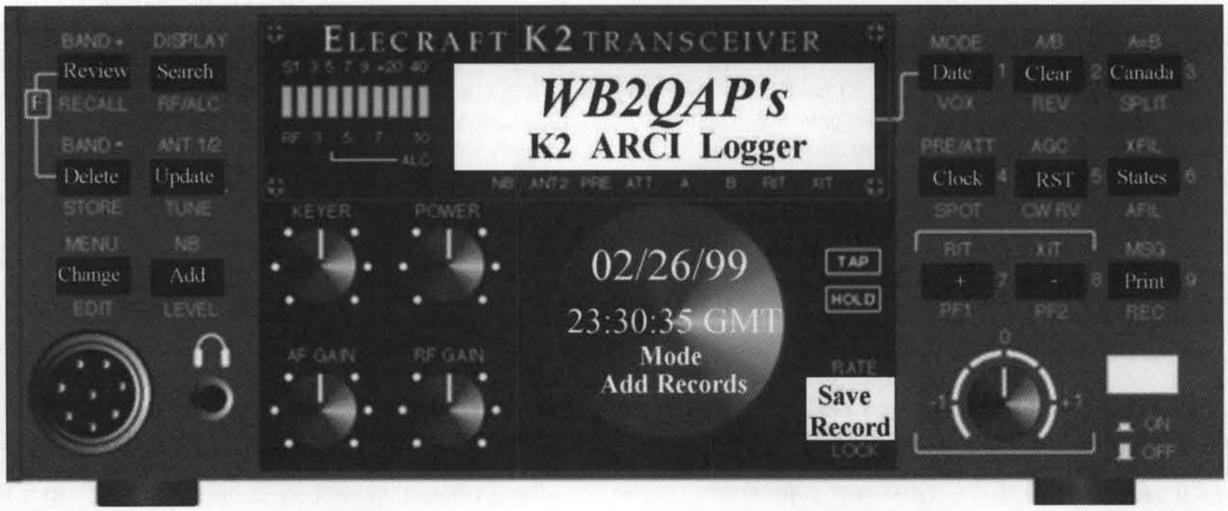
A few words on contest tactics. Easterners may have an advantage in RACking up points, because they can tap into populous ON and QC and the lush Maritime multipliers with their low-band antennas. W5VBO and K5ZTY couldn't hope to do as well on the low bands, and more of their QSOs were made with high band Yagis. On the high bands the advantage shifts to the middle of the U.S, since the skip from the east is mainly into semi-coyote country. Far westerners with mediocre antennas get the shaft either way. If your antenna is efficient enough, of course, the rules are different; using a 40M dipole at 82 feet, VE6YC aced the multipliers on that band. Generally speaking, QRPers will have to search-and-pounce for their contacts, although K5ZTY was able to run a frequency at times. At first I thought pileups would be a problem; a weak signal with a U.S. prefix should be pretty far down the priority list of rare VEs. Usually, though, I was answered after a few tries. I never concluded my callsign with "/QRP." A quick, in-and-out comeback is better, I think, to slip in during pauses in pileup QRM. Incidentally, W5VBO and K5ZTYdid crack the mammoth pileup on VY1RAC that I couldn't – which shows what good technique and a gain antenna can do on 5 Watts.

So, around Christmas, when the icicles are longer than your J-pole, and on the first of July, when even the wiring's perspiring, one of the RAC contests is about to begin. It's a good time for QRPers to fire up their rigs and pitch in.

Edited by W1HUE

K2 Logger Program for ARCI Contests

Bruce Milne, WB2QAP *2350 Clark Road, Penn Yan, NY 14528*
e-mail: bmilne@afcon.net



Several years ago, I wrote a simple logging program on an Epson Geneva laptop computer, using BASIC as the programming language. The program was designed specifically for ARCI sponsored contests. Later versions ran on MS-DOS, Windows, etc., and were reviewed in the Quarterly. Another version of Logger was incorporated into QRPPAL, a QRP program that included rig reviews, club information, etc.

This latest version is designed to run on Windows 95/98. It was written using Visual Basic 5, and will run as is on Windows 98. Windows 95 users may need to download a Visual Basic 5 runtime engine (vbrtsp3a.exe) or the like from one of the shareware sites (www.shareware.com, etc.). THE PROGRAM REQUIRES THAT YOU RUN YOUR SCREEN RESOLUTION AT 800 X 600. The program uses the Elecraft K2 transceiver as a graphic interface. Due to the number of controls on the K2, 800 x 600 resolution was the best choice to show off the rig. Use of any other resolution will result in a very "scrambled" screen.

The program will check for dupes, print out your log, and even print out a summary sheet in ARCI format (a new feature). You simply enter the date (callsign, rst, spc, etc.) and the program does the rest. The time and date are filled in automatically, however, you must set the time and date when you start the program. A file called Qrpdata.dat is created to store your data. A secondary file called Arcifile.dat is also created, and can be used as output to a word processor, etc. (Another new feature). You must remember to delete these two files or change their name after each contest.

Below the K2 graphic, are two data entry forms. The first is used to enter new contest contacts into the program. The second form is used to make changes, deletions or review entries. Below these two data screens, is an update box, which provides you with a visual display of how you are progressing (points, multipliers) for each band.

As with previous versions of Logger, Canadian SPC needs three letters (ex: ONT), DX requires four letters (ex: SCOT). Help is provided in convenient drop down menus to show the proper Canadian abbreviations to use. A state abbreviations menu is also available. Drop down menus are also available for setting the clock and date. Another drop down menu displays the RST system.

An extensive help file is available as a drop down menu. All help files are displayed on the K2's frequency dial. The spinner knob on the K2 displays the date, current time in GMT, and the program feature you are using.

The buttons on the left side of the K2 are used to search records, delete records, add records, update records, review records and change records. The buttons on the right side of the K2 are used to bring up the drop down menus (clock, date setting, RST system, SPC abbreviations, etc.) Although I have no connection with Elecraft, a separate drop down menu provides specifications for the rig (general features, cw features, receive specs, etc.)

This program has one feature that is identical to my previous QRP efforts. It is absolutely FREE and can be freely distributed.

The program can be downloaded from:
http://wg104a.wh.uni-stuttgart.de/~n4bp/
(Bob Patten, N4BP's homepage)

Link-Coupled Antenna Tuners
Part 5: Components, Construction, and Measurement

L. B. Cebik, W4RNL *1434 High Mesa Dr., Knoxville, TN 37938* *email: cebik@utk.edu*

This is the last installment of my series of articles on inductively coupled antenna tuners (ATUs). The remaining questions we need to examine are component values and ratings, construction practices, and measurements to assure best results. Let's look at these questions, one at a time. We shall be focusing upon parallel-tuned secondaries, with either taps on the inductor secondary or a capacitor-divider to accommodate a wide range of load impedances. Figure 1 provides an abbreviated schematic diagram of both types of circuits. We shall use C_P, C_S, and C_D to sort out the capacitors in the primary, secondary, and (if used) divider circuit. L_P and L_S will designate the inductor primary and secondary windings respectively.

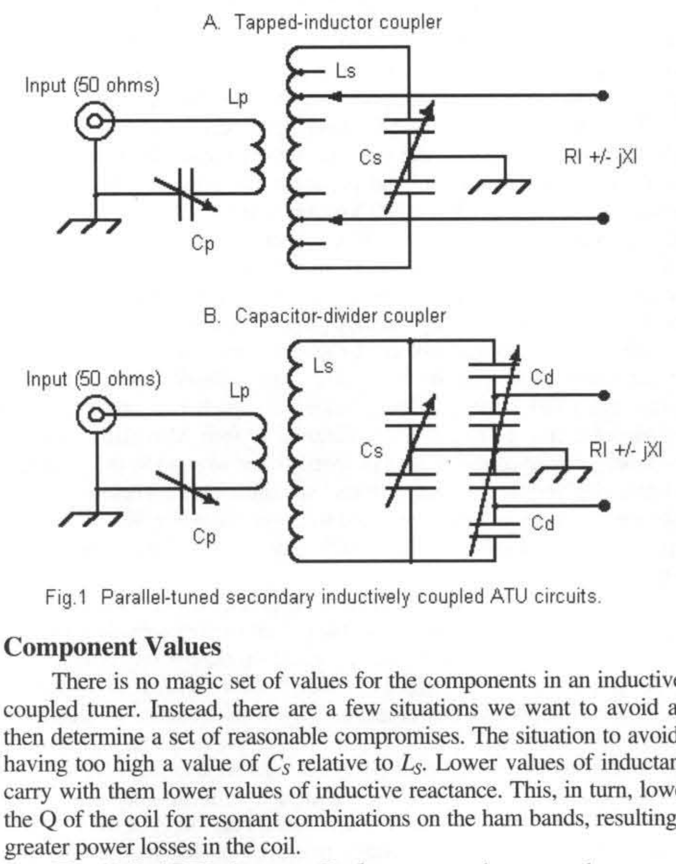


Fig.1 Parallel-tuned secondary inductively coupled ATU circuits.

Component Values

There is no magic set of values for the components in an inductively coupled tuner. Instead, there are a few situations we want to avoid and then determine a set of reasonable compromises. The situation to avoid is having too high a value of C_S relative to L_S. Lower values of inductance carry with them lower values of inductive reactance. This, in turn, lowers the Q of the coil for resonant combinations on the ham bands, resulting in greater power losses in the coil.

The 1960 ***ARRL Antenna Book*** recommends a secondary component reactance value of about 500 Ohms as a reasonable compromise. This value tends to yield higher Q inductors whose physical size is not too much different from the physical size of variable capacitors having the desired characteristics. The following table lists the resulting values, not only for the secondary components, but for the primary components as well (assuming a 50-Ohms matching with the transmitter). I have extended the list to include the WARC bands.

These recommended values tell us several very practical things. First on the list is the reason why commercial ATU manufacturers rarely try to cover 160 meters with an all-band tuner. The 160-meter coil will be roughly twice as large—for any given power level—as the 80-meter coil. Likewise, the tuning capacitor will be large. In the primary circuit, the series capacitor may require either ganging two variables or adding fixed capacitors in parallel with a 1000 pF unit.

In general, the component size question for 160-meter tuners also inclines builders to use a tapped coil secondary circuit (instead of the capacitor-divider system). Taps every two or three turns down to a coil size of 50% of the full length should suffice for most loads encountered. For a specific antenna system, once the correct taps are found, they should not need to be changed. Indeed, it may be possible to use a good ceramic wafer rotary switch to move between taps.

Recommended Component Values for a Link-Coupled Tuner

Band	L_S (µH)	C_S (pF)	L_P (µH)	C_P (pF)
160	42	170	4.2	1700
80-75	22	90	2.2	900
40	12	45	1.2	450
30	8	32	0.8	320
20	6	23	0.6	225
17	4.5	18	0.45	180
15	4	15	0.4	160
12	3.2	13	0.32	130
10	2.9	12	0.29	120

Second on our list of lessons from the recommended values is the practicality of an 80-10 meter link coupled tuner. For a very simple design, coil taps may be used, but the capacitor divider system may prove far superior in terms of its continuous range of adjustment. A dual differential capacitor of about 100 pF per section will generally suffice for the capacitor divider.

If we use the primary series capacitor, we may be able to combine the 12 and 10 meter positions to save one band switch position. Likewise, the 17 and the 15 meter position may be combined. A three section, six-position ceramic rotary switch should suffice to cover all the bands.

Notice that the primary coil should also be tapped for band changing purposes. Depending on the coil construction, some builders may wish to cover more than two bands with a single tap, since tapping at partial turns may be physically inconvenient. Tapping the primary is normally done on only one end of the coil. Hence, the position of the primary coil may not be perfectly centered for all bands. This slight imbalance does not produce any significant negative effects.

The series circuit may be altered to use lower values of series capacitance by increasing the size of the primary inductor. Values up to double or triple the recommended value may be used on 80 meters to make use of series capacitors in the 350-500 pF range. As the frequency is increased, the coil taps may be brought closer to their optimum recommended values, since the required resonating capacitance would fall within the range of the smaller unit selected.

As one increases frequency toward the high end of the HF spectrum, the range of the capacitors is not optimum for smooth tuning. Although circuit Q may be satisfactorily low, control positions may be very sharp. Ideally, one should consider separate tuners for 80-20 meters and for 20-10 meters. The latter unit may use smaller capacitors and more widely spaced inductor turns. However, for all-band doublets and similar wide-ranging antennas, the 80-10 meter ATU is usually the design of choice.

In principle, if space is available, paralleling a high value with a low value variable capacitor can provide more optimal control of capacitance. Both capacitors should have the same voltage rating. At 14 MHz and above, the larger capacitor is switched out of the circuit. Below 20 meters, the smaller capacitor is set at mid-range, with main tuning done with the larger capacitor. The smaller capacitor may then be used as a "fine tuning" control. Since this system requires extra space, an alternative is to use a reduction drive with the main tuning capacitor.

The capacitance values given in the above table are the total capacitance across the parallel-tuned secondary circuit. Split-stator or ganged capacitors are normally used to preserve balance across the circuit. Each section should have a capacitance of twice the listed value so that the series combination equals the recommended value.

Varying the circuit values does little harm to coupling efficiency so long as sufficient flexibility is maintained in the primary series resonant circuit and in the secondary load impedance transformation circuit. Limitations show up chiefly in the range of load impedances that the coupler can effectively handle, and careful line-length adjustment can usually provide load values within the capabilities of the coupler.

Component Specifications

The best way to look at the components, is one at a time.

Inductors: For moderate power levels up to 200 Watts or so, air-wound inductors with a diameter of 2 to 2.5 in. and eight turns per inch (TPI) are very practical. They provide reasonably sized inductors with good Q across the HF range. Inductor Q will normally decrease at the highest frequencies in the range. For 160 meters, a coil of larger diameter may be required to keep its length within reason.

Placement of the link at the center of the secondary usually follows one of two physical designs. In simpler designs, the link may be several turns of the main coil stock. The turns adjacent to the limit of the link are tied together to provide continuity in the secondary. Although this system will work, it limits the range of coefficients of coupling. Tighter coupling can be obtained by placing the primary inductor over the secondary. For fixed links using typical air-wound inductor stock, a nonconductive adhesive can bind together the support bars of the coils.

The current that the parallel-tuned secondary coil must handle can be estimated from the following simple equation:

$$I_C = Q_L\sqrt{\frac{P}{R_L}} \qquad 1$$

where I_C is the estimated maximum circulating current in Amps, Q_L is the loaded or working Q of the coupler, P is the power level in Watts, and R_L is the load resistance in Ohms at resonance. For a maximum Q of about 10, a power level of 100 Watts, and load resistance of 5000 Ohms, the maximum current will about 1.4 A. If we use the ideal case in our running example of a load resistance of 1500 Ohms and a Q of 2.8, the current is only 0.7 A.

Increasing the power to 1500 Watts from 100 Watts increases the circulating current by the square root of the power ratio. For the two sample cases, the maximum current will be 5.4 A and 2.7 A, respectively. For high power applications, #12 wire is generally satisfactory for these levels, while #14 wire may be used at mid-level powers.

For very low power levels, such as those encountered in QRP work (five Watts or less), it is theoretically possible to use wire as fine as #20 or #22. However, at very low power levels, every effort should be made to minimize power loss. The high power wire sizes do not guarantee minimum loss, but only that power losses in the inductor wire are not problematical. Minimum loss wire sizes would be larger, and at QRP levels #18 wire or larger is always in order for inductors with minimal losses.

The current in the primary winding is a function of the coil reactance and the power level. For example, if we use a coil with a reactance of about 50 Ohms, the current at 100 Watts power will be about 1.4 A. Viewed another way, the current will be about the same as the maximum circulating current in the secondary tank circuit. Hence, wire size recommendations applicable to the secondary are also applicable to the primary.

Capacitors: The chief problem facing inductors is heat from the conversion of RF currents. This problem has a time domain, and brief periods of excessive current are often without harm. With capacitors, the chief problem is arc-over, which may result from virtually instantaneous peak voltages across the capacitor plates.

The voltage across the primary series capacitor will be a function of the capacitor reactance and the power level. If a 50-Ohm capacitive reactance is used, then at 100 Watts, the voltage peak will be 1.4 times the R.M.S. voltage across the capacitor or about 100 Volts. At 1500 Watts, this peak voltage will increase by the square root of the power increase to about 385 Volts. These levels are within the abilities of various sizes of receiving capacitors, which are often employed to achieve the high values of capacitance needed at 80 meters.

If the 80 meter capacitance is reduced to 1/3 of the recommended 1000 pF, the capacitive reactance will increase by a factor of three. In this case, the peak voltage at the 100 Watt power level will be about 170 Volts. At 1500 Watts, the peak voltage reaches about 665 Volts. More widely spaced capacitor plates will be required.

In the parallel-tuned secondary circuit, the peak voltage is simply 1.4 times the R.M.S. voltage across the tuned circuit. The line voltage is a function of power level and load resistance, where

$$E_{peak} = 1.4\sqrt{P \times R_L} \qquad 2$$

For the example using a load of 5000 Ohms at 100 Watts, the peak voltage is about 1000 Volts. Where the load is 1500 Ohms at the same power level, the peak voltage drops to 540 Volts. At the 1500 Watt power level, these peak voltages increase to 3870 and 2100 Volts, respectively. However, off-resonance voltage peaks may be considerably higher.

The actual arc-over voltage for a capacitor depends on many factors, including the sharpness of the edge of the capacitor plates and the air quality and humidity around the capacitor. In general, capacitors are chosen with a good reserve. 1500-Volt units are common at 100 Watts, 3 kV units at 250 Watts, and 7 kV or higher units for the legal amateur power limit. These values provide about a 2:1 safety margin in balanced circuits using split stator or ganged capacitors, where each unit of the whole capacitor sees only half the total peak voltage across the line.

An often overlooked aspect of capacitor construction is the size of the capacitor frame and its materials. Large, closely spaced metallic frames can restrict the minimum value of capacitance obtained by a variable capacitor. E. F. Johnson units used in their MatchBox series of link tuners employed the minimum metal frame to support the capacitor and provided very low values of minimum capacitance. These or similar units are desirable in tuners designed to cover the entire 80 to 10 meter range of amateur bands, especially in the parallel tuned secondary of the coupler.

Capacitor construction is equally important in maintaining circuit balance with respect to ground. Split-stator capacitors provide an inherently balanced structure, with roughly equal influences on both sides of the circuit from stray capacitance to a metal case or other metallic objects in the circuit. Single-section capacitors, while usable, tend to unbalance the circuit by coupling more capacitance through the larger structure of the frame than through the set of plates not connected to the frame.

For capacitor-divider circuits, the capacitors form a series chain of four units across the line. Each unit sees about one-fourth of the total line voltage. However, with considerable reactance on the line, the voltage across each unit may be somewhat higher. Therefore, the voltage rating of the dual differential capacitor is usually set to be the same as for the split-stator tuning capacitor.

When an inductive coupler is undergoing initial tuning, the control combinations may result in very high voltages across capacitors in the circuit. Therefore, initial tune-up should always be done at the lowest power possible to prevent component arc-over.

Rotary Switches: Rotary switches used to change bands or coil taps should have large, well-spaced contacts. The material should be ceramic, rated for RF service. For medium power levels, standard 1.25-in. wafers are normally satisfactory. For high power, use larger switching wafers with more widely spaced and large contacts.

Shorting switches—that is, switches that connect together all preceding switch positions—are preferable to simple switches that leave preceding switch positions open. Shorting out the unused turns in the secondary coil normally results in fewer problems with power losses from circulating currents in those turns. However, only experiment can usually determine whether the inter-turn capacitance in combination with the inductance of the unused turns may result in a resonance at some harmonic of the operating frequency. For this reason, some designers add an additional coil position on multi-band tuners, roughly tuned to 5 to 5.5 MHz. Although this tap might prove useful on some occasion with particularly troublesome 80 or 40 meter loads, its chief function is to reduce the size of shorted inductor sections when operating above 40 meters.

Terminals: The input terminal for most ATUs will a standard coaxial cable fitting. Output terminals should be ceramic feed-through types. Ring or U terminals are normally used for both inside and outside connections to the threaded shaft that runs through the dual ceramic pillars. Steatite, developed three quarters of a century ago, is still the usual ceramic of choice for RF service in the HF bands.

Construction and Operation

The inductively coupled tuner is essentially a combination of passive circuits and produces no power of its own. Therefore, the shielding practices normally used for power producing equipment are to a large measure optional with antenna tuners. Perfectly operational tuners may be laid out on breadboards or placed within attractive wooden or clear acrylic cabinets. Perhaps the only operational caution with unshielded layouts is to insulate control shafts in order to prevent shock hazards and hand-capacitance effects. Safety to shack visitors (or to the operator) is a strong reason for enclosing the tuner.

If a metal case is used, it should be large enough to permit all components to be well spaced from metallic surfaces. This precaution reduces the introduction of stray capacitance, which can reduce the flexibility of the variable controls, especially at higher frequencies. With metal cabinets, long, sturdy ceramic standoff insulating posts must be used for components that require isolation from ground.

Component layout should follow good RF practice, with attention to maintaining secondary circuit balance. Hence, leads to and from comparable points on either side of the center of the secondary should be as short as possible and of roughly equal length and proximity to adjacent components. Leads in the secondary should use wire of the same size as the coil winding. It is possible to space switch wafers to achieve this physical balance, and the rest is largely a matter of component placement.

The primary side should use short heavy leads. If the coil primary assembly is at some distance from the coax fitting, a length of coaxial cable may be used to connect the two.

A common ground of the smallest spread provides the least potential for excessive current circulating in this path. Even when metal cases are used and form the ground buss, care should be taken to use contact points in closest proximity to each other, commensurate with the use of short leads.

Input and output measurement circuits, if internal to the tuner, should be isolated from the fields surrounding the main components of the tuner. The DC and meter portions of the measuring circuits are best isolated by placing them in grounded metal boxes as far as possible from the main coil and capacitors.

The input side of the coupler is normally an unbalanced circuit. It requires a common ground. Ideally, this ground should be common with the other station equipment ground as well as the station earth ground.

The balanced secondary of the tuner presents the user with some options. Ordinarily, the center of the coil is left ungrounded (or "floating"), largely due to difficulties presented by the centering of the link over the center of the secondary inductor. The center of the split-stator tuning capacitor and the junction of capacitor-divider differential units are often grounded as a matter of construction convenience when using metal cases or chassis. This connection is, however, optional. (However, it is good practice to connect the junction of the differential capacitors to the common rotor of the main tuning capacitor.)

Grounding the center of the secondary circuit provides a common reference for the two sides of the feedline and the secondary circuit. However, it also provides a point of direct coupling for out-of-band signals. Such coupling is significantly reduced if all secondary components are left floating. Home constructors may wish to experiment to determine the best system for their individual situations. A floating secondary may be especially useful with 160-meter tuners, where strong AM broadcast band stations require all the filtering possible.

Tuning the coupler is a matter of finding the correct control settings for maximum output and a 1:1 SWR at the input. Initial tuning is largely trial and error in the absence of definitive knowledge of the load resistance and reactance. For a tuner using a tapped secondary inductor, a trial balanced pair of taps is the starting point (at low power, of course). The secondary capacitor is resonated, as indicated by a dip in the SWR metering circuit that is in the primary line either inside or outside the tuner. The series capacitor is then adjust to the lowest SWR, followed by a series of alternate "tweakings" of the primary and secondary capacitors. If the initial taps do not result in a 1:1 SWR, the next adjacent set should be tried—and so on until the match is obtained.

The goal is to use the set of taps closest to the outer limits of the secondary inductor that permit a perfect match. These taps represent the lowest working Q for the circuit and thus provide the largest bandwidth for satisfactory operation without further control adjustment. Ordinarily, they also provide maximum power output. However, as noted along the way, it is possible—although unusual—to find a perfect match while most of the current is circulating within the components rather than going into the load.

For the capacitor-divider coupler, the coil tap is usually fixed by a band switch. Adjustment involves alternate changes to the series primary capacitor, the secondary resonating capacitor, and the differential capacitor. However, the aim is the same: the lowest Q (and broadest tuning) that still permits a perfect input SWR reading. Since an opaque case and simple reference marks tend to obscure what is happening with the capacitor-divider, the bandwidth of an adjustment set may be the only indication that the most satisfactory match has been obtained.

All final setting should be logged and attached to the tuner case. Not only do they ease the adjustment when changing frequencies, they also provide a reference for antenna system diagnosis. If the required settings drift with time, vary radically with certain weather changes, or change suddenly to a new permanent set, antenna and feedline maintenance is indicated.

Measurement

Two measurements are important to any coupler: the match of the input circuit with the line to the transmitter (and receiver) and the relative power output. Ordinarily, we make the first of these measurements and simply presume that the second needs no measurement. The ordinary is simply not good radio practice.

The input monitor usually consists of an SWR metering circuit mounted within the tuner cabinet or placed in the line between the tuner and the transmitter. Either system works well. Since SWR circuits are legion, no further comment on them is required, except perhaps for the reminder that the DC metering portion of the circuit should be well shielded from the fields of the tuner components.

Output measuring has long been unnecessarily difficult, since standard recommendations call for RF Ammeters, which are difficult to find, especially in the ranges useful for the wide variety of amateur power levels. For higher power, light sources coupled to high-voltage positions along the line have provided an alternative power output indication.

Since the coupler may encounter a wide range of load impedances whose actual values are not easily determined, true power output is not the measurement of choice. Rather, efficient operation of the coupler is a matter of achieving the highest possible power output for any given input. Hence, a relative power output indicator is sufficient for most non-laboratory applications.

For any given load impedance, both the current and the voltage will rise as power is increased. Both rise as the square root of the power increase. Therefore, a simple voltage sampler may be connected to the output terminals of the coupler and left in the line permanently. The sample voltage can be rectified, filtered, and then measured with a Voltmeter. For relative readings, where we wish to track the rise and fall of the voltage as we adjust tuning controls, an analog meter is preferable.

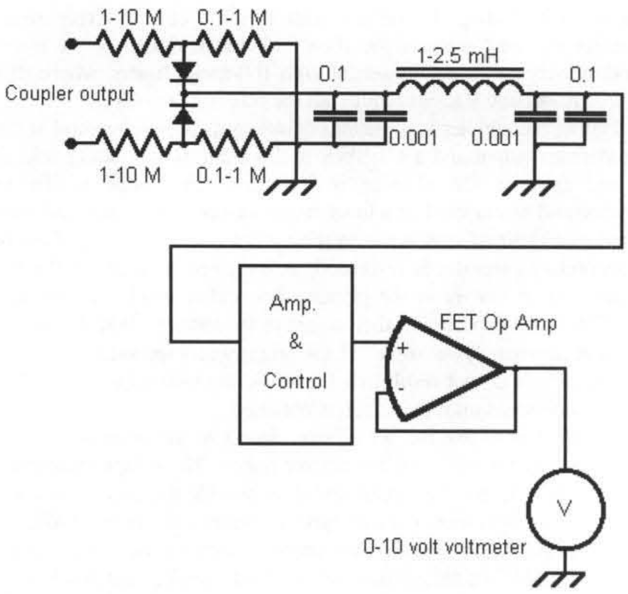


Fig. 2 Partial schematic diagram of an output-monitoring circuit.

Figure 2 shows the basic diagram of a relative power output meter. High value voltage dividers go from each terminal to ground. The resistors should be in the megohms, but the exact values should be determined experimentally for the range of impedances and power levels used by a particular station. Diodes provide full-wave rectification of the sampled RF. At levels above QRP, use high-voltage diodes as a protection from reverse voltage breakdown. The potentially high impedance at the ATU output, with its high voltage excursions, requires a higher level of filtering than normally used with low impedance SWR metering circuits.

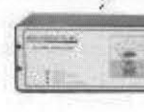
In this basic circuit, a simple potentiometer may act as a sensitivity control and thus be the only element within the "Amp. & Control" box in Figure 2. An FET op-amp in a voltage follower circuit provides the voltage and current for the Voltmeter. It is wise to add a Zener diode or other protection to prevent meter damage from excessive voltage levels.

The circuit is open to innumerable improvements in the "Amp. & Control" section, especially for automating the meter range for the wide variety of sample voltage levels that the tuner may provide. A second voltage divider might be used as a reference to one of the bargraph LED driver chips to obtain up to ten decades of control. The chip output would not only light an LED telling the operator which decade was in use, but as well trigger a control chip that inserted the correct voltage reducing resistor for each step rise in power level. Of course, such improvements require a modicum of power, and all such circuitry requires excellent shielding.

The point of this exercise is to move us into contemporary means available for monitoring coupler output without disturbing the balance of the tuner at any power level. By tracking relative power output from the tuner, we can assure that we not only have achieved a correct input-side match, but have achieved maximum power output as well. It is the output that does the work of communicating, not the match.

This small tutorial has drawn on a large number of sources in an effort to bring together the principles and practices of inductively coupled tuners. If such tuners are better understood, they may once more take their proper place beside network tuners, each doing the job for which it is best fitted and not being forcefully adapted to a task which it is not well-fit to perform. Despite nearly a half-century's effort to make coaxial cable the only ham cable, amateurs are discovering that parallel transmission line has an important place in the array of antenna-transmission line combinations. And wherever parallel transmission line is used, the inductively coupled tuner has a natural home.

Edited by W1HUE



The Great Power Divider

by Al Bates, W1XH

Contests Rules handle the problem of power equalizers in much the same way. Above (or below) a certain power level, you multiply your score by a fudge factor. For those of us under 5 watts, you might multiply your score by 4 or 8 or whatever. From 5 watts to 100 watts, a multiplier of 2 might be applied. Above 100 watts the multipler is usually, 1. (Above the legal limit, the power multiplier is zero! Think about it.)

That never seemed altogether fair to me. It's too random. I mean what's the advantage to running 1 watt or 5 watts if the multiplier is the same? I got to thinking and came up with a different power multiplier. It's the Power Divider.

It's simple. Take your number of contacts and multiply by the states/countries or other factors and then divide the total by your output power in watts. For example, 100 QSO's times 2 points per QSO times 16 sections gives you a raw score of 3,200. Now apply your "Power Divider" of 5 for five watts to get the final score of 640. See how easy it is? If you run only two watts and make the same number of contacts, your final score is 1,600, a vast improvement. Score equals QSO's divided by power.

(I actually sold this idea to a not-to-bright QRO type at work. We had our own private competition during a Sweepstakes one year. He ran 100 watts and I ran 5 watts. It doesn't take too much math to realize he had to make 20 contacts for every one of mine. My easy 200 contacts "out scored" his 1000 + total. He bought coffee and doughnuts for a week after the contest.)

All you contest managers out there might want to adopt my power divider scheme. It is a great equalizer. By the way, the skeptics among you might want to get out your calculators and see what happens if you run less than 1 watt.

Al Bates, W1XH, 2 Coach Road, Chelmsford, MA Email w1xh@arrl.net. First licensed in 1961 as WV2RIN, then WA2RIN, and WA1RNS. Most recently employed at Museum of Science in Boston. Ham interests are QRP, contests, rag chewing and playing with antennas. Member of QRP ARCI since 1961, but more or less active since 1977.

Review: EZNEC Antenna Modeling Program

Denton Bramwell, W7DB 2853 E. Country Oaks Dr., Layton, UT 84040 email: denton@bramwell.org

Many people are running QRP and don't know it. The reason: inefficient antennas, or antennas inappropriate to the task. Start with 100 Watts, throw away enough signal in a poor antenna, and you're an accidental QRPer. The pity is, you'll probably miss the fun of intentional QRP.

EZNEC is a terrific tool for making sure that your antenna does what you want it to do. It's also a great way to see if a commercial antenna lives up to its published specs. Modeling the antenna is much easier and cheaper than building it, and the picture that EZNEC gives you of performance is very complete—probably better than you'd have after several months of using the real thing. Almost any practical thing you can build out of wires or tubes can be modeled and checked out. EZNEC is an analysis program, not a synthesis program. It won't tell you how to build a +30 dB compact antenna for 160 meters. However, if you come up with a design, EZNEC will tell you the azimuth and elevation patterns, the bandwidth, the input impedance, and several other interesting things.

Input into the program consists of specifying the diameter (or wire gauge) of the element(s), their end points in an XYZ type reference frame, and the positions of any feed points. A dipole, for example, can be specified simply as extending from (-33,0,65) to (33,0,65). This means that the antenna extends from -33 to +33 feet on the X axis, and is 65 feet in the air, the Z axis. Place the feedpoint in the middle, and you have a standard dipole.

To see how the program works, let's walk through an antenna that I was thinking about building: A 20 meter full-wave loop, using the guy wires at the top of my antenna as the top of the diamond. Since I use three guy wires, the proposed loop does not lie in a plane, like a regular loop, and I wanted to see how it would behave. I broke the antenna into five pieces, one for each side, plus a very short piece at the bottom, with the feedpoint in the middle. This is actually one of the more difficult antenna types to model, but even so it was not overly burdensome.

Once the antenna is in the program, you can look at it on-screen, and rotate it, slide it around, and zoom in and out. This is very helpful in visualizing the antenna, since it lets you see it from any perspective you like. Straight on, my model looks like Figure 1a. Rotate it a bit, and it looks like Figure 1b, distinctly showing that it does not lie in a plane.

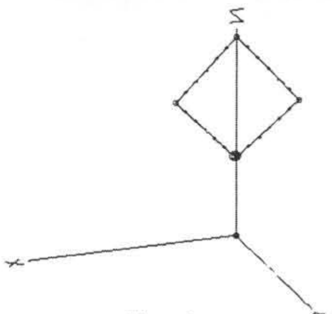


Figure 1a

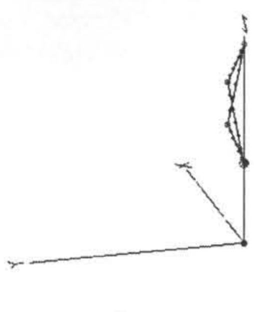
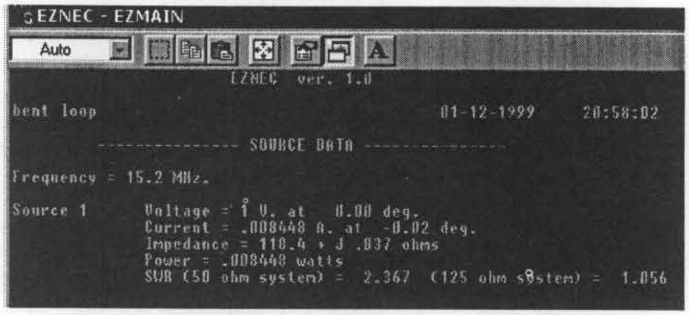
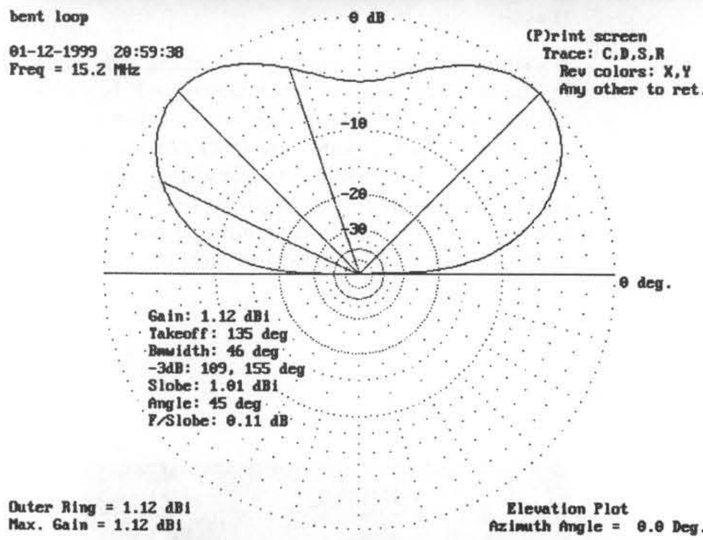


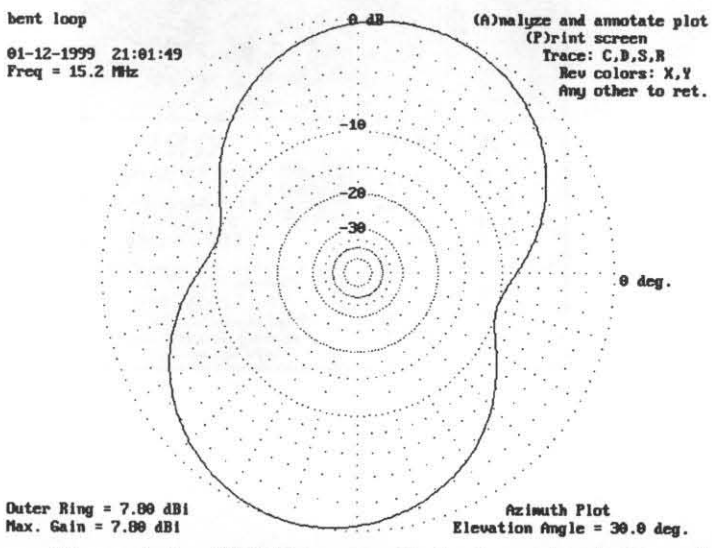
Figure 1b

My next step was to get my input impedance information, as shown in the next figure. The program will step through a number of different frequencies, and give you a good picture of the bandwidth characteristics of the antenna. My design was quite a bit off, and resonated at 15.2 MHz. It's much better to learn that on the computer than up in the air.

My final step was to run azimuth and elevation plots of the radiation, shown in next two figures. The elevation pattern was a bit puzzling at first; the radiation angle was high, and the antenna was several dB below expectations. However, running an azimuth plot at 30 degree elevation showed that the main lobe is actually about 8 dB, and is skewed a bit because the loop does not lie in a plane.







My conclusion: EZNEC is an excellent value, and a big time and effort saver. It comes with an extensive manual on disk and a money back guarantee. It requires an IBM compatible PC with 386/387, 486DX or Pentium processor. It is available for about $90 from:

Roy Lewallen, W7EL
Box 6658, Beaverton, OR 97007
Phone: 503-646-2885
Email: W7EL@teleport.com
URL: http://www.teleport.com/~W7EL/

Edited by W1HUE

Rainbow Power Meter – Part 2

by Joe Everhart, N2CX

The Rainbow Power Meter is a successor to the Rainbow Bridge and Antenna Tuner presented in the December 1996 issue of QRPp and January 1997 QRP Quarterly. That bridge was a simple resistive RF SWR bridge that automatically displayed SWR on a mulit-colored LED bar graph display. This power meter incorporates some of the same techniques in a combination QRP dummy load and RF power meter.

The dummy load will handle a QRP full gallon of 5 watts CW or 10 W PEP SSB using non-inductive resistors to provide a low 50 ohm SWR across the HF bands. The power meter display consists of multicolored LEDs to form a linear display indicating power at levels of 1, 2, 3, 4 , 5 and 5.5 watts.

Auto RF sensing switches DC power on when RF is applied and back off when it is removed, so no manual controls are needed.

The first article described the circuit blocks and basic operating theory. A few details will be repeated in this piece for completeness of discussion.

What will now be presented is a "pre-breadboard" schematic and complete description of the design and component selection. The design presented should be close to operational but there are no guarantees that it is complete. The discussion closes with a description of the actions needed to proceed with the breadboard to complete the development process, some ideas for physical layout and a means of adding a "QRPp" range. Now let's cut to the chase by reviewing how it works.

A block diagram of the major functional block is shown in Figure 7 (Figs 1 thru 6 were in Part 1).

RF input goes directly to the dummy load. A simple diode detector rectifies some of the RF and feeds a DC sample to the Power Switch and Comparator sections. The Power Switch connects DC power and the comparator reference voltage to the Comparator section when RF is sensed.

The comparators monitor the DC sample and compare a fraction of this voltage to the regulated reference voltage. Comparators are set to trip at threshold settings corresponding to predetermined power levels. The comparator outputs, in turn, light LEDs to indicate the input power detected.

Operation of the LED display was discussed in Part 1 but it bears repeating. Figure 5 is also reproduced for reference.

Figure 5 - Rainbow Display

Figure 5 shows a possible LED display arrangement. Blue, green, yellow, orange and red LEDs are arranged in a row to form a bargraph display. For 1 watt the blue one lights, at 2 watts the blue and green are active, and so on up to 5 watts where all of them are on. This give both an accurate power reading at each level and a kind of linear display that can be useful for "peaking up" a transmitter's tuning. A sixth power level 5.5 watts is displayed by having a dual current drive to the red LED. At 5 watts it lights with a partial intensity and becomes even brighter with 5.5 watts. With a little practice, this lets you set a transmitter to the "legal" 5 watt level without going over.

The "pre-breadboard" circuitry is presented in Figure 8. Its operation will now be detailed in the same functional areas as the block diagram description.

RF input to the dummy load is via a coaxial connector of you choice, J1. 200 ohm, 2 watt resistors R1 through R4 are paralleled to form a 50 ohm 8 watt load with low SWR. Diode D1 outputs a DC voltage equal to the peak value of the RF sine wave across the dummy load. Part 1 described the math, but suffice it to say that the DC sample will range from 10 volts at 1 watt in to 23.45 volts at 5.5 watts. Capacitor C1 smoothes out RF on the detector output.

The detected sample applied to MOSFET Q1 switches it on at levels above its turn-on threshold. The device is chosen for a low turn-on voltage. Practically speaking, it will be active with RF inputs of 100mW or more. Q1's conduction provides base current to Q2 which supplies operating power to the active circuits. Integrated circuit U1 is a low power regulator that outputs a stable 5 volt source as a reference for the comparators. Resistors R12 and R14 along with potentiometer R13 form an adjustable voltage divider to set the reference voltage for calibration purposes.

The DC sample voltage is fed to comparator ICs U2 and U3 through a voltage divider string composed of precision resistors R5 through R11. The comparator sections each see a fraction of the DC sample and compare it to the reference voltage. As described in Part 1, the voltage divider sets the switching point of each comparator section. The comparator chips have open collector ouputs that are normally open-circuited.

When the inputs of each individual section reach the switching point, the corresponding output transistor turns on, driving the associated LED to ground. LEDs D2 through D5 have their anodes each connected to the unswitched power source while their cathodes go through a 1 kilohm resistor to a comparator output. When the comparator output turns on, the LED passes a current of about 10 ma lighting it up.

Red LED D6 operates slightly differently. Its cathode goes to two comparator sections, U3C and U3D through individual 2 kilohm resistors. When U3C turns on corresponding to an RF input of 5 watts, D6 lights but its current is only about 6 ma so it lights at less than full brilliance. When U3D turns on the additional current through the second 2 kilohm resistors the LED becomes more brightly lighted for visual confirmation of the additional power level.

Refer to the Parts List shown in Figure XX. Several component types in the power meter have been selected for best performance.

Resistors R1 through R4 are inexpensive carbon film resistors available from Digikey (P/N P200W-TR-ND). They are fairly inexpensive at $.27 each. (If you want a really optmum dummy load you can buy 10 of them for $1.00 and select the four that are closest to 50 ohms when paralleled.) Diode D1 can be either a germanium 1N34 (even Radio Shack has them!) or a more physically robust hot 1N2711 hot carrier diode. Either has a fairly low forward drop to maintain accuracy though the 1N2711 may prove more repeatable than the 1N34. Not only that, but the 1N34 is more subject to heat damage than the silicon hot carrier device. I generally I use the 1N34s except for precision Rf detectors!

Transistor Q 1 is an enhancement mode metal oxide field effect transistor (MOSFET) that has a very low turn-on threshold. I used the

VN10KM device in the Rainbow Bridge and Tuner since the ones I bought would all turn on with only 1.8 VDC on its gate. That may be overkill for the Power Meter since it corresponds to an input power of less than 100 mW. The other devices listed in the parts list have slightly higher thresholds but they are more available. However if you attempt the QRPp wattmeter, the VN10KM is probably the best choice.

Precision resistors R5 through R11 are important to the accuracy of the meter. The values shown are calculated values, though and a thorough check of the circuit my require that some of the values be changed slightly. The parts shown are very economical at $.54 for 10 pieces (but you gotta buy 10 of each value to get that price).

The LEDs are not really too critical, though you may have to shop around to get an inexpensive blue one. Most new prices for them range to several dollars each! Surplus outfits such as Alltronics often sell them for under a dollar each.

Now all that needs to be done is to breadboard the power meter and do any circuit tweaking necessary. As they used to say in school, that exercise is left to the interested student! Hopefully there will not be too many changes needed to make things work, but Murphy is always lurking in the wings. I'll give you a little guidance about how **I** would proceed from this point. You can decide if that's how you want to go!

1. Check out the dummy load. Connect the four resistors in parallel and first check the DC resistance. As mentioned earlier, if you have more than the minimum four resistors needed, you can select the four that come closest to 50 ohms. Others can be used for non-critical dummy loads. When you are satisfied that the DC resistance is fine, check it over the HF band with an antenna analyzer or noise bridge to be sure that it gives low SWR over the whole range.

2. Apply RF power and verify that the DC sample is as was calculated in part 1 of this series. If it is not close, you may have to adjust the precision resistors R5 through R11 to compensate. To verify input RF use a well-calibrated RF power meter or oscilloscope

3. Check to be sure that the RF power switch and voltage reference turn on with RF power. The turn-on point should be slightly below 100 mW of RF.

4. Using a variable DC source, check the comparator and LED display operation. Feed the variable DC to the top end of R5 in place of the DC sample and set the voltage to the DC measured in step 2 with 5.5 watts of RF input (about 23.45 VDC). Set the reference voltage via potentiometer R13 so that it is equal to the voltage measured at the junction of R10 and R11. Now vary the voltage and check comparator trip points.

Information on trip voltages for each comparator section can be gleaned from Part 1 of this series.

5. Now put it all together and do an overall test. Easy to say, but this may be the most revealing step!

Figure 9 gives a possible parts layout on a board sized to fit in – you guessed it!- an Altoids mint tin. The dummy load resistors and RF detector components are on the right had side and a shield is indicated to their left. This may prove necessary to keep the high RF potential from affecting the more sensitive voltage reference and comparator circuits. Short leads on the dummy resistors and wide ground traces will preserve the low reactance presented by the carbon film resistors. If used, the shield can be either a thin piece of sheet metal or copper clad pc board placed on end and soldered to the RF ground on the dummy load. By the way, the left-hand end of the resistors should be the ground end. The remainder of the circuit layout is non-critical.

Now for a parting shot! While the design presented is for a 1 to 5 watt, power meter, it can be scaled downward as well. Since the voltages corresponding to the RF input track at lower powers as well (except for error at low input power due to the unavoidable minimum drop across D1), the meter can be used at lower power by simply readjusting the reference voltage. The "bogey" value of reference voltage is 3 volts, but if it is reduced to 1.34 volts, the power steps will be 0.2, 0.4, 0.6. 0.8, 1 and 1.1 watts. And lowering the reference to about 0.95 volts will give 0.1, 0.2, 0.3, 0.4, 0.5 and 0.55 watts. Accuracy may suffer somewhat at the low end because of the diode drop problem noted above. And if you really want to go bonkers you can set up several switched voltage reference voltages so that you can select the power range you want. Again, that is left to the interested student...

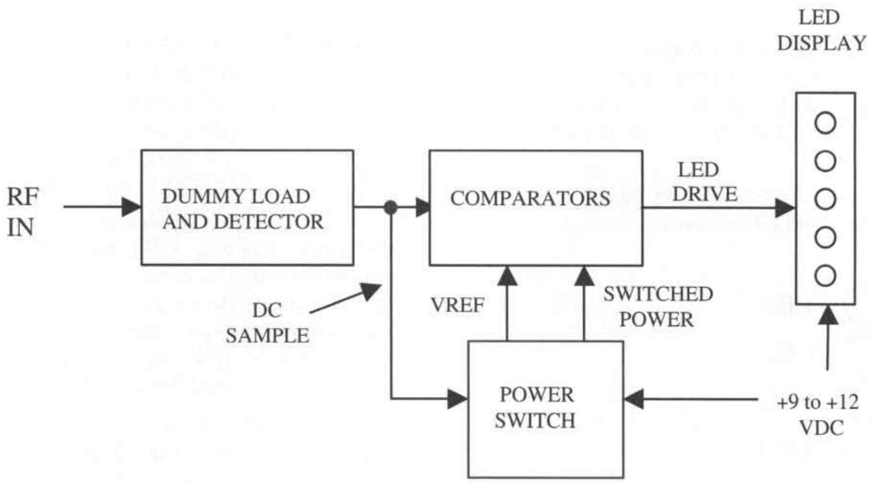


Figure 7 – Rainbow Power Meter Block Diagram

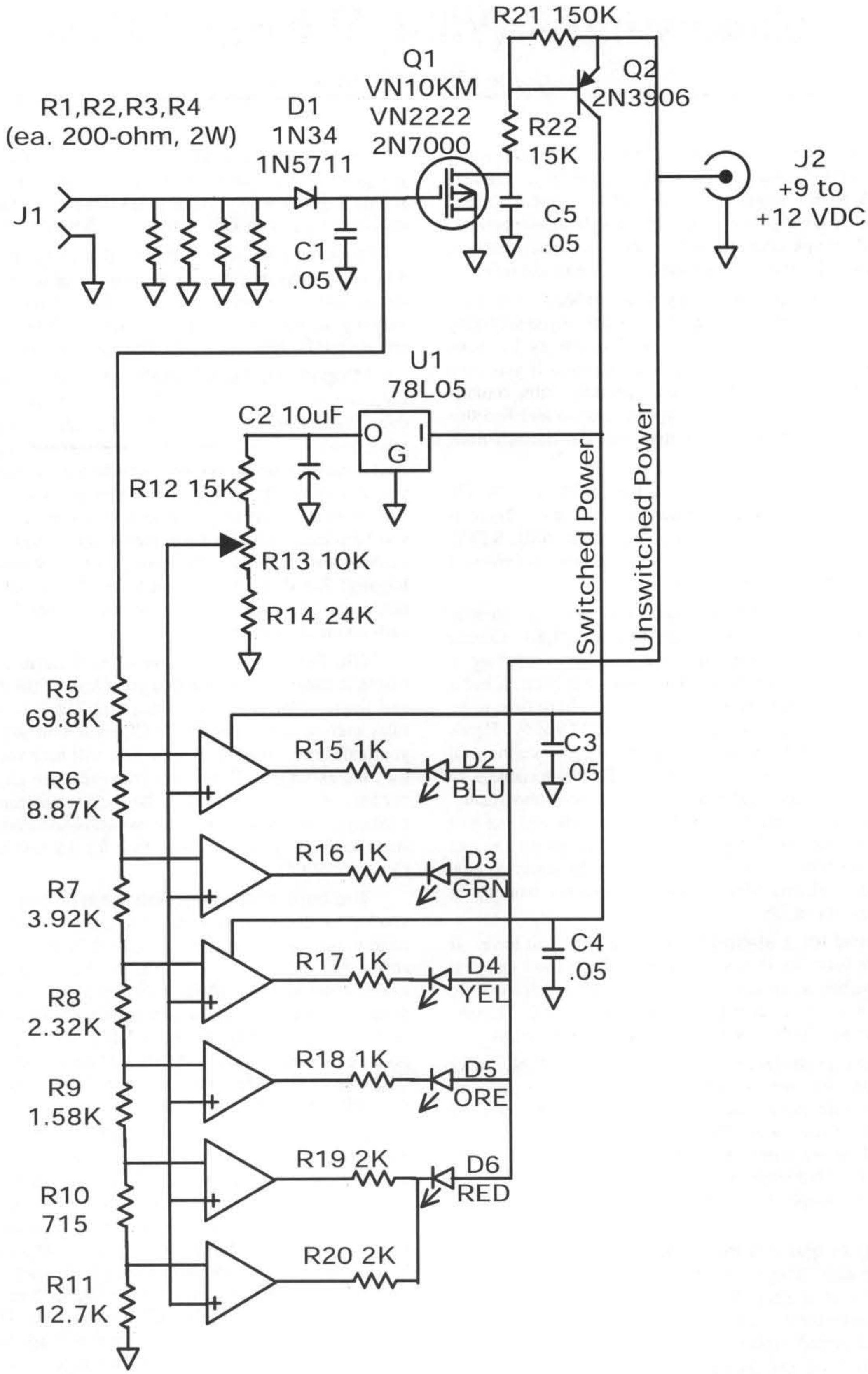


Figure 8: Rainbow Power Meter (Conceptual Circuit Diagram)

Contesting – What, Why and How

by Monte "Ron" Stark, KU7Y

Contesting is many things. It can be as simple as the Fox Hunts sponsored by the QRP-L Internet mail reflector. It can be as complex and fast at the NA Sprint, sponsored by the NCJ (National Contest Journal). What I will be talking about in this article will include both the QRP contests and the major contests. I will also give some ideas you can use to get started in this fun and rewarding area of amateur radio.

Why would you want to come play in a contest? There are about as many reasons as there are people in a contest! If you are trying to get an award, contests are a great time to find activity by many stations who can do a great job of hearing weak signals. If you are a new operator and would like to improve your operating skills, contests are a great place to do it. If you are a "Type A" person and find that you just have to try to do things better than you did the last time, contests are for you.

Contesting takes many forms. I'll limit this article to CW HF contests because these are the ones I understand the best. There is nothing wrong with all the other contests. If you like SSB, RTTY, VHF, UHF, moonbounce or any of the other contest activities, I encourage you to do them. They are all fun.

"How do I start?" you ask? First, you have to just do it! Read to what Mary, WN6HYX has to say about starting: "QRP Contest Courage. Being new to ham radio, my first leap into contesting is crystal clear in my mind. The first word that comes up is "fun". I had a blast. You're in and out of that QSO so fast you don't have time to be nervous. It's great. Just "here's mine, give me yours,73 QRZ?". Here's some sound advice I received from an A-1 op. Know your station well so you can focus on the newness of the contest. Be comfortable with the exchange you'll be sending and receiving. And most importantly, know and trust that your contacts are with ham friends and not just stations. They are people just like you. Grab the key and/or the mic and have fun. Always turn in your logs. You might be surprised how well you really did." Thanks Mary. (I have heard her working in contests and she does a great job!)

"What do I need for a station?" Just use what you have. If you have one single band rig, then you will be a single band entry on that band. Put up the best antenna you can. And it always helps to have more than one antenna. You never know when one will fail. Indoor, outdoor, high or low, just do the best you can and then go have fun.

"Do I have to have a computer with a logging program?" No, paper and pencil work fine. As your skills build and you begin to get more contacts you might want to consider using a computer. Older DOS machines work fine. I use an old 33 MHz 386 running TR Log and have no trouble. There are many logging programs available, TR Log, CT and NA being the "big three" for contesting. The use of contest software is beyond the scope of this article. That would take an article of it's own!

"OK, I'm ready to give it a try. Now what do I do?" Pick a QRP contest to start with. They tend to be more laid back. People take the time to say "Hi" to each other. Set aside the time. Do all the chores around the house before the contest starts. Try to arrange for others to answer the phone, door and handle all the other little interruptions that happen. (I tell my wife that in case of a fire, just call the fire department and leave me alone!)

You can look in this magazine at the Contest column and find a contest to get ready for. The QRPTTF sponsored by the NorCal QRP Club should be coming up soon, the 24th of April, 1999 if I haven't marked my calendar wrong! This would be a good first contest. Begin by reading and understanding the rules. Know what the exchange is. Know when the contest starts and when it stops. Be sure to set your clock to WWV. If you don't already use UTC for all your logging, now is a good time to start. All of the major contests use nothing but UTC so you might as well get used to it sooner rather then later. Also, if you exchange very many QSL cards you will need to use UTC.

Check out your station. Be sure that everything works. If you have a memory keyer, put the exchange in one of the memories. If you have enough memories, set up to have each bit of the exchange in a separate memory so you can just push a button when someone needs you to repeat your QTH for example. This gives you time to log and dupe.

"Dupe? What's a Dupe?" A dupe is a second QSO with the same station during a contest. Most contests only let you work a station once. Some contests let you work the same station once on each band while others only let you work a station once regardless of the band. And contesting would not be complete without having a contest where you can work the same station three times on each band but some amount of time has to go by between contacts! A dupe sheet is how you keep track of it all. There are almost as many styles of dupe sheets as there are operators! The most popular one now is called computer logging! But if you are doing it by hand, just make up a paper with 26 box's, one for each letter. Use the first letter of the suffix to arrange the calls on the dupe sheet.

"OK, I've got my log sheets and dupe sheets ready. The contest started 2 minutes ago. Now what do I do?" You look and listen. Find a station calling CQ TEST or whatever the contest rules suggest using. When the CQing station stops sending, you send your call once. If all goes well, you will hear you call being sent and then the exchange. Copy the whole exchange and ask for any repeats needed. After you have the whole exchange copied right, send your exchange. When the other station sends something like QSL TU and starts calling CQ again, you go look for the next station to work. You can also call CQ.

"The contest is over. Now what?" Now is the time to recheck you log for dupes. If you find any, just give them zero points but leave them in the log. Each contest scores differently. Read the rules again and score you log. Most sponsors have log and summary sheets available for either a SASE or to download from a WEB site. After double checking everything, send you score into the log checker. Full instructions will be in the rules. It's important to send in you log because it shows support for QRP. Many of the major contests have a QRP class but if they don't get logs from QRP stations there is no reason for them to keep that class.

In the major contests where QRP is just one of several classes, remember that many of the "big" stations are in there to win. The object of these contests is to work as many stations as you can during the contest period. Another way to say that is to work stations as fast as you can. This means that they don't want to stop and chat. They don't want to waste time doing anything but your call and the exchange. Most serious contest operators don't like it when someone signs /QRP after their call. To them it's just a waste of time. That QRP will not show up in the log or on the QSL card anyway. Don't repeat your call and exchange. If they need a fill, they will ask for it. If they ask for your state, send just your state, not the whole exchange.

Contesting is one of those activities where you will never be "just right". You learn from every one of them. To me, it is a blast when I find a "hole" and slip my call in and get a station while the QRO crowd is busy fighting each other! You never know when you will look in the mail box and find a nice certificate from a contest sponsor honoring your effort! So come on in, the water's fine and fun.

de Ron, KU7Y

Voltage Feeding SCV Loops

L. B. Cebik, W4RNL 1434 High Mesa Dr., Knoxville, TN 37938 email: cebik@utk.edu

The bobtail curtain, half-square and various loop antennas are well known to DXers and contesters on the low HF bands. These antennas are all about one wavelength long (some longer) and share some common properties. "LB" has dubbed this class of antennas "self-contained, vertically polarized wire antennas", or SVCs for short. This article discusses voltage feeding SVCs rather than the more common method of current feeding them. For a wealth of interesting information on these and other types of antennas, pay a visit to LB's WEB site at http://web.uk.edu/~cebik/radio.html. -W1HUE

It is relatively easy to feed half-squares and bobtail curtains at a high voltage point. The dangling 1/4 wavelength vertical wires exposed the voltage node[1] and placed it within relatively easy reach.

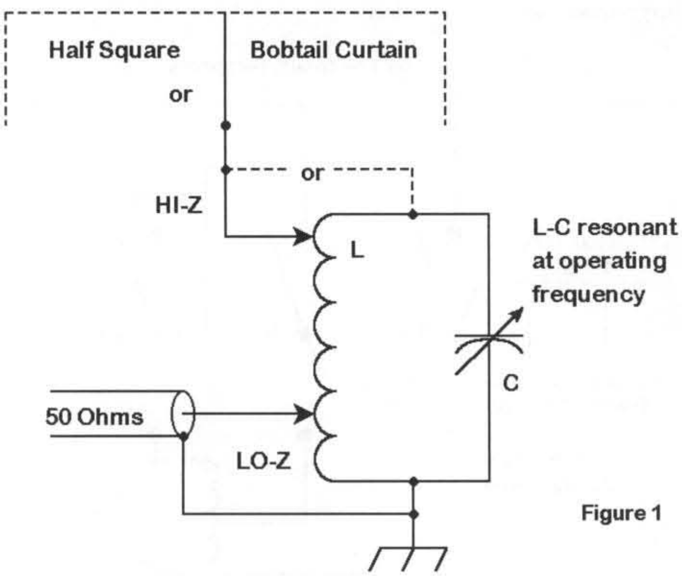


Figure 1

The circuit for effectively feeding a voltage node of the open-ended SCVs is in Figure 1. The top—or a tap near the top—goes to one of the half square verticals or to the middle vertical of the bobtail curtain. This remote circuit can be set and weather sealed.

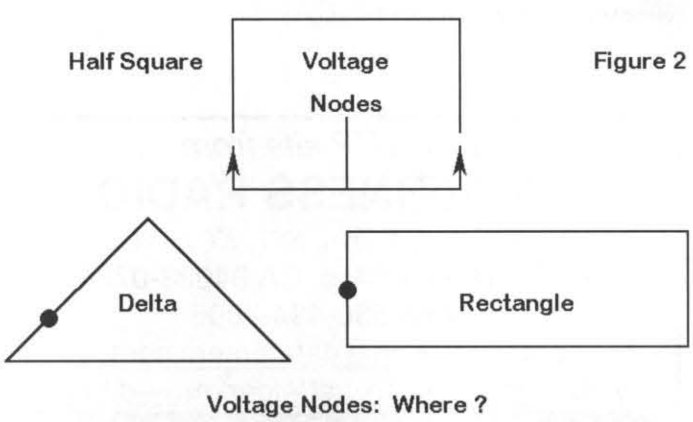


Figure 2

The loop versions of the SCV—the triangles and rectangles—present a different problem, as revealed in Figure 2. They have no exposed ends. Moreover, the current node of effective SCV operation with a maximum of vertically polarized radiation is way off to the side and elevated.

The shame of it all is that the loops can be used as general purpose wire antennas for most of the ham bands above their resonant SCV frequencies. However, they operate better in this role if fed at the center of the bottom. You will need balanced feeders and an ATU, just as you would for a doublet.

Just for initial comparative purposes, here are some numbers for a right- angle delta, resonant for SCV use at 7.15 MHz, with its base at 35' and its apex at 65' up over average soil, as sketched in Figure 3. The first numbers list the gain, take-off angle, and source impedance if we attempt to feed the antenna on all bands at the SCV side feed point, about 12% up the triangle leg. The second set give the same modeled data if we feed the antenna at the center of its base leg.

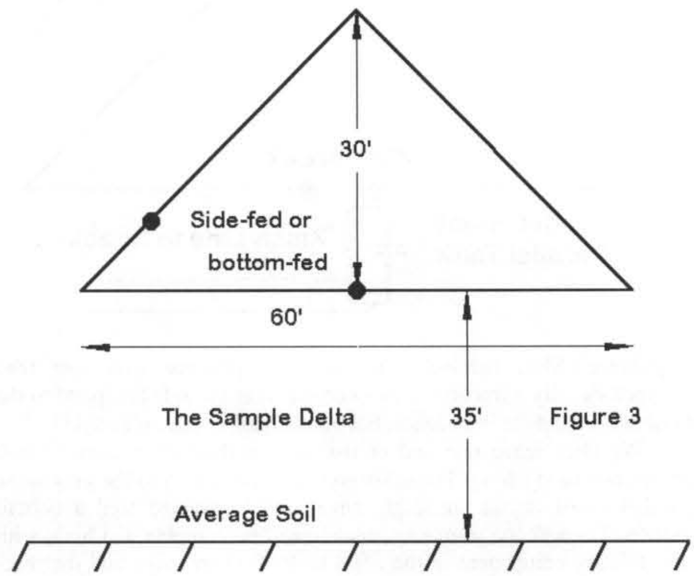


Figure 3

Right angle Delta: Side Fed

Frequency	Gain dBi	T-O angle	Source Z (R±jX)
7.15 MHz	1.97	16 deg.	49+j0
10.1	4.60	57	5700+j4500
14.15	6.92	37	115+j135
21.2	6.42	22	270+j295
24.95	7.96	18	790-j105
28.5	8.10	15	435+j510

Right angle Delta: Bottom-center Fed

Frequency	Gain dBi	T-O angle	Source Z (R±jX)
7.15 MHz	5.83	42 deg.	255+j75
10.1	7.57	29	3510+j2100
14.15	7.47	35	175+j120
21.2	7.90	14	235+j350
24.95	8.91	68	665-j1150
28.5	8.49	15	615+j415

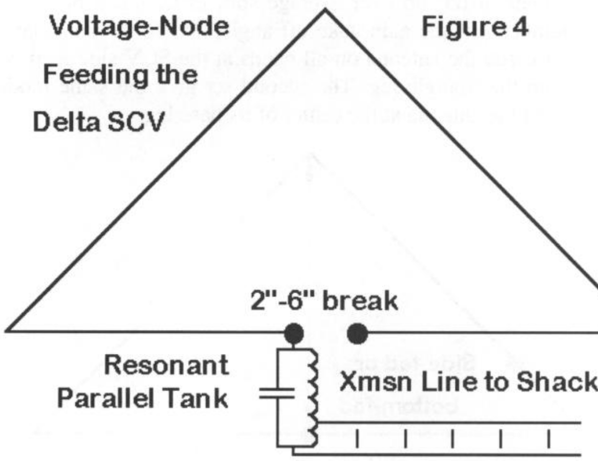
Where SCV-type operation is not involved, on every band except 12 meters, the bottom fed loop shows either higher gain or a lower take-

[1] The term "node" in this article refers only to a location and should not be confused with the older "loop-node" differentiation between maximum and minimum values [of current or voltage].

off angle than the side fed version. Hence, for general use, the bottom-center position is the better feed point. Of course, it is also more convenient than the side position.

It would be nice if we could get SCV operation at the same point. We can. For SCV operation, we cannot simply place the feedline in series with the wire, as we would for general operation. Instead, we must separate the wires a bit at the very center of the bottom. This is the equivalent to the first step in converting the antenna into a half square. This position is a high voltage node where the current reverses polarity. Separating the wires at this point does not materially affect the gain or take-off angle of the antenna. In other words, it does not affect the ratio of vertically polarized to horizontally polarized radiation.

However, as shown in Figure 4, we shall not change the shape into a half square. We shall retain the delta shape. The spacing of the break in the wire is not critical – 2 to 6 in. appears to make no significant difference. For the particular right angle delta model we are using, opening the bottom did not change the gain, take-off angle, or source



impedance. More precisely, the source impedance with side feed changed by only a fraction of an Ohm. Moving the side feedpoint to the bottom changed the impedance, but not the gain or take-off angle.

We shall leave one end of the wire at the bottom-center break unattached to anything. The other end, we shall attach to the very same parallel tuned circuit we might have used to voltage feed a bobtail curtain. The antenna source impedance will be complex and high, with the resistive component in the 3500 to 4000 Ohm range and the reactance between 8000 and 10000 Ohms. A good high-Q coil with well-spaced turns to prevent arcing and a good variable capacitor, also with wide spacing between plates, will handle the job easily. The only task is patiently finding the right tap points for both the antenna and the feed-line so that a coax line sees 50 Ohms.

However, since we are making this move to use the antenna with parallel feedline, the situation is not so critical. The use of the parallel tuned circuit is still recommended, since the impedance of the antenna end is still very high, even with 600-Ohm parallel line. However, we need only find a tap that approximates the line impedance and let the tuner in the shack do most of the work. In fact, with this system, once we find a good setting, we can replace the variable capacitor with a door knob high- voltage capacitor and protect the expensive variable from the weather.

We shall still need a weatherproof case for the capacitor and the coil. So we might as well add either a knife switch for manual operation or a relay for remote operation. The switching job is this: when we wish to use the antenna as an SCV, one side of the base-leg break goes to the tank circuit and the other goes to nothing. The feed line goes across the tap(s) on the coil. When we wish to use the antenna for general operation, the tank is disconnected and each side of the base-leg break goes to each side of the parallel feed line. The switching, suggested in Figure 5, may require three sets of contacts.

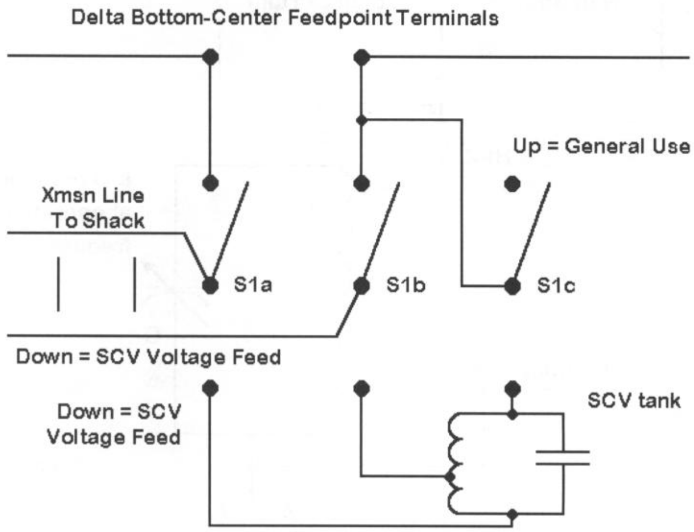


Figure 5 Switching Between Uses

This system should work equally well on rectangles as well as triangles. If you are inclined to try this system, I recommend that you start with a manually switched system to see if it will suit your needs before you invest in a remote switching system.

Edited by W1HUE

Notes from the President

Mike Czuhajewski, WA8MCQ

NEW AWARDS MANAGER

Chuck Adams, K5FO, has stepped down as the QRP ARCI awards manager. He served us for many years, putting a lot of work into the program. His most notable achievement was placing all of the QRP ARCI awards data since Day One onto a computer, something that had never been done before, and a huge undertaking. We appreciate all the work he's done for us. (Chuck is a member of the QRP Hall of Fame and the founder of the QRP-L Internet QRP discussion group, which he still oversees.)

I recruited a replacement by asking for volunteers on QRP-L and had several people express interest in taking it over. **Steve Slavsky, N4EUK**, appeared to be perfect for the job, so I awarded the position to him and he was ratified by the Board of Directors. His postal and e-mail addresses can be found on the back cover.

If anyone has applied for one of our awards and never received it, please contact Steve and he'll work with you. We want to catch all the things that have slipped through the cracks over the years.

KU7Y NOW A PERMANENT DIRECTOR

In January I announced that **Byron Johnson, WA8LCZ**, had been incommunicado for some time and that former QRP Quarterly editor **Monte Stark, KU7Y** was appointed to fill the position temporarily. Byron later submitted his resignation since he felt he was no longer able to devote sufficient time to it. We appreciate the work Byron did for us as a Board member and in other capacities. The Board voted unanimously for KU7Y to fill out the remainder of the term vacated by Byron.

AB7TT REPLACES N6GA AS CONTEST MANAGER

Cam Hartford, N6GA, has served us well as contest manager for several years but felt that it was time to pass the ball to someone else. Usually, someone submits their resignation and leaves it up to us to find a replacement. However, as KU7Y did with the job of editor, Cam submitted the name of a highly qualified replacement along with his resignation, which is greatly appreciated. He said he had been quietly observing **Joe Gervais, AB7TT**, for a year as Joe handled a number of QRP contests that were sponsored by QRP-L. The Board of Directors quickly approved Joe to take over the position before he changed his mind! (Joe has held the title of Assistant QRP Quarterly Editor for a while but that never really took off, so he asked to be relieved of the title recently.)

Cam had this to say about his time doing contests for us-- "My first column appeared in the January, 1994 issue. Prior to that, the last real contest column was in April 1992 issue. Needless to say, there was lots of catching up to be done. **Dave Little, AF5U**, lent much assistance in those early days as we plowed through the backlog of unscored contests. **Paula Franke, WB9TBU**, editor at the time, gave me as much space as she could spare so we could get the results published.

"It wasn't until the January, 1995 issue that we were finally caught up. Then came the next shock - certificates! During the first year I spent all my time scoring the back contests. Then I turned to the certificates, and that was a much bigger chore than I had anticipated. Eventually **Steve Pituch, W2MY**, volunteered to help with the production. Steve prints and mails those beautiful certificates which have drawn rave reviews from all quarters.

"One thing I discussed with Joe was how much the world of QRP contesting has changed. When I started, we sponsored 8 events a year, and I think Michigan QRP had two. In 1998, my calendar included at least 20 events sponsored by QRP ARCI, QRP-L, etc, plus 12 Adventure Radio Society "Spartan Sprints". And already in 1999 we've had another new one, the HW event, a contest generated by QRP-L, focusing on old Heathkit QRP rigs. The advent of the local clubs has brought many new operating events, and it's getting difficult to find an empty weekend on the QRP calendar. "

We really appreciate all of the work Cam has done on the QRP ARCI contest program over the years.

ATLANTICON, THE EAST COAST QRP SEMINAR

First we had QRP Dayton and FDIM, then Pacificon in California, run by Doug Hendricks (KI6DS) and crew. Now the New Jersey QRP Club, spearheaded by George Heron, N2APB, is starting up something on the East Coast. This is the first year for it, and it will be held on the same weekend as the ARRL Maryland State convention and Greater Baltimore Hamboree and Computerfest. The site is right down the street from the fairgrounds, and this is one of the major ones on the East Coast, a two day affair. There's a Friday hospitality suite, QRP seminars all day Saturday, a Saturday night building contest, then down the street on Sunday to enjoy the second day of one of the largest hamfests on this side of the country.

Unfortunately, this is all in the past tense as you read this, since it's at the end of March, although there was a full page announcement in the January issue. Luckily for those on-line, it has received tremendous publicity via the QRP-L mail reflector, and the 125 seats for the seminar were quickly reserved. And following the FDIM and Pacificon lead, the speakers are world class and there will be printed proceedings. According to the web page (www.njqrp.org), these are the scheduled speakers: L.B. Cebik, W4RNL; Dave Benson, NN1G; Paul Harden, NA5N; Chuck "dit dit" Adams, K5FO; Joe Everhart, N2CX; Steve "Melt Solder!" Weber, KD1JV; and Bob Berlyn, N1PWU.

I don't know where it will be held next year, but I think it's safe to say this will be an ongoing event somewhere in the region. Personally, I think they made an excellent choice of choosing this particular convention and hamfest to tag along with, since it's a major draw in it's own right. (And my living only 35 miles away doesn't hurt!) The QRP Quarterly will have a report on it later, and for those of you on this side of the country it's an excellent alternative if you can't make it to Dayton or Pacificon. Keep an eye out for future Atlanticons.

NEEDED: SECRETARY/TREASURER

Ken Evans, W4DU, has asked to be replaced as secretary/treasurer, a position which he has filled for a couple of years now. He wants to turn it over by the summer. He recommends that we get someone with CPA or other accounting experience, although we would consider others.

One thing that is a definite requirement, though, is having an e-mail account. Anyone who is interested in the position of Secretary/Treasurer can contact me by e-mail at wa8mcq@erols.com and we'll talk.

We really appreciate the great work that Ken has done in his tenure as Secretary/Treasurer, and he's been very responsive and an absolute joy to work with. He'll be a tough act to follow.

--qrp--

An All-Band CW/SSB QRP Transceiver

by Frank Nance, W6MN frank@w6mn.reno.nv.us

On the new rig lot, kick the tires, open the hood and check out this model. It will do well in those QRP road races. It has high-performance, big-rig results with a low, build-it-yourself parts and cabinet price tag and these key features :

1. Covers of all HF bands, 1.8 thru 29 MHz, including the WARC bands, SSB, and CW,
2. Has USB, LSB, RIT, and QSK CW modes,
3. Tuning via a Vackar VFO with two circuits providing feedback to reduce drift to zero,
4. VFO has a variable bandspread from a few KHz to over 1MHz,where the smaller bandspreaded selection can be positioned anywhere in any part of the selected ham band,
5. Steep sloped SSB & receive response via a dual, half lattice, 9 MHz crystal filter,
6. An IF scanning circuit.
7. Zero-beat CW is always insured in this rig, with RIT turned off, in that the transmit frequency is exactly the same as in receive. That is, there is no receive LO offset as in a typical superheterodyne operation. For round-tables or nets, an RIT feature is included to adjust only the receive frequency for those stations that are off frequency.

As indicated in feature 3, the source of tuning of this rig is an LC oscillator. This is not a step backward into radio history at the expense of disregarding such RF sources as direct-digital synthesis (DDS) and phase locked loops (PLLs). The Vackar type VFO is considered by many to be superior to other LC oscillators. After two years of prototyping and testing, there is no compromise in the performance of this rig because of using an LC oscillator. This type of oscillator was chosen because of the significantly lower cost of parts vs the higher price tag on such items as the parts and ICs needed in a PLL or a DDS oscillator. A renewed interest in, and usage of LC oscillators in QRP rigs is evidenced in about half of the recent QRP articles.

Often, the most tedious task in using LC oscillators is the experimenting needed to calm down frequency drift, especially if a varactor is used in place of an air variable capacitor. As implied in Feature 3 above, this rig uses two types of frequency-drift compensation circuits. These are of my own design. Having no desire to patent these circuits, any ham is welcome to use them. Inexpensive, readily available ICs, parts and a $2 thermistor are used in these circuits. The two outputs of these circuits plus the tuning pot voltage are precisely added algebraically in a 3-input analog, op amp adder. The output of this adder feeds the desired DC bias to a varactor which is the C part of the LC circuit in the Vackar VFO. Thus, the often tedious compensating task mentioned above is alleviated in this rig.

The Transmit and Receive Signal Paths

In the block diagram, Figure 1, functional sections of this rig are outlined by using dual thin lines. The transmit signal path is highlighted with a heavy line. Arrows shown along the signal paths are marked with "T" for the transmit and "R" for the received signal flow.

The Transmit Path: Along the entire top part of Figure 1, the transmit signal is processed, mixed, amplified and filtered, producing a signal that falls in the passband of the First IF. This First IF signal is applied as one input to Mixer 4. The other input to Mixer 4 is the output of a crystal oscillator which is selected by the band switch. The output of Mixer 4 is a signal that falls in the desired ham band. A tuned RF amplifier and two broad band amplifiers, followed by a 2 section harmonic filter, build this signal to the desired output.

The SSB Path: The SSB signal starts with an AF output from the mike which is passed through the Mic AF Amplifier. Mike gain is adjustable via a front panel pot which is connected to this amplifier. The frequency response of this amplifier is 159 to 3150 Hz using a Butterworth AF bandpass circuit.

The outputs of the Mic AF amplifier and Oscillator 1 are applied to the balanced modulator. The frequency of Oscillator 1 is 6.00 MHz. For simplification, call the AF bandpass 200-3000 in the following discussion. The output of this modulator is a DSB signal. The two sides of the DSB are these ranges: 5.9975 to 5.9998 and 6.0002 to 6.0025 MHz.

This DSB passes through the TR switch, becoming one input to Mixer 1. The other input is the output of Oscillator 2, the frequency of which is selected by the SSB select switch to be either 15.000 or 15.0025 MHz. for proper side band selection. With either of these selected frequencies, the desired side of the DSB is passed and the unwanted side is rejected by the 9 MHz. filter.

The 9 MHz. filter section, between Mixer 1 and Mixer 2, is a bi-directional circuit. That is, transmit signals go from Mixer 1 through the filter to Mixer 2 when passed by the filter. Received signals go in the reverse direction.

At first glance, it might seem seem strange or even useless to put in 6 MHz at Mixer 1 and get out 6 MHz at the output of Mixer 2. However, there is more to this circuit than meets the eye at first. The two functions performed by using Mixer 1, 2, Osc. 2 and the 9 MHz filter are: (1) to select the desired sideband and (2) to provide for effectively sliding the 9 MHz. filter band pass under the incoming signal without affecting receiver tuning. The result is to move any QRM on one side of the desired signal to a point where the slope of the 9 MHz. filter rejects it. I first found and used this feature in a home-brew tube-type receiver in 1950. It has been revived in modern ham rigs and is often called IF Scanning.

Once again continuing with the SSB signal path, the output of Mixer 2, is the selected side band falling in the range of 6.0002 – 6.0025 MHz. This signal is mixed by Mixer 3 with the tuning VFO signal to produce the First IF. The First IF is (1) tunable, (2) covers the same bandspread as the VFO and (3) is made to track with the tuning of the VFO. Incidentally, note that the TX/RX RF amplifier is also tunable and is also made to track with the VFO tuning.

As indicated above, the output of the First IF is applied to Mixer 4. Also mentioned above is the second input to this mixer which is the output of a crystal oscillator that is specifically selected by the band switch. Mixer 4 output is the transmit signal which now falls in the selected ham band. Once tuned, amplified and filtered by the circuits shown along the lower portion of Figure 1, the rig transmit output is sent to the antenna. The power output is adjustment range is from low milliwatts to about 10 watts.

From the Editor

With this article, Frank Nance introduces the newest entry in the growing QRP equipment kit market, featuring a band-switching scheme that allows SSB and CW operation on all of the amateur HF bands from 1.8 to 29 MHz. Frank uses a relatively unknown LC oscillator, the Vackar, for the VFO. A companion article on LC oscillators appears in this issue.

DE N7ZWY

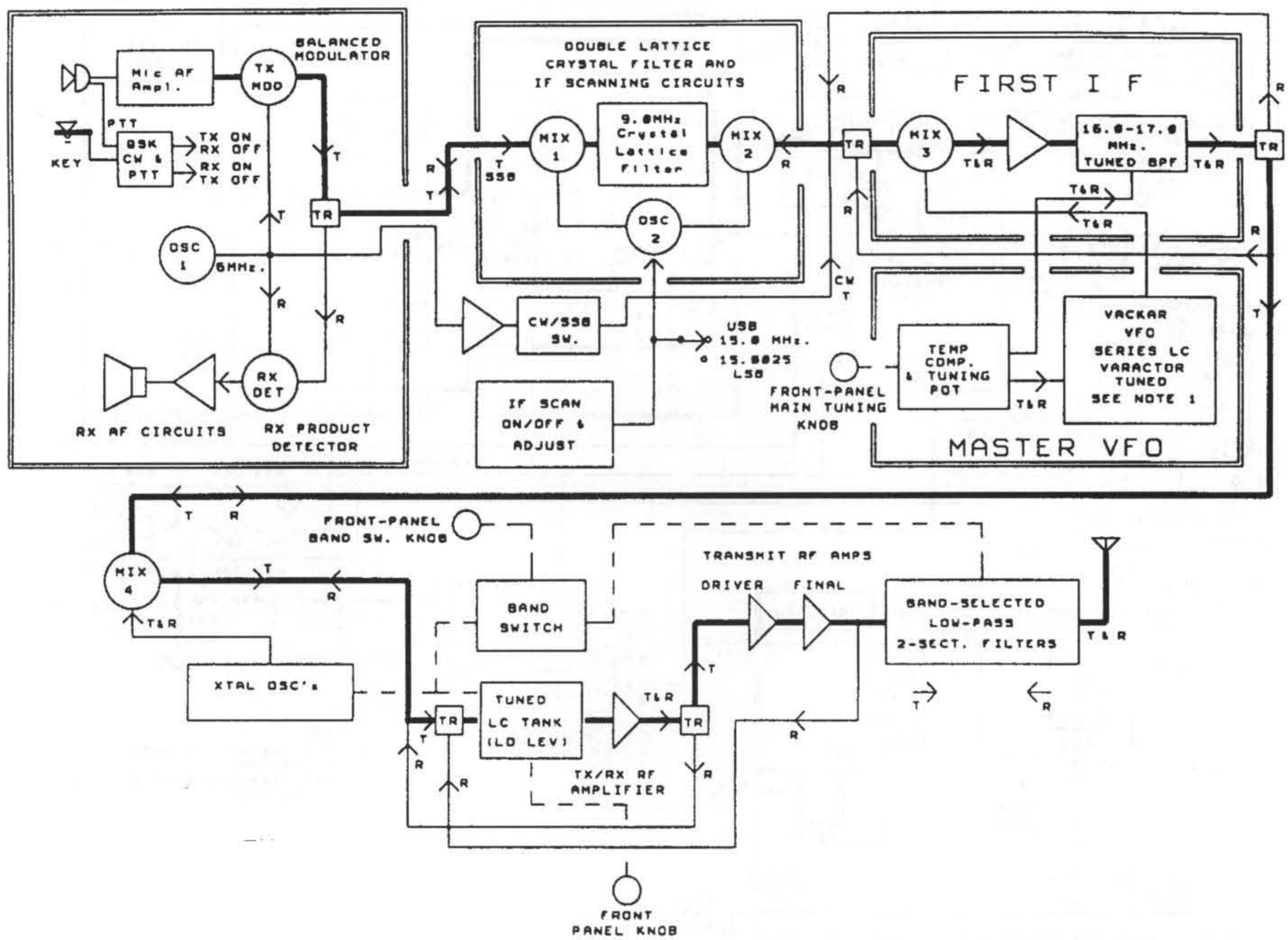


Figure 1 - QRP Transceiver Block Diagram

The CW Transmit Path: The only difference between the transmit path for SSB and CW is the source of the CW signal. The CW signal does not originate in the balanced modulator as is the usual method in modern rigs. (I found it better to leave the balanced modulator alone and not try to upset one leg to put out carrier.)

This CW signal begins by passing the output of OSC 1 through an amplifier with gain adjustment, to set the 6.0 MHz CW CXR Level.

The output of this CW 6 MHz. amplifier is fed through a SSB/CW switch to the input of Mixer 3, bypassing the 9 MHz section in transmit only. This input to Mixer 3, the CW transmit signal, now follows the same path as did the SSB signal, all the way to the antenna.

The Receive Path: Received signals from the antenna, flow to the left through the 2-section LP filter & thru the RX/TX RF amplifier. This amplified signal is converted to the First IF by Mixer 4. With selection of a given ham band, both the transmit and receive modes use the same crystal oscillator. Also, note that the TR switches handle the flow of transmit and receive signals, steering them through both the TX/RX RF amplifier and the First IF in the appropriate directions.

The received input, mixed by Mixer 4 and sent through the First IF, is applied at the right of Mixer 3. From this point, both the SSB and CW signals are sent from the Mixer 3 output in a left direction, all the way across the top of the block diagram to the product detector.

Unlike the CW transmit path, the received CW is sent through the 9 MHz filter from right to left to make use of the sliding-bandpass feature of Oscillator 2, Mixers 1 & 2 and the 9 MHz filter, briefly described above. With the IF scan turned on and adjusted, QRM on one side of the desired signal can be rejected by sliding the frequency of OSC 2. toward one steep slope of the 9 MHz. Filter, causing the QRM to be rejected.

Tech Info

Only a portion of the tech data originally planned for this article is presented here, doing so to keep down the article length. I originally thought of splitting this article into parts, but the second part would follow in a subsequent issue of QRP Quarterly and would not be timely with kit availability. The remaining information will be written up and made available ahead of kit availability, for those interested. See the end of this article for source info.

This tech onfo part covers the Vackar VFO and the temp comp circuits shown in Figure 2 and are now discussed.

The VFO: The Vackar VFO, which is used in this rig, was first introduced by Jiri Vackar, of Czechoslovkia, in 1949. It was followed by other classic LC controlled oscillator articles. A few of these inventors/ author's works are listed at the end of this article. Both Clapp and Vackar oscillators use series LC circuits for frequency control. A solid state version of both was popular during the '60s and '70s. Before this, a vacuum tube counterpart was used by many ham experimenters.

I first used a triode tube in this VFO, and later the popular 2N918 transistor. Then, in the mid 60s, I introduced this VFO to one of my fellow Members of the Technical Staff at ITT, Gary Jordan. He did extensive R&D on this oscillator and wrote a fine article, entitled, "The Vackar VFO, a Design To Try" which was published in the Feb '68 issue of *Electronic Engineer Magazine*[1]. He featured a 10 meter rig with a Vackar's VFO. Three distinct VFO advantages are given by Gary in his article, (1) a tuning

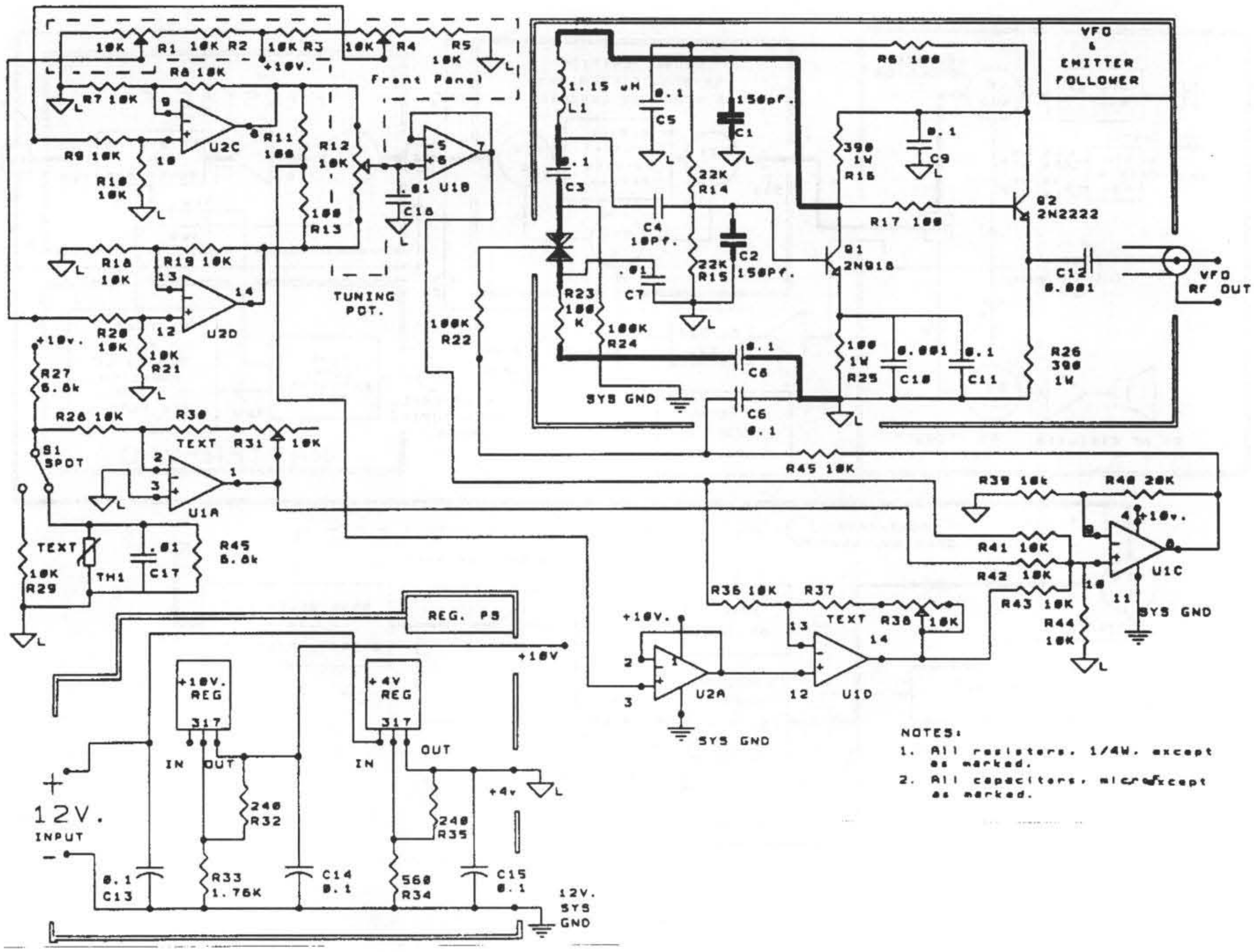


Figure 2 - VFO Schematic Diagram

range of 2.5:1, (2) an output that can be made constant over that range, and (3) the greatest inherent stability of any known LC tuned oscillator without the aid of more elaborate external loop feedback.

Note also that Gary found it necessary to decouple the base from the collector supply voltage to prevent an unwanted AF oscillation much like the ole term "motorboating". The decoupling in this rig consists of resistor R6 and capacitor, C5, shown at the top right of Figure 2. are required in order to prevent an unwanted modulating signal in the VFO oscillations.

The Varactor, D1: Diode D1 is shown in the heavy line path in Figure 2. It is a Motorola MV104 varactor (or replacement part, NTE617 or ECG617). The linearity of the MV104 extends over a much wider range than that which is required in this rig. Also, the linearity of a dual-diode varactor extends beyond that of single diode types. With good linearity in the MV104 and with a good, linear taper tuning pot, the readout on the tuning dial will also be linear. However, before continuing with the circuitry associated with MV104, it is beneficial to also discuss the thermistor, TH1 in the next two paragraphs.

Thermistor, TH1: In the circuit of Op Amp U1A, shown at the left center of Figure 2, temperature changes are sensed by thermistor, TH1. The resistance of TH1 is guaranteed to be within +/- 1% of 10K at 25 C. The value at 0°C. is 27.28K ohms and at +50°C., it is 4.161K ohms. This part is available from Radio Shack, # 271-110 for $2.

However, this thermistor is purposely made nonlinear so that with resistive loading, such as a series and a parallel resistor, the output voltage developed across TH1 can be made linear with temp change. I calculated the values of these resistors required for this linearity. They are shown in Figure 2 at the left center as R27 and R45.

Op Amps: The LM-324 Op amp IC was chosen, (both for U1A thru D and U2 A thru D, in Figure 2) because, (1) it is inexpensive, (2) it is one of the high gain types of op amps (typically 200K open loop gain), and (3) it can be used with one power supply source.

High gain op amps are known for their five-place analog signal handling accuracy in terms of using input and closed-loop negative feedback circuits. Fortunately, current types of op amps are so well protected that the op amp DC supply voltage can be safely applied directly to the either input without doing any damage to the op amp.

In these ICs, there are two abrupt limits to the output voltage swing, referred to as voltage rails. These rails are similar in idea to lower and upper saturation points of a tube or transistor except that the output between these limits is very linear until they suddenly reach one of these rails. Rails in most currently popular IC op amps are about 0.5 volts inside of the two power supply voltages.

Note that unity-gain op amps U2A, C & D and U1B are (1) non-inverting, (2) have unity gain and (3) are used as excellent load isolators. For example, U1B isolates load variations from paralleling the wiper of the tuning pot, R12. Without this isolation, the loading would cause the tuning potentiometer voltage to be non linear. For isolation, this op amp circuit has a very high input impedance and a very low output impedance, isolating their high impedance inputs from output load variations.

In this rig, an unusual method of supplying power to U1 and U2 is used. In the lower left corner of Figure 2, two voltage regulators are shown.

The 4-volt regulator output feeds the negative supply of U1 & 2, enabling a floating, signal ground for U1 & 2 in comparison to the power ground used throughout the rest of the rig. This greatly simplified having to use more elaborate single-ended off set circuits in U1 & U2.

Reference Temp of 25°C: From the semiconductor data library by Motorola, Vol II, 2nd Edition, page 3-1219, the MV104 capacity is approximately 22 pF at 11V reverse bias, and 55.5pF at 1V. This is a change of 33.5 pF with a 10 volt change in reverse bias or a scale factor of varactor capacity change = 3.35 pF / V or 0.00335 pF per mV.

This latter figure might seem to be very insignificant, however, at a VFO operating frequency above about 10 to 15 MHz, only slight changes in capacity result in a significant change in VFO output frequency.

Varactor TC Data: At 4.0 volts, the MV104 TC is 280 parts per million per degree C change in temperature. This capacity change is in the same direction that of temperature change. Uncorrected, this would result in several KHz of drift for each degree change in temperature, a negative frequency drift, i.e. frequency drift in the opposite direction as the direction of temperature change.

A second drift factor was mentioned in the opening. It enters the picture when the value of MV104 bias, and thus tuning, is changed. This second characteristic of the varactor is referred to as DC and is explored in a bit more detail later in this article.

For use in the design of this rig, the effects on varactor capacity from both temperature and bias changes are taken from Motorola's data, Figure 4, page 3-1220, where 3 plots are shown, one at 2.0, one at 4.0 and one at 30.0 volts dc. In this rig, only the two lower voltage plots are referenced.

An operating temperature range of 0° to 50°C (32° to 122°F) was chosen because consumer-grade ICs also cover this range and this type of ICs are used in this kit to keep part prices as low as possible. Components with a higher temperature range could be incorporated by using more expensive industrial or military equivalents of these commercial-grade ICs. This choice is left up to the builder. In addition, the range of the TC compensation can also be extended considerably by changing the op amp scaling resistors.

The two sources of frequency drift mentioned above are now examined more closely by using some data from these two Motorola plots, as follows (as mentioned earlier, 25°C is the reference temperature and it applies to these two plots.) **:**

Using the 2.0 volt plot, the varactor capacity at 0°C is 0.990 of what it was at 25° C. At 50°C it is 1.011 more than at 25°C. Using the 4.0 volt Plot it is, at 0°C = 0.993 less , and at 50° C = 1.007 more than at than at 25°C.

Reference temp comp circuit: Both the MV104, D1, and Thermistor, TH1, which are shown in Figure 2 at upper center and at the left center respectively, have a reference temperature of 25 C. Specifically note in Figure 2 resistor R29 (left center), which can be switched in place of TH1. R29 is 10K, which is equal to the reference temperature of TH1. With this resistor in place and the dial set to mid point, the rear panel pot R31, shown at the left center of Figure 2, can be set such that there is no drift. This eliminates the need to put this rig in a temperature chamber to set drift to zero at this reference temperature and mid-dial setting.

The Case of DC at a Given Bias: The changes in the capacity of the varactor at 4.0 volts are given in the Motorola specs as 280 ppm/ °C. If 1.0 pF was used, 280 ppm would be: 280/1,000,000 = 0.00028 pF/ °C. However, at 4.0 volts bias, varactor capacity is approximately 35 pF. Therefore, the change in capacity per degree C is 35 x 0.00028 = 0.0098 pF/ °C.

To get some idea of DC bias correction requirements, using the scale factor determined above, i.e. 0.00335 pF/mV change in bias, a change of 0.0098/0.0035 mV = 2.8 mV. for each degree C of temperature change would offset change in varactor capacity. As implied before, the gain of op amp U1A, which is connected to TH1 is scaled so that the corrective bias out of U1A is adequate to provide a good range which covers an under to an over correction value. The output of U1A is one of the three signals mentioned in the opening which are added and applied to D1. More specifically, the output of U1A feeds R41 as one of the three inputs to three-input adder, U1C (lower right part of Figure 2).

Thus, varactor capacity change with change in temperature is met and offset by an equal and opposite compensating feedback signal from U1A. Note that this compensation only applies to the mid point of the tuning pot. However, this is not the only compensation required. Changing the dial is where the second TC factor comes in, as is now covered in the next few paragraphs.

The Case of DC: The problem of DC is now looked at a bit closer. Even though U1A, using the thermistor, is set to zero drift at the mid-dial setting, this compensation is no longer able to stop drift at other dial settings and gets worse the further the bias is changed from the fixed-bias setting.

At 2 V, compared to capacity at 25°C, varactor capacity decreases to .99 at 0°C and 1.01 at 50°C. This amounts to a change of 35 x 1.01 - 35 x 0.99 = 0.7pF for a 50°C change. While at 4.0 v., the change it is: 35 x 1.007 - 35 x .993 = 0.47pF change for a 50°C change.

The op amp circuits and rear panel pot used for this DC (second source of) compensation are shown at the bottom center of Figure 2 and are described as follows: U2A input is from the junction of R11 & R13 which are equal in value. U2A is used as a load isolator. Thus, the output of U2A is a voltage equal to the center of the tuning pot and is applied to U1D (+) input. U1D (-) input is scaled down and the output of U1D is (1) referenced to the tuning pot center voltage by using the output of U2A, and (2) inverted. The gain of U1D is set by R38, which is the second temp drift rear-panel pot. The range of R38 provides for correction of DTC and ranges from an under to an over corrective value. The output of U1D is the third input to the adder, via input resistor, R43.

My Current Plans For This Rig

I hope that these plans are not overly ambitious, but everything looks good to meet my goal of having kits ready for sale by mid-March 1999. At the time of submission of this article, one task under way is to finish writing and then print up a manual much like the ole Heatkit ones. Thus, one goal is to have this package ready by March '99 and available at my printing + mailing cost.

The second plan is for me to finish PC layouts and production. Then my wife, my daughter, and I will assemble the first 100 kits which will include the manual mentioned above as well as labeled parts, etched, drilled, and silk screened PCs. Included in this kit is a nice cabinet with etched and drilled front and rear panels.

A ham friend, Hal, W6YJL, who has three electronic stores in No. Calif., HSC Electronic Supply, said that he would be glad to help me by taking on the sale of this rig in kit form. Hal referred me to his ham buyer, an active QRPer and the sale of kits will be done thru these stores.

Several of these kits are being spread among ham friends and the goal is to check out the assembly instructions and the rig's operation and repeatablility using common types of electronic parts.

I look forward to receiving your inputs and especially any constructive comments. For those who want to order the manual, or get kit ordering info, please contact me at my Email address.

Good Luck & happy QRPing...de, W6MN, Frank.

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LC Oscillators - A Brief History

by Chris Trask, N7ZWY, ctrask@primenet.com

Ever since radio communications evolved from the Dark Ages of spark gap transmitters and cat-whisker detectors, the art of radio receiver and transmitter design has been constantly evolving. However, even though we now live in an era of 200 MHz+ home computers , which until 20 years ago existed only in science fiction, our communications equipment still relies on the basic circuit topologies and innovations that were introduced in the 1930's. Oscillators, which form an essential building block in communications receivers and transmitters, generate the necessary carrier and local oscillator signals that form and manipulate the communicated intelligence. For crucial fixed frequencies, we generally rely on oscillators whose frequency is determined by quartz crystal resonators. For applications where a variable frequency is required, LC oscillators come into play, even in synthesized frequency sources.

The Beginning

The earliest form of LC oscillators were generally of a form known as tuned grid[1], or Armstrong. As shown in Figure 1, the Armstrong oscillator consists of a tuned LC tank from the control grid to ground, with a "tickler," or regeneration, coil providing feedback coupling from the plate. This circuit suffers from sensitivity to power supply variations,

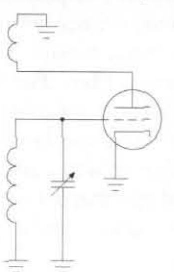
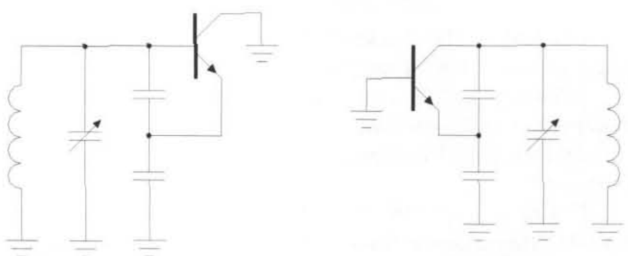


Figure 1 - Tuned Grid (Armstrong) Oscillator

and sees very little use today. It was improved by placing an additional tank circuit in the plate, which then became known as the tuned-grid/ tuned-plate, or electron-coupled oscillator.

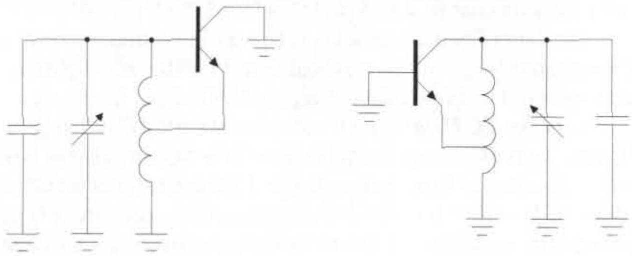
Bridged-T Oscillators

Late in 1931 a family of oscillators that were to become the basis for all further LC and crystal oscillator development was introduced by F.B. Llewellyn[2]. These oscillators, known universally as Colpitts and Hartley, are part of the bridged-T family. Figure 2 shows two forms of the Colpitts oscillator, and Figure 3 shows the same oscillators in the Hartley configuration. Both oscillators function by transforming the emitter voltage to the base to a degree where the loop voltage gain is greater than unity. Those of you who have made simple impedance matching networks will readily recognize the two capacitors in the Colpitts circuit as being a capacitive voltage divider, while in the Hartley circuit the tapped inductor is an autotransformer. In the Colpitts circuit, the inductor in parallel with the two capacitors completes a resonant tank, the variable capacitor



Grounded Collector Grounded Base

Figure 2 - Colpitts Oscillators



Grounded Collector Grounded Base

Figure 3 - Hartley Oscillators

providing the tuning. In the Hartley, the variable and fixed capacitors in parallel with the tapped inductor also complete a resonant tank circuit. A multitude of variations on these simple topologies exist, and in crystal oscillators these circuits take on the name Butler[3].

Further Improvements

Although the Colpitts and Hartley circuits represented a considerable improvement over their predecessors, there was still much room for improvement. As is the nature of all progress, when the most serious problem in a circuit or system is dealt with, a previously secondary one takes its place in the order of importance. With the sensitivity to power supply variations summarily laid to rest, the problems due to changing parameters in the active element (tubes at the time) became the task of the moment. In the late 1930's, G.F. Lampkin recognized that the frequency of oscillation depended on the net impedance of the tube and circuit in combination, and since the impedance of the tuned circuit depended chiefly on its' physical dimensions, it was necessary to devise a method by which the impedance of the tube would be minimized relative to that of the tuned circuit[4]. His solution, shown in Figure 4, was to modify the Hartley oscillator, actually placing the active element (shown here as a transistor) much lower in the tapped inductor. His reasoning was very simple: By placing the impedance of the tube lower in the tank inductor, the impedance of the tube is increased by the autotransformer properties of the tapped inductor, therefore decreasing the effect of the tube impedance relative to that of the tuned circuit. Therefore, the drift of the tubes'

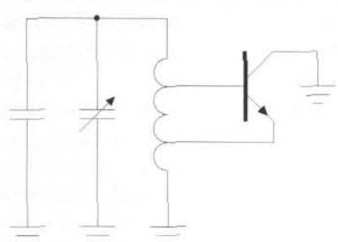


Figure 4 - Lampkin Oscillator

From the Editor

Frank Long's article this month, introducing his QRP transceiver kit, prompted a short sidebar on LC oscillators. After a literature search on the subject, it became obvious that there was a lot more than met the eye, and that a broader history lesson would be appropriate.

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impedance is now minimized, and in turn the change in frequency with temperature and tube-to-tube variations is minimized. Although we can look at this innovation as being obvious and rudimentary, it was, as the time, a significant improvement. The circuit does, however, have a tendency to break into spurious oscillation, and as a result sees little or no current usage.

Capacitors vs. Inductors

The Lampkin oscillator significantly improved the stability problems associated with LC oscillators, but it also introduced yet another tap in the tank inductor, which is a bit of a manufacturing problem. The obvious solution here is to substitute a capacitive voltage divider for the tapped inductor, a further innovation which was introduced in *QST* by E.O. Seiler in 1941[5], and is shown in modern transistor form in Figure 5.

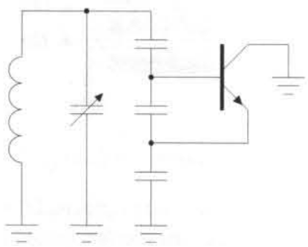

Figure 5 - Seiler Oscillator

The Seiler oscillator is related to the Lampkin ascillator in the same manner as the Colpitts is to the Hartley: A capacitive voltage divider is substituted for the tapped inductor. Simple, but it took two years for somebody to recognize this in print. Sometimes progress can be slow.

Post-War Improvements

You would think that at this point no further improvements would be necessary, but not so. In 1948, J.K. Clapp, of the General Radio Company, published his paper disclosing a simplification of the Seiler oscillator[6]. Shown in Figure 7, the Clapp oscillator simply moves the variable capacitor in the tank circuit, actually giving the oscillator a wider tunable range. Normally, the variable capacitor is placed between the inductor to ground, but it is shown here in this manner as to provide a better understanding of how the parallel resonance of the circuit, thus its' tuning, is achieved.

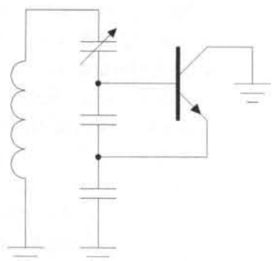

Figure 7 - Gouriet/Clapp Oscillator

It is interesting to notice that in Clapp's original paper the Seiler oscillator is not even mentioned., even though the Seiler is a more obvious step in oscillator evolution than is the Clapp. Whether or not this was an oversight or a professional snubbing of amateur radio is for historians to contemplate. The former may be the case, as in Clapp's subsequent paper he refers to the Seiler oscillator as being a "parallel counterpart of the Gouriet-Clapp oscillator"[7].

So Who's Gouriet?

Speaking of parallel counterparts, it just so happened that the Clapp oscillator circuit had been devised by an engineer working for the British Broadcasting Company (BBC) some nine years prior to Clapp's paper[8]. Publication of this innovation by Gouriet was not made until after Clapp as the circuit was considered to be proprietary by the BBC, and was used exclusively in every crystal-controlled and variable LC-controlled transmitter in Britain. This has, over time, become a mute point, except that in the United States we refer to the circuit as a Clapp/Gouriet, or simply Clapp, oscillator, whereas in the rest of the world it's known as the Gouriet/Clapp oscillator[9]. How you refer to it depends more upon your allegience to the crown rather than a knowledge of history.

The Vackar Oscillator

The last of the significant improvements in LC oscillators was developed at the same time as the Gouriet circuit was being devised, but was not published until after Clapp[9]. Created by Jiri Vackar in Czechoslovakia, the stability is improved by placing the variable capacitor midway between where Seiler and Gouriet/Clapp had placed theirs, as is shown in Figure 6. The same circuit, also known as a Telsla oscillator[10], was developed independently in Italy by O. Landini[7]. Clapp recognized this method as being a means by which the Q of the resonant tank can be made to increase with frequency, which, by keeping the signal amplitude constant, results in a wider tuning range than is possible with other circuits using a capacitive voltage divider[7].

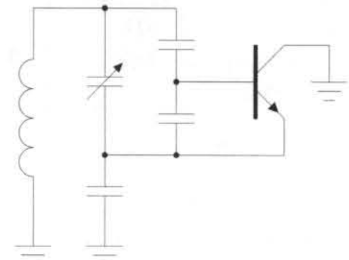

Figure 6 - Vackar (Tesla) Oscillator

Further Reading

The design of LC oscillators is an art unto itself, and there are people who spend their entire professional lives in the design and development of low-noise wide-bandwidth LC oscillators from VLF on up to Ka-Band microwave frequencies and beyond. I used to be one of the latter.

The amount of literature devoted to the art of LC oscillator design can be overwhelming, but the last three references mentioned here[11, 12, 13] will give more than enough information for the advanced hobbyist.

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Low Noise RF Amplifier

by Todd Gale, VE7BPO, qrp@qrp.pops.net

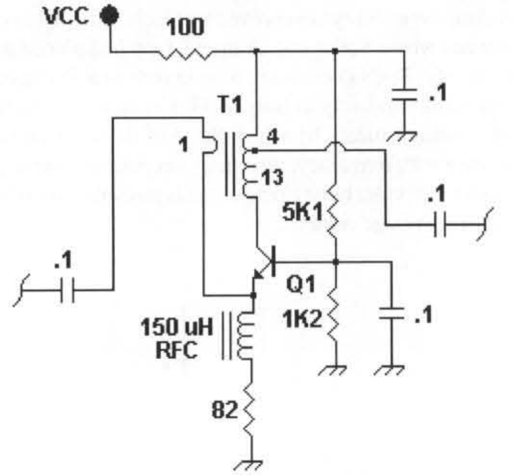


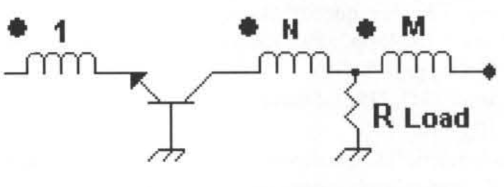
Figure 1 - Norton Amplifier

Discussion

The schematic shwon above in Figure 1 is a version of a circuit developed and patented by David Norton and Allen Podell in June 1974. This variation was described by Joe Reisert, W1JR in the now defunct Ham Radio Magazine. The Norton design uses transformer coupling to achieve "noiseless negative feedback" and is really outstanding. A great article utilizing and augmenting this technique in receivers was written by Jacob Makhinson, N6NWP in the Feb 1993 issue of QST magazine entitled "A High Dynamic Range MF/HF Receiver Front End". Makhinson arranged two in push-pull to obtain excellent results. Obtain a back-issue of QST for closer study. If you are building a contest-grade receiver and need a good RF preamp and/or post mixer amplifier, the Norton type is quite suitable. An amp built using a 2N5109 can have a noise figure in the 2.5 - 3dB range. I have also built them with the 2N3866, MRF517, MRF581, and 2N5179, although the last transistor would be a somewhat poorer choice. This schematic with a 2N5109 is good from 1.8 to 150 MHz with a 1.2:1 VSWR or less according to Joe Reisert. I have even put one in a friends CB radio and he was delighted.

Winding and Construction Hints

Making the Norton amps requires some planning to keep all component leads as short as possible. The transistor leads and any connecting components should be trimmed as short as practical to promote stability. Sketch the component layout on a piece of paper and modify it until you are satisfied you have designed a good layout. I usually use a terminal strip piece to support the transformer and to attached the positive voltage wire to. The ferrite beads on the transistor collector aid in stability and should be used to preserve the noise figure by squashing any oscillations should they develop. The 22 uH choke can be the little epoxy coated units that are color coded and look somewhat like resistors. Do not use a choke less than 22 uH.



N = 1 , M = 2 , GAIN = 6 dB
N = 5 , M = 3 , GAIN = 9.5 dB
N = 11 , M = 4 , GAIN = 12 dB
N = 19 , M = 5 , GAIN = 14 dB

Figure 2 - Four Practical Transformer Ratios

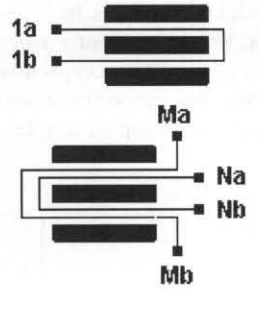


Figure 3 - Transformer Winding Illustration

Before winding, the builder must first decide how much gain is needed from the amp. For an RF preamp, the stage should have gain equal to or greater than the passive stages after it. Also there will be losses in the transformer, so the theoretical gain of the Norton amp maybe 1 dB off and will need to be factored in. Figure 2 shows some practical transformer ratios and their associated gains.

For the purposes of discussion, a 9.5 dB amp is desired , so N = 5 and M = 3. The first step is to mark one side of the core with a dab of liquid paper, paint or a small piece of tape. This will allow you to keep track of the transformer later. To mark, hold the core so that both channels are parallel to the floor, one on top of the other. Apply your dab of paint to the top of the core and use the marked top to denote the A windings. 1a, Ma and Na will all start from the top channel in the balun core.

Referring to Figure 3, use 32 AWG wire for all three windings. Start with winding 1 and wind a single turn from point 1a to 1b. Cut off the leads so thay are shorter than 2 inches. Next, wind Ma to Mb three complete turns through the binocular core and trim the leads if needed. Tie a small knot in the wire at both ends. This will clearly mark this M winding. Both windings should look like the diagram in Figure 3. Winding 1a to 1b is on the left of the balun core and winding Ma to Mb is on the right side of the core. Mb has a distingishing knot at the tip of both wire ends. Ma starts from the top of the core which you have marked with a dab of paint or something.

Finally, wind Na to Nb with five complete turns through the core in the same direction as the previous winding M. Strip wires Na and Mb (Mb has the knot), twist together, and solder. Strip the leads VERY gently with sandpaper or your favorite method. Insert the transformer in your circuit, cut the leads to their proper length, and then solder away. It may

From the Editor

Todd Gale sent us this article on the practical aspects of building Norton amplifiers from his web page. A bibliography of articles, papers, and books that relate to the Norton, or lossless feedback, amplifier follows.

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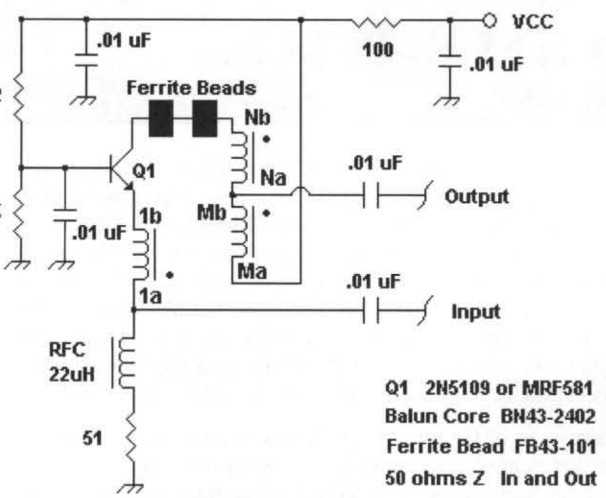

Figure 4 - Experimental Norton Amplifier

be preferable to prestrip the leads on winding 1 as it is hard to strip the enamel off a fine wire that has only one turn and it may accidentally pull out of the core. If it does, just re-insert it into the balun core on the correct side. Once you have soldered Na and Mb you can always identify the windings later because you have marked the top of the balun core which denotes the Ma and Na leads. Try and make your windings gently tight as if there is too much slack you may have difficulty getting the last few windings thru the core holes. A 14 dB gain amp may be impossible to wind with 32 AWG wire, it may best to use 34 AWG for that amplifier. I have never built one for greater than 12 dB. The transformers are a bit tedious to wind, however persevere and the results will be well worth it. For HF, you can substitute 0.1 uF caps for the 0.01 caps shown if you like.

Experimental Norton Amp

The amplifier shown in Figure 4 is experimental, useing a ferrite toroid for the transformer and has approximately 10 dB of gain. Incidently, it can also be wound on a balun core using 2 windings, a one turn loop and then a second wire with a tap as shown in Figure 4. A balun core would not be experimental and this amplifier is very stable with a balun core.

To wind the toroidal version of this amp, wind 13 turns of AWG #26 on a FT37-43 core. Next wind the 14th turn but leave a generous loop for tapping into. Then wind 3 more close turns on the coil to finish. You should have 17 turns of wire with a tap 4 turns from the end, thus creating the 13 - 4 inductor as shown in the schematic. To complete the coil, wind 1 turn of wire over the cold end as shown in the schematic. It is tricky, but try to keep the one turn link as short as possible. A ferrite bead over the transistor collector is also helpful, but not mandatory. You can try increasing the turns (1:21:5 etc) to experimentally obtain more gain from this amp. The toroid version of this amp is good for understanding how the Norton amp works and may be an option for builders who do not have balun core ferrites in their junkbox.

Norton (Lossless Feedback) Amplifier Bibliography

by Chris Trask, N7ZWY, ctrask@primenet.com

Todd Gale's article on Norton amplifiers gives a good practical approach to the construction of these interesting and highly useful circuits. For those of you who wish to pursue this even further, here's a bibliography of everything tthat I presently know of that has been written on the subject.

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Remember When ... QRP Nets

by Les Shattuck, K4NK

In the early days of ARCI nets played a very important role in the operation of the club. I remember listening one night as club president Thom Davis K8IF (c.1979) polled the members on the 40 meter net about some club business. It was a great way to keep in touch with all the happening of the club. As for my self I always strained an ear to hear the net control as he sent the latest club news. In 1982 when I came to office exchanges of offical info was common place.

Now while our net manager Danny Gingel K3TKS could tell you more details about net stats, but let me tell you about some of the old nets and times.

The old net, and again I'm talking about 1979, met on 80 meters on 3.560 on Thursday nights at 0200Z. During the summer months it moved to 7.060 same time. Yes we had a Saturday AM net also and 7.060 was the chosen spot. Many other nets were tried with some success; we even had a 40 meter net on 7.060 at 1 pm for a short while.

In the early 80's the net organization really started to take shape. Net designators took form and if anyone said to meet on TCN, we would know to be at 14.060 at 23:00z Sunday evening. Others were SEN (South East Net), GSN (Gulf States Net), GLN (Great Lakes Net), NEN (North East Net) and of course WSN (Western States Net). The times and frequencys reflected the best thought on holding the net.

Did you know that a very nice certificate is availible for QNI's (checking into) our ARCI qrp nets? I have one and it was issued to me in 1983 by Red Reynolds the net control director at that time.The original certificate was for SEN and I earned endorsements for NEN, TCN, and GLN. To qualify you had to check into a net 25 times. It didn't have to be within any time frame. All you had to do was add up your QNI's and, when you reach 25, submit your application. I see my certificate says #22 … boy does that make me feel old!

Each issue of the Qrp Quarterly has always held a space for the net control director to print current information on nets and net happenings. As a former net control operator I must tell you of the excellent operator skills I developed. There is no better place to hone those skills.

I have read that the nets are not getting many check-ins these days and that the qrp-l and Internet have taken over as the communication medium. I would urge you all not to let the nets die out. The fraternal bond which got this club up and running leaned heavily on the nets, the least we can do is check in and give a friendly hello to our QRP friends .

Les Shattuck K4NK

ARCI CLUB HISTORIAN

The G5RV Antenna System: Some Myths, Questions and Improvements

by Al Bates, W1XH

The G5RV Antenna System is probably the most popular all band antenna among QRPers if not the general amateur population. Few people know what it really is, what it was designed for and how it can be modified and improved. After a little research and some reading between the lines, I've uncovered one or two myths, several possible alternatives, and some improvements.

What is a G5RV Antenna System? It's a 102 feet long dipole fed with 34 feet of open wire or ladder line. To put it in more general theory terms,. it is a 3/2 wave length dipole with a 1/2 wave length transmission line matching section. If you go back to the formula (length = 492 x (n-0.05)/frequency, n= 1/2 waves), you find the design frequency of this antenna is about 14.22 MHz. The original length was 102.57 feet for a frequency of 14.15 MHz. It is a twenty meter 3/2 wave dipole that works on all bands.

"I only operate CW. Why do I want an antenna that is cut for the phone band?" OK, here's the first "improvement." If you want a G5RV Antenna System designed for the 20 meter CW band (14.050 MHz), increase the length to 103 feet 4 inches and you will have a G5RV Antenna System cut for the 20 meter CW band. Oh, by the way, changing the length won't improve your signal in the slightest.

On 20 meters, the G5RV Antenna System radiation pattern looks like that of a half-wave dipole but has better lobes. On other bands, it looks like everything from a random wire to a multi-element collinear array. Impedances presented at the end of the matching section are everything from a few ohms reactive to 75 ohms to hundreds of ohms reactive. This is all theory, however, as height above ground, nearby objects, and the ground conductivity itself all effect the performance. None of the antenna modeling computer programs can handle these variables. In short, you can't predict or even guess at the radiation pattern or the impedance so don't worry about it.

Half- and Quarter-size G5RV Antennas. Somebody sells a half-size and a quarter-size G5RV Antenna System. If you go back to the calculator, you find the half-size one is designed for 28.46 MHz, which is still in an amateur band. The quarter-size version is designed for 56.92 MHz which is in the middle of TV Channel 2. I don't know why you want to use an antenna designed for a TV channel, but that's up to you. There are other alternatives.

Table 1: G5RV ANTENNA SYSTEMS FOR OTHER HAM BANDS

BAND	FREQUENCY (MHZ)	FLAT-TOP (FEET)	MATCHING SECTION * Ladder line	300 Ohm Twin Lead
160	1.8	806.33	260	219
80	3.56	407.70	131	111
40	7.04	206.16	66	56
30	10.11	143.56	46	39
20	14.05	103.30	33	28
17	18.07	80.32	26	21
15	21.05	68.95	22	19
12	24.4	59.48	19	16
10	28.35	51.20	16	14

The choice of 20 meters for a design frequency was based on a reasonable lot size and the fact that 20 meters is a fun DX band. You can, in fact, build a G5RV Antenna System for any of the other ham bands. Table 1 above gives you the dimensions.

Note: I've given the dimensions for both ladder line and 300 Ohm twin lead. Don't be shocked by the use of Radio Shack twin lead. If you know its limitations, it is easier to used and cheaper than ladder line. Don't worry about excess loss. At these frequencies and lengths, it won't make any difference. (We can cover the myth behind 300 Ohm twin lead at a future date.)

Just a brief word about baluns and coax. Don't use a ferrite or coil balun where the transmission line joins the coax. The impedance is unpredictable and weird. Some baluns fold up and die if SWR is too strange. A choke balun a few turns of coax is OK if you don't want RF on the outside of the shield. The coax itself should be 75 Ohms, but 50 Ohm stuff won't hurt that much because the SWR is high anyway. There is no minimum or special length for the coax. Any "special" or "minimum" lengths of coax are chosen in an attempt to "fool" the transmission line tuner (transmatch). Keep the coax run as short as practical.

(By the way, unless your tuner is mounted at the antenna, it is a "transmission line" tuner, not an "antenna tuner." Think about it.)

Improvements. Yes, Alice, you can "improve" a G5RV Antenna System. Things like getting the antenna as high as you can (but no higher) and as far away from everything else as possible will improve the performance of the G5RV Antenna System. A counterpoise is almost required when operating on 160 meters with the 20 meter version. These improvements will have a greater effect on your antenna than anything else you can do. But then again, this is true with any antenna.

The not so obvious improvement to the G5RV Antenna System is the choice of longer lengths for the flat top section. If 3/2 wave length is good, then a length equal to 5/2, 7/2, or even 9/2 wave length will work even better. (For various reasons, I'm avoiding even multiples of 1/2 wave length. Temporarily, that is.) If you have the wire, the space, and the sky-hooks, there is no reason not to build a as large a G5RV Antenna System as you can. Here are the dimensions for the flat top.

Table 2. Multiples of 1/2 Wave Length G5RV Antenna System

Band	Flat Top Dimensions (Feet) 3/2	5/2	7/2	9/2
160	806.33	1353.00	1899.67	2446.33
80	407.70	684.10	960.51	1236.91
40	206.16	345.94	485.71	625.48
30	143.56	240.89	338.33	435.55
20	103.30	173.34	243.38	313.41
17	80.32	134.78	189.23	243.69
15	68.95	115.70	162.44	209.19
12	59.48	99.81	140.14	180.47
10	51.20	85.90	120.61	155.32

If you've got the room to put up a 160 meter, 9/2 wave length antenna, send us a picture. I'm sure you will be pleased with the results.

All this is well and good, but what about practical stuff. I've used the 15 meter version of the G5RV Antenna System on Field Day and general use. It has a low SWR on 15 meters (for whatever that is worth) and works well with my Johnson Matchbox on 80 through 10 meters. The height is only moderate and it is not very far from the house and trees. I'm pleased with the results.

I mentioned avoiding even multiples of a half wavelength. Hams avoid full wave dipoles because they are hard to match to 75 Ohm transmission lines and transmitters. The whole idea is to get your transmitter output power into the antenna. If the tuner can do this, there is no reason not to use a full wave antenna. A 20 meter G5RV Antenna System operating on 10 meters is a three wavelength long antenna. That's six half waves.

How does the G5RV Antenna System compare to other antennas? If, an only if, two antennas are installed at the same height above ground and the same distance away from nearby objects, you will find the following to be true:

1) *The 20 Meter G5RV Antenna System will work better than a one band dipole on all bands from 40 to 10 meters, but not on 80 meters. Except on 80 meters, there is more wire than in a dipole.*
2) *An 80 meter dipole (135 feet long fed with ladder line) will work better than a 20 meter G5RV Antenna System on all bands. There is more wire in the 80 meter dipole.*

Any antenna is effected by height above ground and nearby objects. Some of the things that will have no effect on the antenna are drooping the ends of the antenna (up to about 1/6th of its length), bending the antenna, installation as an Inverted-V and changing the length of the antenna or the transmission line. Huh? Yes, if you use a tuner, changing the length of either the antenna or the transmission line will have no effect on the performance. The radiation pattern may change, but you can't predict that anyway. The impedance will change, but you're going to make up for that in the transmission line tuner, too. If your tuner can handle it, your best alternative to a G5RV Antenna System is to build a dipole that is as long as possible, feed it with ladder line that runs from the antenna to you tuner, and install the antenna as high in the air as possible.

So, have I convinced you not to build a G5RV Antenna System? Have I convinced you that it isn't all you thought it was? Or have I given you some alternatives and some things to think about? If you want to read more about the G5RV Antenna System, find a copy of "The Antenna Compendium - Volume I", ARRL, 1985, and check out page 86. This is an article about the G5RV written by G5RV. Read it and think about it.

Al Bates, W1XH, 2 Coach Road, Chelmsford, MA Email w1xh@arrl.net. First licensed in 1961 as WV2RIN, then WA2RIN, and WA1RNS. Most recently employed at Museum of Science in Boston. Ham interests are QRP, contests, rag chewing and playing with antennas. Member of QRP ARCI since 1961, but more or less active since 1977.

Scale	22%	32%	45%	55%	63%	71%	77%	84%	89%	95%	100%
Power	5	10	20	30	40	50	60	70	80	90	100mW
Power	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1W
Power	0.5	1	2	3	4	5	6	7	8	9	10W

Table 2

From the Membership Chairperson

Dave Johnson, WA4NID

At the risk of sounding like an endless loop tape, I want to remind you of important rules.

Please send all inquiries about subscriptions to me directly. The Treasurer does not keep records of payments, because these are kept in the database that I maintain. If you are inquiring about delivery please wait until the middle (or, preferably the end) of the month following the issue month, because the delivery times for third class mail vary greatly.

Remember to renew early. Do not wait until after the date usually shown on your mailing label. Please send a proper form along with your funds, to the Treasurer, or at least include all requested information (NOT just a check in an envelope).

Please type or print legibly. I need to receive forms by the first of the month prior to the issue month, in order to ensure delivery for that issue, and there is a delay introduced by the transfer of forms from the Treasurer to me. This means that you should send your renewal to the Treasurer prior to your last issue, to be sure of uninterrupted delivery.

Renewals are accepted for only one or two year periods, and then only if your renewal does not extend your subscription more than (about) two years beyond the present. Payments that cannot be accepted under this policy will be refunded.

Please send any changes of address to me promptly, as the U.S. postal service does not forward domestic third class mail.

Feel free to send material for the web site to me. I have limited time for gathering material myself, but am glad to add your contributions! I appreciate any help in pointing out errors, supplying data on upcoming QRP events or contests, or suggestions for improvement. I am especially glad to receive data on upcoming contests that recognize QRP entries, sponsored by ANY club. The Web site is at http://www.qrparci.org

Dave WA4NID, wa4nid@amsat.org

A Thermal Test Chamber

by Curtis Preuss, WB2V

Introduction

Why would anyone want a thermal test chamber? Well, maybe you don't. But if your going to get to the bottom of circuit problems caused by temperature changes it sure helps to have a temperature controlled test chamber. If you follow QRP news groups one of the recurring discussion threads is "My VFO drifts". If you're really going to do something about temperature drift you need to measure it. A thermal test chamber makes these measurements much more practical and accurate than stuffing your rig in a refrigerator or an oven.

What follows is a description of a thermal test chamber I built and used to test a temperature compensated DDS VFO[1]. The chamber used a thermoelectric module to pump heat and a PIC microcontroller to control the chamber temperature. In Part 1 of this article I'll describe the chamber and the business end of the control circuit. In Part 2 I'll describe the PIC part of the control circuit and how the software works. Actually this description is of a new and improved chamber which has a wider temperature range. I'm also working on an improved control program and hope to have it ready in time for the next issue of QRP Quarterly.

Pumping Heat Electronically

In 1834 Jean Peltier discovered thermoelectric heat transport, (now know as the Peltier effect). The effect Mr. Peltier discovered is illustrated below in **Error! Reference source not found.**.

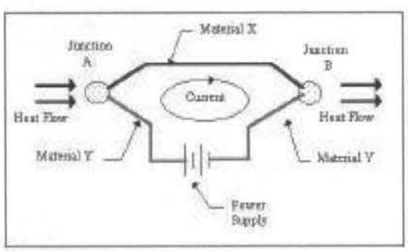

Figure 1: The Peltier Effect

When current flows from a wire of one material to a wire of a different material the current carriers will absorb or give off heat. In the figure electrons absorb heat at junction A and carry the heat to junction B where the heat is expelled. I don't want to impersonate a physicist so if you'd like to dig deeper there is a lot of literature available on this subject. A place to start might be the "CRC Handbook of Thermoelectrics".

For a practical thermoelectric module (TEM) it is necessary to have materials that are electrical conductors and at the same time reasonably good thermal insulators. Otherwise the heat carried from A to B by the electric current would be swamped out by heat being conducted from B to A by the wires themselves. Practical thermoelectric coolers didn't appeared until around the 1960's when semiconductor materials with good thermoelectric properties were developed. Now days TEM's use conductor pairs or couples made from N type and P type Bismuth Telluride semiconductors. Tens to hundreds of these couples are wired to together and packaged in ceramic holders to construct TEM's.

To get an idea of what sort of thermoelectric products are available check out the web sites for Ferrotec[2] or Melcor[3]. New or surplus thermoelectric modules and assembles are sold by various electronics suppliers. You may also have seen portable 12 volt electric coolers under the Coleman or Igloo brand in stores which sell camping equipment. The thermoelectric assembly for my chamber, shown in **Error! Reference source not found.**, is a surplus unit purchased from JameCo Electronics, (stock # 147942). This unit has the TEM, heat sink and cold plate all together in one assembly.

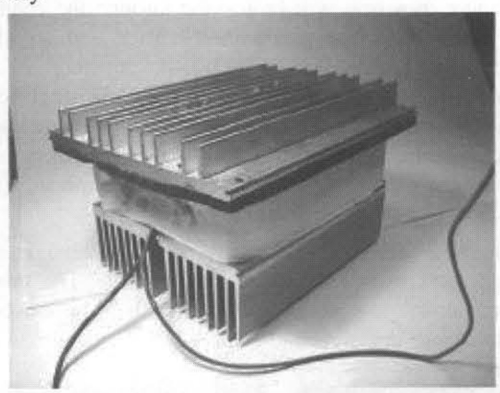

Figure 2: Surplus Thermoelectric Assembly

A couple key features of the Peltier effect are important to building a thermal chamber. First, by reversing the TEM connections to the power supply, heat can be carried just as well from junction B to junction A as from A to B. So the same module could be used to heat or cool a chamber just by flipping a switch. Second, the heat carried is proportional to the amount of current. This allows the temperature of a thermal chamber to be controlled by fiddling with the amount of current supplied to the TEM.

Chamber Construction

A generic thermal chamber is illustrated in **Error! Reference source not found.**. Basically an insulated box is constructed around one or more TEM's so that one junction of a Peltier effect couple is inside the box and the opposite junction is outside the box. The web sites I mentioned earlier provide a great deal of application information. So for this article I'll just summarize some points to keep in mind.

If the chamber is being cooled, heat is being pumped into the heat sink that sits outside the chamber. The thing to realize is that the power being used to pump the heat also shows up on the heat sink. Suppose the TEM is pumping 10 watts and in doing so draws 5 amps from a 13.8 volt supply.

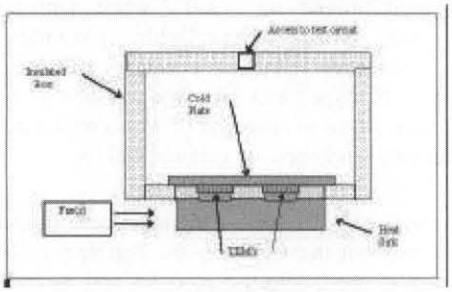

Figure 3: Generic Thermal Test Chamber

The heat sink must dissipate 79 watts. The main point is that the efficiency of a TEM decreases as the temperature across it increases, (efficiency goes to zero at about 60 degrees C). So if the heat sink side gets hot, the chamber can't be cooled as well. Use a big heat sink and blow a lot of air across it.

When the chamber interior is above or below the outside air temperature then heat will be leaking through the chamber walls. The TEM must pump this leakage and any heat produced by the test circuit inside the chamber. As the chamber temperature is being lowered the TEM efficiency is decreasing, meanwhile the heat leakage is increasing due to the larger temperature gradient. At some point things will equal out and a lower limit on the chamber temperature will be reached. Use lots of insulation.

Keep it small. This will improve the response time. Heat is stored in the chamber walls and the air inside. The smaller the chamber the less stored heat that needs to be moved in order to change the temperature.

Figure 4: Photos of Thermal Chambers

Beware of temperature extremes. Water vapor in the air can condense inside the TEM or chamber and short things out. When heating, the chamber temperature may be limited by components on the circuit being tested or the materials used to build the chamber.

Error! Reference source not found. shows how I built my chamber. A plywood shell and base were used to encase the TEM unit. After assembly the shell was insulated by using a can of "Fast Foam" I got from a building supply store. The heat sink side of the TEM unit was mounted so that it stuck through the base then fans and air ducts were mounted around the heat sink. The lid is also an insulted shell. Connections to the test circuit go through a foam plug in the lid.

Power Control Circuits

The schematic in **Error! Reference source not found.** shows how I interface the TEM to a PIC microcontroller. The RELAY input allows the PIC to select between heating or cooling by picking relay K1 which reverses the power supply polarity to the TEM. The PWM pin drives a power FET, (available from Digi-Key). This FET has a very low on resistance so it can switch several amps without generating a lot of heat and is driven fully on/off by a 5 volt logic signal, so a PIC output signal is all the drive required. The average current in the TEM and therefore the chamber temperature can be controlled by using pulse width modulation, (George Heron had an excellent article on PWM in the last issue of QRP Quarterly) .

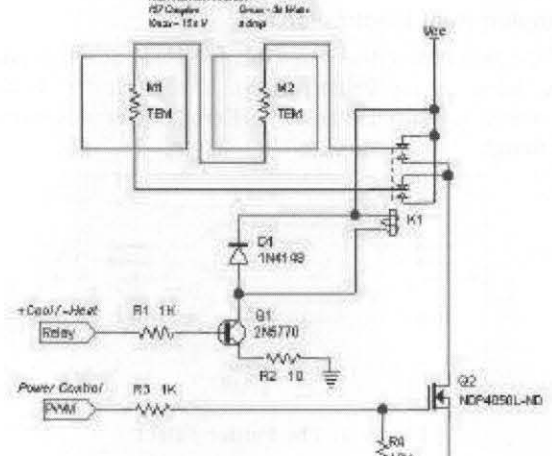

Figure 5: Thermal Control Schematic

On thing to note is that the TEM is drawing 4-5 amps and switching this much current will create a lot of noise. The switching noise can raise havoc with the controller and temperature sensing circuits. Resistor R3 in conjunction with the FET input capacitance acts to slow down the switching rise time and generated noise.

Ok, that's all for Part 1, in Part 2 I'll describe a way to sense the chamber temperature with a PIC then compare that temperature with a user input and then adjust the PWM output to the TEM.

Notes

Review: The Kanga "Oner" Mini-Stockton QRP Power Meter

Tony Fishpool, G4WIF *email: g4wif@btinternet.com*

Building QRP rigs is a little like Chinese food. After a while you have to build another. Accurately measuring the power output from these small transmitters is not too difficult if you have an oscilloscope but the average inexpensive power/swr bridges struggle at QRP power levels, particularly on the lower frequencies.

A few years ago, Dave Stockton GM4ZNQ described in SPRAT (the journal of the G-QRP club) a circuit (see figure 1) that was very sensitive and had a relatively flat H.F. frequency response. Kanga Products have recently produced this on a printed circuit board that is only one inch square to complement their "Oner" range. I thought this would fit well into the rather insensitive SWR bridge that I had previously obtained at a junk sale for a few pennies. The conversion worked perfectly.

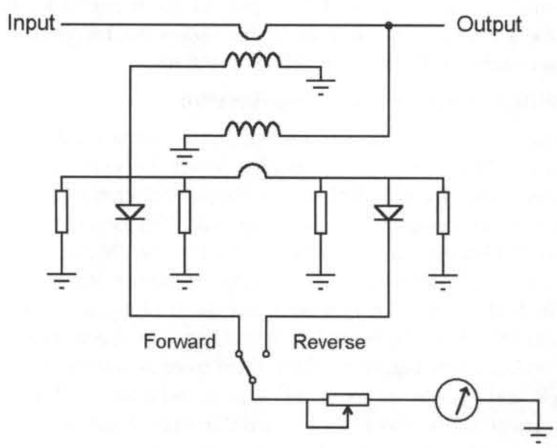

Figure 1 - Circuit diagram

With just a handful of components, it takes very little time to build. The time consuming part was winding the two toroid transformers.

The small size of the PCB requires patience and nimble fingers. I found that drilling a couple of extra small holes either side of where the toroid was to be mounted, and tying them down with lacing twine, helped to secure the cores while soldering the wires. The miniature coax supplied was very springy. Hot glue has apparently also been used effectively by other constructors.

The meter supplied is a 200uA unit that appears to have been originally intended for S-meter use. The instructions were rather brief over the matter of SWR calibration. A 10k potentiometer is provided to place in series with the meter, but strangely, the instructions suggest this is only needed if measurement of SWR is required.

Some form of multiplier resistor must be used, as without one, the meter would be capable of reading only very low powers. By adjusting the potentiometer for full scale deflection, and then by operating the switch, SWR can be read. If you would like to save on the maths (see Figure 2), mark the scale at the points shown in Table 1.

$$\text{SWR}=\frac{1+\sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}}{1-\sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}}$$

Figure 2

% Full scale	SWR
21%	1.5:1
31%	2:1
50%	3:1

Table 1

This kit though, is sold a directional watt meter, displaying the power going out, and (if due to a poor match) the power coming back. Dave Stockton in his SPRAT article described it as *"a 4 port hybrid which is simple circuit involving two transformers and a few resistors* (see diagram). *As the output signal from the transmitter passes through the primary of the first transformer, a small sample flows into one of the 50 ohm terminations. A sample of the reverse power flow also flows into the other termination. The ratios between the primary and secondary of both transformers determine the sensitivity of the instrument and a choice of power ranges can be achieved by different multiplier resistors in series with the meter*".

Although an extra meter is available at addition cost, the Kanga kit is supplied with only one, and a change over switch is supplied to enable the meter to read either forward or reverse power. If some form of calibration of the potentiometer's position was made, several power ranges are possible.

I chose to have three ranges, 200 milliwatts, 2 Watts and 20 Watts, and you can see by the photograph that these are provided by the two banks of pre-set potentiometers (one for forward power and the other reverse), selected by a three position wafer switch. The "Oner" PCB sits in the centre.

There are a number of options when marking the meter faces - I used a computer CAD package and I calculated the position to place the markings. Power scales of course, are not linear when displayed on a meter designed to be linear with current.

If the range you want is not shown in the table, simply multiply all power figures of one of those above by the same factor. So for 2 Watts 95% (of full scale deflection) indicates 1.8 watts.

Conclusions

With the addition of a small metal box and a few coax sockets, this is a very effective and low cost kit. It can also be used to convert an existing SWR bridge and reuse the meters and (perhaps) the scales. The instructions provide no guidance as to how to calibrate the unit and that is a pity, as while construction may require a little dexterity , it is well within the ability of most beginners. Hopefully this review will pick up where the instructions left off.

Scale	22%	32%	45%	55%	63%	71%	77%	84%	89%	95%	100%
Power	5	10	20	30	40	50	60	70	80	90	100mW
Power	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1W
Power	0.5	1	2	3	4	5	6	7	8	9	10W

Table 2

Quick, Inexpensive and Effective: A Simple Satellite Mobile QRP Station for the Beginner

by Douglas Quagliana, KA2UPW *email: dquagliana@aol.com*

This paper first appeared in the Proceedings of the AMSAT-NA 14th Space Symposium (November 8-10 1996). AMSAT is a registered trademark.

Abstract

This article describes how the author's AO-27 satellite station evolved from its simple beginnings. The author has used this station to make contacts with fifteen states and over twenty grid squares while operating satellite QRP mobile. This article was written for the Amateur Radio operator who has little or no experience using satellites and is interested in creating and operating a simple inexpensive satellite station for AO-27.

Introduction

AO-27, also known as EYESAT, was one of several amateur radio low-earth orbit satellites that hitched rides as secondary payloads on an Ariane V-59 rocket launched in September 1993. AO-27 is a small microsat class satellite that performs commercial functions and also acts as a part- time mode J FM repeater within the amateur radio bands. At present (August 1996), the satellite is configured to turn on its FM transponder for a fixed amount of time starting several minutes after it emerges from the Earth's shadow. AO-27 has a very sensitive receiver that will detect even a few watts from an HT.

The Satellite Station

My original satellite station was a Tempo S1 two meter HT, a 5/8 wavelength magmount, a homebrew quagi and a handheld scanner. I have improved upon the original quagi and replaced the scanner with a preamp, a downconverter and a Uniden HR2600 10 meter transceiver. My whole station fits neatly into the trunk of the car, and easily sets up in less than five minutes.

Photo 1: KA2UPW's portable satellite station

When necessary, everything except the quagi boom and 5/8 wavelength antenna can collapse down into a backpack or carrying case. The entire station runs off of batteries, which allows me to operate from just about anywhere. Since the very beginning I have tried keep everything as simple as possible, consistent with successful operations and good operating practice.

AO-27 : The QRP satellite

While AO-27's uplink receiver is very sensitive, the downlink is usually at the 600 milliwatt level. This means that a good low noise preamp with 15 to 20 dB gain, or at least a five element beam, is needed. I made my first AO-27 contact with a homemade five element quagi that I built from an article in the December 1987 QST. The first quagi was just thrown together. The boom was a wooden dowel. The reflector and driven element were #12 insulated solid copper wire supported by wooden dowel spreaders which were held in place with hot-melt glue. The directors were one-eighth inch welding rods secured to the boom with rubber bands. The quagi was pointed manually and fed a few feet of RG-8 connected to my Radio Shack Pro-38 scanner. It worked. For an uplink signal, I used my HT and a 5/8-wave antenna magmounted on my car. The antenna was is a commercial version, but the magmount was homemade. The HT put out about one and a half watts. Using the quagi, scanner, two meter ht, and 5/8-wave, I worked six states in my first month of QRP mobile satellite operations.

Downlink Improvements : The Receiver

After the first few contacts, I found that the scanner didn't receive very well except during the highest elevation passes. I also observed that there were times when the downlink would Doppler between two channels, and neither one was copyable. This had more to do with the fact that the scanner tuned in 15 kHz steps at 435 MHz than the Doppler. My first solution was to use a 435 MHz downconverter with the scanner set at 29 MHz, where it tuned in 5 kHz steps. This reduced, but didn't eliminate completely, the problem of the downlink being between channels on the scanner. However, it also added a new bigger problem: there were now three times as many channels, and the scanner could only scan in one direction. If I scanned too far I had to go all the way to the end and start over. If not for this problem, I probably would have stayed with the downconverter and scanner with 5 kHz tuning. The current solution uses my Uniden HR2600 10m HF rig with the 435 MHz downconverter, effectively turning it into a 435 MHz all mode receiver. This provided several advantages over the handheld scanner. The combined preamp/downconverter/HR2600 receiver has finer tuning (100 Hz) and copies the downlink at lower elevations better than the scanner. The only disadvantage of the HR2600 was the higher current that it requires. This was easily overcome with a 7 amp-hour "brick" gel cell.

Downlink Improvements : The Quagi

Soon after I finished the first quagi, I started thinking about improvements. While it fit in the trunk of my car, it seemed to occupy more volume than it should. Since I wanted it to be portable, it had to be collapsible, light weight and easy to hold and point. In addition, I didn't want something which was overly complicated or required tools for assembly and disassembly. With these goals in mind, I redesigned the quagi.

To solve the pointing and holding problem, I took an angled handle from an old garden tool and attached it to one end of the boom. It allows my hand to grip the handle at a natural angle. I also used a smaller diameter dowel as the boom to make the whole antenna lighter. These two improvements made the antenna aiming much easier and reduced the arm strain. Next, I connected four short wooden dowels to each of the loops with some creatively cut plastic tubing. The other ends of the dowels are plugged into wooden spools attached to the boom. This allows the loops to be removed from the boom if necessary. The directors are held in place with cord locks from the local camping supply store. Two cord locks, one above the boom and one below, effectively hold the directors in place while providing an extremely quick assembly and disassembly.

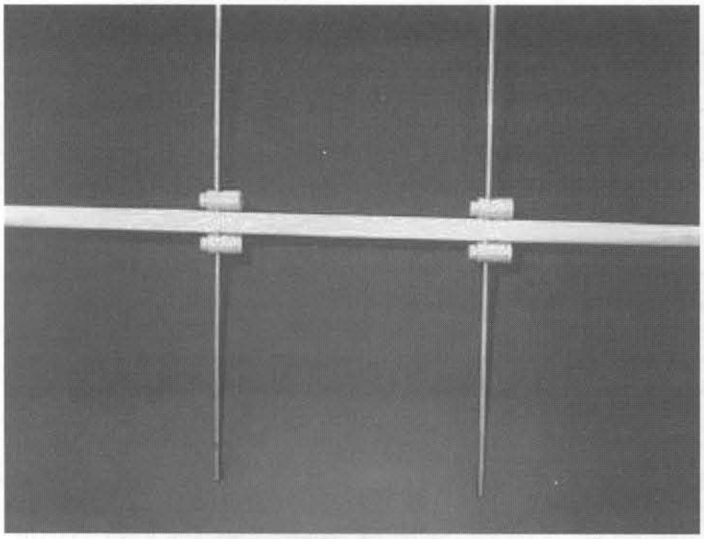

Photo2: Quagi Construction

The preamp was tied to the boom and configured to run off of a 9-volt battery. The director is soldered to an N-type connector for convenience of connecting it to the preamp, but it should work just as well with the director connected to the coax shield and braid.

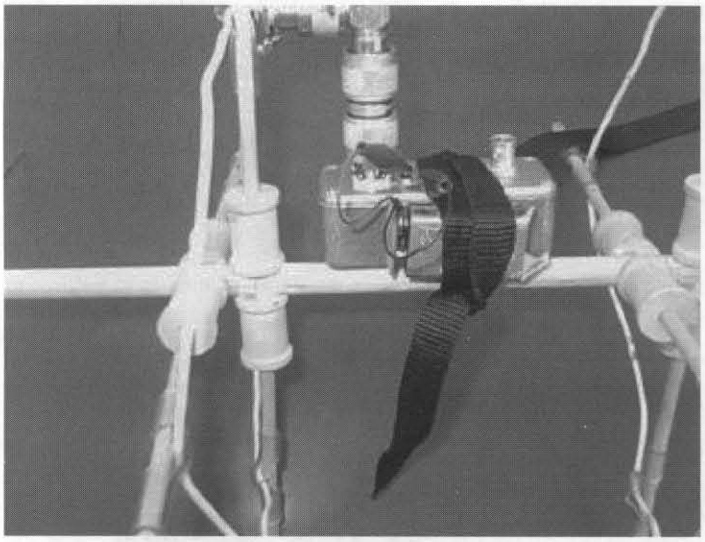

Photo 3: Close-up on the boom-mounted preamp

When building this antenna, the prospective quagi builder should follow the old axiom, measuring the lengths of the loops and directors twice then cutting once. Also, the builder shouldn't be overly concerned about the exact resonant frequency, the antenna pattern or the absolute gain. The 435 MHz quagi was only used on receive with AO-27 so the dimension were not as critical as they would be if the antenna was used for transmitting.

Although it is possible to get started without one, I highly recommend the use of a preamp. I built a Down East Microwave 70-cm preamp from a kit. This kit was almost entirely surface mount but contains only a few parts. I mounted mine directly on the boom by tying it down with a strap from an old backpack. Power was supplied from a 9- volt battery attached to the case with double sided sticky tape. A small battery connector with alligator clips served a means of connecting and disconnecting the battery. The difference was dramatic. A downlink signal which was completely unreadable without the preamp became easy to copy with it. The 436.8 MHz downlink signal, once amplified by the preamp, was converted to 29.3 MHz by a Hamtronics 435 MHz downconverter that was also built from a kit. Interested builders should be aware that the kit contains numerous small surface mount parts. The version which I bought requires an enclosure and connectors. I mounted mine in a small 3"x5"x2" box and powered it from another 9-volt battery. While it does an adequate job of downconverting, my version required a preamp to allow reception of AO-27 with the HR2600.

Once the downconverter was built, I needed to test and align it. Normal alignment required a 435 MHz signal generator, which I didn't have. I suspect most beginners won't have one either. I did have the previously mentioned handheld scanner, which it turned out was a very effective VHF/UHF programmable signal generator. The scanner allowed me to easily test and align the downconverter. A quick examination of the insides of the scanner revealed a crystal and what was probably a 455 kHz ceramic resonator. This suggested that the first intermediate frequency (IF) was near 10 MHz and that the second IF was 455 KHz. Knowing that the scanner did receive on 435 MHz, it seemed reasonable that the local oscillator was near 435 MHz also. Not knowing the exact IF frequencies, I set the scanner for 446.00 MHz, connected the downconverter and HR2600 and tuned until I found the local oscillator signal. On my scanner the frequency of the local oscillator (LO) was about 10.85 MHz below the scanner's programmed receive frequency. When the scanner was set to receive 447.65 MHz, the local oscillator became a 436.80 MHz signal generator. Other scanners use different intermediate frequencies and different mixing schemes but will probably still have a LO frequency about ten of megahertz from the received frequency.

The local oscillator signal was quite strong and easily detectable when placed near the downconverter. To distinguish it from other signals and images in the receiver bandpass, I configured the scanner to scan between two or more channels; only one of which had a LO signal near 435 MHz. The desired LO signal will be present and absent as the scanner moves among different channels, giving it a distinctive beeping sound.

The preamp can be tested in a very similar manner. I again configured the scanner such that the downconverter could receive the local oscillator signal. Next I placed the scanner at a distance from the receiver such that the signal was just barely discernible and installed the preamp with the power disconnected. The preamp was inline after the antenna but before the downconverter. After I found the local oscillator signal and applied power to the preamp, there was a noticeable increase in the received signal strength. As a check, I removed the power from the preamp and moved the scanner farther away to the point where it was undetectable. When the preamp was turned back on, the signal was clearly audible.

It also turns out that the antenna can be tested using this technique. Although the actual gain can not be determined, I verified that my antenna was directional and that it did provide some amount of gain. As before, I placed the scanner at a distance from the receiver. Then I alternately pointed the antenna at the scanner and away from the scanner. The received signal strength increased as the antenna moved towards the scanner and decreased as antenna was pointed away from the scanner.

Basic Operations : Making your first contact on AO-27

Before you can make your first contact through any satellite, there are several pieces of information you will need to know: when the satellite is above your horizon, exactly where in the sky it will be, and when it will be available for use. The first and second are determined through satellite tracking and the third requires knowledge of the transponder schedule. You should also find out what your grid square is. This isn't really necessary, but just about everyone will ask you for it.

These days the way to track satellites is to use a computer with a satellite tracking program. Several tracking programs for various computers as well as the necessary up to date Keplerian elements are available from AMSAT at http://www.amsat.org. Any of the tracking programs will give all of the details necessary to access the bird: the exact time that AO-27 will be visible above the horizon, the compass direction to point the antenna (the azimuth) and how far above the horizon to tilt it (the elevation).

Once I started working stations on AO-27, I noticed some of the nice regular characteristics of its orbit: most of the passes are near lunch time, and on these passes it will always rise towards the north and set towards the south. Whether the satellite track more to the east or west depends on the particular pass. The transponder schedule for AO-27 has the mode J transponder active for these passes all the time. Less frequently, the transponder will also be active on the evening passes when AO-27 rises from the south and moves north. Compare this to RS-10 or MIR, whose schedule and directions vary greatly from month to month. It is relatively easy to follow AO-27 in its path across the sky once the signal is found. At the time indicated by the tracking program, point the antenna at the azimuth where the satellite should rise. You may need to adjust the antenna to obtain the best signal on the downlink. Try moving it left or right, up or down, or rotating it ninety degrees clockwise or counterclockwise. The important point is to aim the antenna for the strongest signal, using the exact azimuth heading as a rough guide only. Once the downlink has been acquired, adjust the antenna in azimuth, elevation and rotation as necessary to maintain the signal. It might take a few tries to get the hang of how to do this.

All satellite passes are not created equally. When I was using my original station with the scanner, I only tried to work AO-27 on those passes that would reach a maximum elevation of at least forty-five degrees. Lower elevation passes will place the satellite at a greater distance exceeding the capability of both the HT and the scanner. Passes earlier in the day will be more to the east and those later in the day will be more to the west. You can use this to your advantage. For example, along the eastern coast of the United States, the earlier passes will place most of the satellite's footprint out over open ocean. This reduces the number of satellite stations which can access the transponder, but it also reduces the interference caused by other signals in the two meter band. Certain passes over the Atlantic include both the United States and England within the footprint for a few minutes. When combined, these features make the lower elevation earlier passes a favorite among some of the operators on the eastern United States.

As the satellite travels overhead, its signal will appear to change frequency. This phenomenon is known as the Doppler shift. In order to compensate for Doppler on AO-27, lower the receiver's frequency gradually as needed. Start listening five to ten kilohertz above the actual downlink frequency of 436.8 MHz. Set the two meter FM transmitter to the satellite's uplink (145.850 MHz) and leave it there. The satellite will compensate for the Doppler on the uplink. On FM, you want to listen for silence or a drop in the static level. This is your clue that you have the antenna pointed in the right direction and AO-27 is getting closer. Now wait until you can hear the downlink from AO-27. DON'T TRANSMIT UNTIL THE DOWNLINK FROM THE SATELLITE CAN BE HEARD! This is very important. The satellite WILL retransmit all the signals it hears. Some people transmit without hearing the downlink and only succeed in disrupting the pass for everyone else who can. You might want to listen to two or three complete passes before you even try transmitting. When the satellite hears your signal you will hear your own voice on the downlink. This is normal, but might take some operators by surprise. Headphones or earphones are highly recommended. It's very easy for the sounds from the receiver to get into the microphone and distort your uplink signal. There will be times when the signal from the satellite appears to be rapidly switching polarity and times when the signal fades for short periods of time. This is normal. Just try to work around it.

Satellite contacts on low Earth orbit birds like AO-27 are usually short and contest style, especially on weekends when many stations are trying at the same time. On weekdays there are far fewer stations.

Assorted tips and tricks for working amateur radio satellites

I try to be ready for the pass five to ten minutes before the expected starting time. This allows adequate time for any last minute complications.

During each pass I wrote down call signs, names and grid squares of every station that I heard that I didn't recognize. If I later worked one of those stations, I could use this information as a check that I had copied the QSO information correctly. I used a preprinted list that contained the time, azimuth and elevation along with room on the right hand side to write in callsigns, names and grids. This served as a quick log during the pass. The details were later entered into my logbook.

I concentrated my efforts on improving the downlink. The uplink was easily obtained with just a few watts from my HT. The only problem is when it's captured (and denied to others) by stations running excessive power. As a beginner, I could not compete against the higher powered stations with large directional antennas, but I was able to make contacts when I dropped my callsign immediately after two other stations ended their conversation. I found that adding "QRP" or "mobile" to the end of my call makes me a more desirable contact.

When working AO-27 mobile, I always brought two sets of keys and tried to find a good spot to set up my station. A great spot would have a perfectly flat horizon in all directions. Being on top of a hill was not necessary a good thing, especially if there was a radio tower on the hill with me. Strong signals from the tower could desense the receiver. I usually set up the components of my station on the trunk of my car in roughly the same positions. This minimized the confusion when looking for a particular knob, the microphone, log sheet, or whatever. Permanent stations don't have this problem.

I didn't try to start off with a great station. I started simple. I got it to work first and then made incremental improvements. This way I got on the birds sooner than if I had waited and tried to build a really terrific station. I also learned how well the various parts of the station worked, and this allowed me to know when a modification had improved or degraded the performance of the whole system.

I noticed that there is sometimes a slight difference between the predicted azimuth for a pass and the actual azimuth which gives the best signal. In these cases, I just pointed the antenna for the best reception and adjusted it periodically.

Conclusion

Getting started on AO-27 is easy. Anyone can do it, and most amateurs probably already own everything they need for the uplink! In addition, several characteristics of AO- 27's transponder and orbit make it ideally suited to the beginner. I hope this paper has been informative and instructive.

That's all folks! And of course, thanks to my wife who assisted in the preparation of this work. If you have questions or comments, feel free to contact me.

See you on the birds!

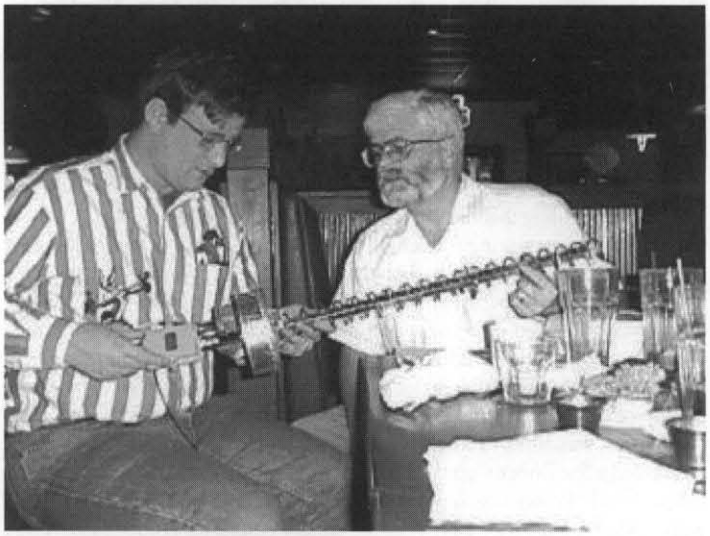

Photo 4: Author KA2UPW (left) discussing the finer points of yet another one of his homebrew satellite antenna creations with Jim Larsen AL7FS during a recent NJ-QRP gathering.

K2-Building and Support Impressions

Taken with permission from the Elecraft Comments page at www.elecraft.com

Jeff Gold (*JGold@tntech.edu*)

Well been seeing the posting of those fortunate hams who have their priorities straight and have finished their K2s. I have been doing 14 or more hour days and on a 6+ day schedule. Luckily I have been sick one or so days so did find some time to start on my K2.

I have built and reviewed many of the available kits over the last 7 or so years. The kits themselves and the finished products have come a long way. Most of the kits you see talked about on this list are pretty good deals.. easy to build, affordable and work great (*the $50 Small Wonders 40+ is an excellent example).

I guess for quite a while I was wishing that someday I would be able to build a multiband portable rig with some of the nice bells and whistles. Figured it would be another 3-4 years from now. So when I saw the K2 from Elecraft.. boy did I get excited. The fact that Wayne Burdick was one of the two developers gave me immediate confidence. I have had fantastic success with the original Norcal 40 and at LEAST one version of each of the updated models.. impressed that the very first kit Norcal did worked about as good as the commercial version. Well thought out and performed extremely well. When this kit became a reality, started selling off a number of rigs to make room and get the cash together.

Taking the parts and the case out of the box first overwhelmed me with shear numbers and then impressed me with the quality of all included. The manual is a very thick and very professional document. Very good quality print, VERY clear unambigous directions, great diagrams and such. The only part that worried me was being a Field Tester for the product and not liking to run into problems while building. I continue to use building as a very effective form of psychotherapy.. I go "into my cave" as my wife describes it, and come out a much more relaxed and happy individual.

The parts were bagged seperately for each of the sections. You basically build the controller board... does all types of computer magic, then the front panel, which has the many buttons and controls and lcd bar graph and digital frequency readout. The REALLY neat concepts have to do with incredibly well thought out design. No wires, the controls mount on the board (as with Wayne's other designs), the kit has a built in DVM and digital frequency counter so you have the tools for tune up built into the rig. The tuning knob is like one you would find on a small kenwood, or other commercial radio, heavy weight, great feel.

Looking at the 100's (now in 1,0000s) I was overwhelmed and got a bit anxious and thought about dropping out of the Field Test. Had two wonderful experiences. One was the fantastic support Eric gave me personally via email (Wayne was out of town), and other Field Testers. There were actually only a limitted number of changes in the manual for such a large project.

I basically made the changes.. Wayne and Eric have a very nice Web site for Field Testers with official changes in building procedures and any corrections or warning. Didn't take too long to change manual. I just followed along in the manual and ended up enjoying every minute of the building experience. Did not encounter even one problem or area of ambiguity while building up the controller and front panel and section of RF board needed to run first power on tests.

At first I thought it would be nice to have a section by section photo of parts placements, especially on RF board where there are MANY parts. I found that this or any other additional information were completely uneccessary. The parts placement coincide so well with the directions that I just put a part in and the next one went exactly where I would expect it to be. This was a real positive aspect of building. The boards are of absolutely the highest quality I have seen with very clear silk screening.

I believe the next item I experienced has been written about and can't be explained suffeciently in words. This is the first power up test which comes after the controller, front panel and some relays and such are placed on RF board. You then put the sides and some parts of the case together. EVERYTHING snaps together perfectly. The mechanical fit if fantastic and very easy. So there you are with what looks like a commercial produced rig with digital display, plenty of buttons and knobs to play with and your first test. I really took my time, used a meter to measure each resistor and capacitor I put in.. wasn't quite so nervous about the smoke test. Powered the rig up.. heard the relays a clacking (not for TX/REC-do band switching and other stuff) and the display read and then the frequency read out. I did have one small problem.. my rig did all the tests at this point with no problem .. my 10ths digit on display was a bit messed up.. took about no time and got email from other testers, Wayne and Eric. My mind was immediately put to rest when what they suggested might be the problem made 100% sense. I had a bit of problem with the pins on the LCD display.. took about 2 minutes, just went back and reheated the places I could get to without taking anything apart.. powered up.. all is well with world.. except maybe my family's ear drums from my very strong decibal vocal response to the fix :*)

I feel very confident that the first full production run will be the most amazing kit for quite a few years... from dealing with Wayne and Eric.. they instill confidence in their product and 100% of its support. I would doubt if anything other than an extremely minor (if anything at all) will show up in the next run.

the neatest part is going to be having a full function rig with all the bells and whistles that I will have built myself. So confident about it.. gonna sell my 850

Jeff Gold (*JGold@tntech.edu*)

Well, believe it or not, another local ham (Conard-WS4S) lent me his K2 for 2 days. Hooked it up last night (really hard.. had to plug in the antenna, and clip the battery leads onto my Gell Cell). Attached my Norcal Paddles, and then pushed in the power switch. The rig did its usual magic, lit the display saying Elecraft and then displayed the frequency.

Now I am use to changing the paddle leads to match the keyer (so that dits are on left and dashes on right.. the way I like it). First try hit the paddle and sent one continuous note. Hit the menu button once to put the rig into menu mode, then turned the knob till it said paddles.. momentarily pressed the menu again to get to change the menu selection.. this allows you to switch between straight key, or which paddle will control the dits and dashes.. lot easier than resoldering.

Was late at this point and not great local WX. Nothing on 10 all the way down till 40 meters. 40 was very ugly.. very loud noise and broadcast. Tuned in a station around 7.0400 and then figured out how to use filters.. another difficult maneuvor. You hit the filter switch and switches between one of the 3 settings. Found the one I liked. and immediately made a contact. Having heard how sensitive the receiver was, I was at first a little concerned because loud signals were about same as band noise. Switched on my Corsair I, with 500 hz filter and switched to it. Found I needed to have the filter on, use the RF gain and then the notch to get the signal thru.. band was just lousy. Same thing again this morning. Did some quick bad band condition comparisons, the K2 held up very well against the Corsair in terms of receiver. I consider the Corsair to be one of the best Cw rigs I have ever owned. The other one is my Kenwood 850.. will try the comparison with that also if I get a chance. The only time that the Corsair was at a slight advantage was when I used the notch on the Corsair.. which on my rig is quite effective. Programmed the memory keyer.. works very well. The keyer also works very well.

Love the QSK on the K2, the speaker tone is beautiful.. very mellow and full, the receiver really pulls in the signals in adverse conditions. The rig on less than 5 watts seemed to cut thru the noise, got very good signal comments when I asked.. in addition to standard number exchange. It is real cool the way when you turn the keyer speed it reads out the speed (and it seems to me to be the actual speed), when you change the power level, it also reads your power out on the digital display. Very well thought out computer interface. The rig is very intutitive.. so far.. many many features I didn't mess with. The keyer worked very well for me. I really like the main tuning knob.. very high quality and nice feel. Very impressed so far. Hope to be able to play on some of the other bands tonight or tomorrow am.. may have to take some vacation time in the morning tomorrow.

K2 sighting on 20m

PDouglas12@aol.com

I am stuck home with the leftovers of the flu, and finally feeling better, found my way into the shack. On the 2N2/40, 40m was dead, but 20 sounded like there were signs of life on the Sierra. I pushed the general CQ button on the CMOS III, but got no answer. OK, pushed the CQ QRP button, and back came a feller in Tenn. name o' Conard, WS4S. Nice signal, easy fist. I tell him my name, QTH and give him a 559.

He comes back with a 429 to 579, with QSB, and a chuckle. He says he's running 4w from a K2 into a vertical. K2? Did I hear K2? I send him a request to repeat the rig, BK, and he sends back Elecraft K2. HI HI, I send. I am on the list for the next round of K2s. Conard says it went together reasonably smoothly, and it is a great rig. Takes thinking and getting used to, but that's the good part. Hey Conard, your K2 sounds OK here in Long Island. My workbench is clear and ready.

K2 Report

Jeff Grudin (*grudin@pacific.vdbs.com*)

The K2 will live up to all it has been touted to be.

Last night I had a 45 minute QSO with a friend in Mo (I'm in CA). He gave me a 10 over S9 report. I was using 10 W at the time. I usually use 100W for this weekly sked.

40 meters is usually quite noisy for our evening sked and I usually use my DSP filter to make listening tolerable. Last night the band was quieter than normal but still pretty noisy. With the filter cranked down to narrow, the sig was perfect and the noise level very quiet. I had no need for the DSP.

For the DXer, the split was well thought out. The REV button temporarily allows you to listen to the transmit freq to find your place when you let go you are back listening to the DX. You can hold the reverse and tune with one hand allowing you to keep your other hand on the key.

The xtal filters work very well and the narrow position is great. There is no ringing even on the very narrow position. The spot tone and CW reverse are also handy for tuning and QRM busting.

I really like the keyer speed and power controls. When you turn them the speed/power show up on the display and let you know exactly where you are. Then they disappear and the frequency is displayed again.

Everything works as it is supposed to.

Last night I built an interface for my computer, that allow me to use the computer for contest keying, and also use my paddles to answer questions. Look out FYBo.

Bruce Hopkins - KL7H (*kl7h@eagle.ptialaska.net*)

It don't get much better than this!!! -45F outside, cozy warm woodstove (75F inside temp), listening to 14.060 on the Sierra, the Mac bringing all my QRP-L buddies onto desk center, and the laptop on the sideboard with the K2 operation manual on the screen...

But it can get better... What is that call I hear finishing up a QSO and talking about the K2 ??? Well, it was Eric - WA6HHQ at about 519... I gave him a call and after a couple of trys he responds and gets my prefix... A very familiar sound to a KL7 is the signal going away shortly to be replaced by increased strength as the beam comes North... Eric's signal went to 549 and I received a 529... K2 @ 10W to Sierra @ 950mW...

What does all this have to do with "Pontiac Blue" ??? For those of you not old enough to remember, ask your dad about the "Blue" jewel in the middle of the Pontiac tail lights back in the 40's & 50's... Many other makes used them as well and they became an aftermarket product you could kludge on to your '55 Chevy's tail lights... I am here to tell you that the K2 sounds like "Pontiac Blue" looks, COOL !!! The tone of the K2 is very pleasant to listen to... It is kinda round and smooth but not too soft... Many rigs key way to hard for my taste, some are way too soft... It is obvious that this rig was designed by CW buffs, to my ear it is just right...

So Eric, it was fun... But don't you two have some work to do??? Lets see if I send the check today, it should be getting here just about the time I reach back from the Bahamas... Do you guys take wimpy sled dogs in trade???

You all take care and have fun... I've got to go chop some wood and get back in here to the K2 manual... Look for you all on FYBO... At these temps I may just stay by the fire with the wimpy sled dog...

K2 Glory

Roy (*marion@montana.com*)

Been using my K2 for a few days and I'm in awe. The the performance and features of this rig is astonishing. For instance, the scaning feature. Scans whatever band segment you want, pauses on the station, if you don't hit a paddle or any button, it resumes scaning. It can tell if it's a carrier and doesn't stop. You can store the scaning setups to memorys and have a band scan plan for every band. Amazing how a "dead band" comes to life. And the audio is great.Any way, there isn't enough bandwidth for me to brag on this fantastic rig. I sure feel I got my moneys worth. I'm on 40 now (0400Z), so get on and and lets have some QSO's. 72 Roy AB7CE, Montana.

First impressions on K2 vs. European BC stn

"Peter Zenker" <Peter_DL2FI@csi.com>

Did some QSO, got some good reports and from critical QRP friends an enthusiastic fat X9 as tone report.

It is getting dark outside. Using a 50 Ohm resistant at the txvr side of my Antenna Tuner and an RF Voltmeter I just measured abt 250 mV RF To explain, thats the sum of all RF coming into my shack from my 41m long 23 m up endfeed ZEPP.

Between 7100 and 7200 I counted 14 BC carriers all peaking the S9+40 bar at the S-meter allthough i used the attenuator. The sidebands of this BC stn all are peaking the S9+40 bar, that means, the real signal of the carriers will be som 60 dB over S9 or more.

The situation within the European 40m band (7000 to 7100): absolute clear receiving of amateur radio stn as week as 529 is position no attenuator, no amplifier. using the preamplifier brings the s-meter up to a constant level of S5. AGC is working fantastic. If I compare with rhe SGC 2020 which I had two times as a test rig, the only coment I can give is "no comment" (I still have some trouble with the German dealers about a comment printed in my monthly QRP-QTC :-((

Until now absolute no need to use the RF gain knob. I tried it, it is workin excellent also on week signals, but as I said, no need to do so. Compared to my FT1000 (the old one, not the MP) the K2 seems to be a little less noisy, but may be thats the same problem a young lover has if he compares his actual love with a model - the more you love her, the more she will. In fact it is at least the same quality. The main difference: Weight of FT1000 is 32kG

Until now, NO IF breakthrough.

In some of my rigs I am using a 7020 piecoceramic filter coupled to 50 Ohm by 2 transformers to make them winners on 40m. I will try the K2 with this filter to see if there is any difference (somtimes you can make good things even better :-))

Lots of European QRPers use the QRP beacon OK0EN in the Czech Republik as an ultimate test. It is at 3600.00 running 100mW into a corner dipole. To copy OK0EN one need a real good receiver. A few minutes ago I remembered this test. I tried it first with the FT1000: the beacon was there, QSA abt 2 to 3 (in other words, 229 to 329) with the 500 Hz filter and 329 using the 250 Hz filter.

Then I switched the antenna to the K2. At exactly 10 Hz above 3600 I heard the beacon QSA 5 either with or without Attenuator or Preamplifier.

Quod erat demonstrandum

AW: K2 in contest conditions?

Peter Zenker (*Peter_DL2FI@csi.com*)

at 40 meter band overhere in Germany we have sereious contest conditions every evening. Al the European big guns with signals up to S9+40 plus lots of BC stn. I measured the RF Sum signal at the end of my 41 m long, 23 m up endfeed zepp severel times BEHIND the ATU. Allthough the ATU should give some extra selectivity plus some lost, I found between 150 mV and 350 mV RF at 50 Ohm. If I have to do measurements with a scope at low ranges, I have to disconnect the feeders to bring it outside of the building (I use a rope to bring it outside and pull it back again :-) If I dont do so, I see the envelope of the sum of lots of BC stn as a signal at the scope.

The K2 handles this all without using the attenuator. Inbandsignals are handled the way that I can listen to S2 and after that to a S9+30 signal without using an RF-Gain regulator.

I like the possility to have 3 filter positions with different bandwiths, that I can choose the bandwith for this filters by myself AND that I can set the BFO to a position I like. The different does not modify the CW tone I hear, but it modifies the sound of the background. I like a CW pitch as low as 400 Hz, but I hate low tone backround sound. So I have choosen settings that enable a 400 Hz pitch and depending of the BFO setting a high tone background noise.

By the way, the background noise level is much smaller than that of my FT1000

[Elecraft] Measurements TX

From: "Peter Zenker" <Peter_DL2FI@csi.com>

Made some measurements at the TX

Load: 50 Ohm

Adjusted power rate at K2: 5Watt

Test Equipment: HM5006 Analyzer (0-500 MHz)

results should be exact within a 2 dB failure rate

Band	Harmonic	Spurs
3560	btr -55 dBc	na
7030	bttr -55dBc	na
10100	bttr -55 dBc	na
14060	bttr -55 dBc	na
18100	bttr -55dBc	na
21060	bttr -50dBc	-46dBc at 11MHz
24900	bttr -50dBc	-46 dBc at 15 MHz
28,060	bttr -50dBc	-43 dBc at 18 MHz

K2 is QRV

"Robert S. Capon" <RobCap@AOL.COM>

Kit fans, my K2 is QRV. The radio was a lot of fun to build, over a ten-day period. I would say it took about 3/4 the time as the Heath HW-9. The HW-9 had a similar parts count, but also had much more complex wiring and mechanical assembly (and was a lot less radio). What a difference ten years can make in kit technology. I only had one problem during assembly: a defective 4.0 MHz xtal that drives the microprocessor. It took me two days to find. Then, I popped in an old 4.0 Mhz xtal from my junk box, and the microprocessor came to life. However, the xtal was off frequency somewhat (probably due to mismatched series/parallel capacitance) which made the PLL hard to align (one more day to figure this out). Otherwise, it went together very nicely, virtually no point to point wiring except the speaker in the top cover. The K2's test equipment is built in. The rig works beautifully. I made my first QSO with WA6HHQ (Eric, one of the founders of

Elecraft) on 30 meters. Nice 559 signal from California to Virginia on 5 watts. The QSK is sweet: like the standard set by the Argo 509. The memory keyer is also a very nice feature. I listened for very watery stations coming from Asia at the noise floor of my FT-1000, and was also able to copy them on the K2. The rig runs on 180-200 miliamps with everything running, but drops to 140 mills with the receiver set to battery save mode, even with the LCD backlight on. The rig draws close to 100 mA with bargraph LED and backlighting turned off. I also notice that the penalty to the receiver is very modest in battery save mode. It sounds like you're turning off the preamp, but would be very acceptable for field use. The K2's display button toggles between frequency readout and a display that provides battery voltage and current consumption. The unit also has a separate built in Freq Counter, which could be used as a general purpose piece of test equipment. The unit also has a built in RF power meter, and very classy Band+ and Band- buttons for switching bands, and the flywheel weighted tuning knob changes frequency at three tuning rates. I haven't used all of the fancy functions yet (like scanning, programming my own xtal filter settings, etc.), but the RIT, XIT, and dual VFO's work very nicely. I understand taht there is direct frequency input, but haven't figured out how to do this yet. (Better read the manual). Kit enthusiasts might want to check out "www.elecraft.com".

Jerry Henshaw (*jhenshaw@bellsouth.net*)

I just finished a QSO with Jan PA0IJM on 14.059mhz! He gave me a 549 (he was 579) here in Florida. We had very nice QSO but I must tell you what about my antenna. It is a 35 foot piece of Radio Shack white wire wrap wire tossed into a 25 foot high tree (the tallest thing I could find) threaded through my first floor apartment window screen (I slipped a piece of Teflon spaghetti over the wire wrap wire so I could close the aluminum window without cutting the wire). Okay Roy Lewellan --- model this antenna!!!! So for all of you who are antenna challenged (read no antennas allowed in your housing development) there is hope in using a stealth antenna and still work some DX.

K2 Practical Performance

Bob Kelllogg (*ae4ic@nr.infi.net*)

My Elecraft K2 has been up and running since Sunday. I've been making a few contacts each day with it as I familiarize myself with the controls and fine tune the filters, etc.

Being a field tester, I expected to deal with some problems as I assembled the kit. There were a few, less than half a dozen, manual errors that would have caused the wrong part to be used. These errors were caught by the first few builders. Here on the east coast, I was behind the west coasters, so took advantage of their suggestions. The only parts I had to remove and replace were those I put in the wrong place because of my own carelessness. There have been many suggestions for making the manual clearer and more complete. It was *very* complete as we received it, but, you know, we had to find something to pick at...

Eric and Wayne have been at it 27 hours a day answering questions, fielding suggestions, etc. If their attention to detail during this testing process is an indicator of future customer service from Elecraft, we are all in for a treat.

I did run into three or four problems that I considered serious. In *every* case these problems were imagined. What I mean is this: I thought the keyer didn't work. It did when I finally set the mode to "CW". :-) I thought the tenth segment on my LED S-meter didn't work. It did when I made the correct adjustments. There were one or two other problems like those.

Today, I went through the rig again, made one mod and realigned it. At this point, the rig is better than I am. By that, I mean it has good features that I've not learned to use properly. So, it's up to me, now.

So far, I've made a couple of DX contacts and some W's and VE's. The latest was Clif, AB5UA/M, while he was tooling around Oklahoma.

I'm having a ball with the K2! I expected a lot, but it's more than I expected.

K2 field test

Peter_Simpson@ne.3com.com

I'm one of the field testers. We got our kits last weekend. The radio comes in 3 boards: control, front panel and RF. I have completed the first two, in about 5 hours (including unpacking and sorting).

The components for each PCB come in marked, pink, zip-loc bags. The 150+ page manual has schematics, photos and illustrated parts lists. Everything in the kit is wrapped up and protected.

The K2 kit is a real joy to build, and the reason you haven't been hearing too much about it on QRP-L is that we're all busy building! There is a private reflector for field testers to comment on things they have found, but they are all minor issues like a missing part here or there, which arrives in a couple of days from Eric or Wayne, who don't appear to sleep, eat, or anything else but stand by, waiting to help. I have never seen support like we're getting!

Several field testers have their K2s up and running already. Build time for the basic rig seems to be running in the 15 to 25 hour range, including alignment. The quality of the components, instructions and [really neat, painted] enclosure is absolutely first-rate. I'm hoping to finish my RF board this weekend, so I can catch the tail end of the fox season with the K2.

Wayne and Eric have done a great job with this kit. You're gonna like it.

K2 field test construction news

Peter_Simpson@ne.3com.com

I am almost done with the RF (final) board. Just have the transistors and the toroids left to do. I spent about 16 hours this weekend, working on the RF board. I am a very careful builder, and my caution and double-checking paid off. The rig came up with all calibrations in the center of their ranges during the first of the three intermediate test sequences that acknowledge your need to see the rig power up and play with it :-).

I did have one problem (turned out to be a shorted trace on the PCB, which looks like it might have been my fault...a scrape across three traces on the bottom of the board). The reason I mention this, is that within an hour, I had an email from Eric, which led me to the solution. We field testers Are getting incredible support from the Elecraft guys.

A nice touch, is the heat-strippable magnet wire for the toroids. All it takes is a few seconds and a ball of solder on the end of an iron to strip and tin the toroid leads. The other nice touch, is the great drawings of the toroids in the manual, which help you to orient the leads correctly. I can't tell you how many times I have wound them the wrong way, so they don't line up with the holes on the board!

Folks, this is a challenging kit. You need an excellent soldering iron, fine solder and good eyes. some of the components are small. I have been using a 10x loupe to check my work. The quality of the whole kit is superb. If you have built the SST or the Forty-9er, you'll be fine. It's just a lot more components! I have about 25 hours into the kit so far.

A comment on the mechanical engineering. The fit on this kit is superb! Everything lines up perfectly!

The highlight of the weekend was when I connected the antenna for the first time, to adjust the 40m input filter. I had to switch the attenuator in, the signals were so loud!

I hope to be able to hunt the fox with the K2 on Tuesday night. Sorry if this sounds like an ad for Elecraft, but I did spend a lot of

Money on this kit, and I feel the need to validate my expenditure :-).

Seriously, I'm a fairly critical customer, and I really am impressed by the quality of this kit. I was willing to lower my standards, given that this is a field test of a prototype kit, but I am glad to report that, as I approach the end of the building phase, the overall quality of the kit and documentation exceeds my expectations.

SABorns@aol.com

My K-2 is up, running and on the air. Last evening I made several stateside contacts on 40 meters receiving good signal reports. Everyone reports the rig as sounding excellent. Today I worked a little 15 meters and in addition to stateside worked Spain. Many of the people I've had QSO's with are anxious to hear one on the air and several people have commented that they have orders in or are about to place one at the conclusion of the field test.

Had no real problems in assembly (only a few imagined ones) Was only short one resistor and the 39uH choke that everyone received in their care package. I started construction a few days after many others so I had the benefit of the Alerts from Wayne and Eric. Having the reflector is an excellent touch and the service is both immediate and invaluable. I just hope that Wayne and Eric are managing to save a few hours per day for sleep, nourishment, and seeing their wives. Good job fellows.

In my opinion the manual is absolutely first rate. Very easy to follow and yet concise. I don't know if this was me working too long at a session but I seemed to have had a few more incorrect parts placements than I usually do. I caught them all during inspection and only missed one one solder joint that immediately revealed itself when I couldn't get any drive on the 20 and 30 meter bands. (one lead of a coil not soldered at all). I do have one possible suggestion. When there are long list of components to install such as resistors or capacitors it might help to break the lists down to twelve or so components followed by a few blank lines. eg:

R-1 10K,	R-3 150	R-6 1K
R-7 10K,	R-8 10K	R-9 10K
R-12 220	R-13 10	R-14 4.7K

R-15 6.8K etc, etc, etc...

However this might just be a case of my tired old eyes losing track. It might also be better not to interupt a string of .01 ufd caps with a lone .1 ufd one. Just a suggestion for what it's worth.

I thought the alignment procedure excellent and trouble free. Everything adjusted and peaked as per the manual. I ran through the procedure as per manual and also with the aid of a scope. For those fellows without scopes don't worry! The manual procedure is just fine.

Now to get a little more time on the air to get used to all of the controls and their functions.

I should comment that the rig is very intuitive and a breeze to operate. I especially appreciate the fact that the menu items are either single push or push and hold rather than hold multi buttons simultaneously as is found on many other rigs.

I have been signing my call K8IDN/K2 and people have called me to both hear the rig and ask questions. I will try to be on 40 again tonight (if I get my chores done) +/- 7040.

Tim Strong (*tstrong@nortelnetworks.com*)

So far I have completed construction of the control board. It went together just as easy as reading the construction manual. I do have a feeling that this board is the easier board of the three. It took me about 5.5 hours to complete, but it has taken other more experience builders much less time than that. So far, I have about 9.5 hours of time invested in the kit, which includes reading the manual cover-to-cover, fixing minor errors in the manual, reworking the control board PCB, and inventorying and constructing the control board.

The boards are great looking! There were a couple of pads that had to be reworked due to manufacturer error, but this will definitely be fixed for the production run. There will also be some other board cleanup in terms of moving/covering some traces away from some mounting hardware, which again will be fixed for production.

Eric and Wayne are doing a great job of supporting us, as well as all of the field testers are supporting and encouraging each other.

I have taken a couple of pictures and hopefully by the end of next week I can have them posted on the web. I don't have a digital camera, so I have to wait for the film to fill up and then get developed. Does anyone have any requests as to what they would like to see? So far I have taken a picture of the kit as it is unpacked from the box and a picture of the cover of the manual along with the front cover. BTW, the front cover looks real sharp! I plan on taking pictures of each completed board, and I'll take a picture of the front panel and RF boards before they are stuffed. What else would you like to see? I am hoping that these pictures will turn out okay.

K2 is alive in Florida

Jerry Henshaw (*jhenshaw@bellsouth.net*)

Finished building my K2 late last night (actually early this morning). It took about 30 hours to complete. I have been a ham for over 35 years and I can say this is the BEST designed kit that I have ever put together. Wayne and Eric deserve major KUDOS for raising the bar on future Qrp rigs.... this is going to be a tough act to follow. Independent of the fantastic specs and operational features, the K2's "fit and finish" is incredible! The kits fits together like a Swiss watch. The mechanical design is just as impressive as the electronics.

Eric has been working the phones and email reflector all week long and I can't believe the level of service he is providing. I have had the pleasure of talking with him on the telephone twice, he was enthusiastically helpful. I don't see how he maintains his energy level with 100 Qrp testers constantly asking questions. Bottom line -- the level of support Eric and Wayne are providing is also raising the bar customer service.

The rig is a absolute Qrper's dream rig. The good news is everything is microprocessor controlled....the bad news is everything is microprocessor controlled. This means we have given Wayne a open invitation to constantly upgrade and improve the K2..... I guess I will have to subscribe to the "chip of the month" club :-) In a former life, I wrote microcode for a living.... I wish I had access to the compiler/assembler for the K2 what fun it would be to roll your own! (Wayne and Eric are you listening?) Talk about a customer service nightmare... trying to troubleshoot someone else's code? I can dream can't I.

The bottom line --- THE IS THE QUINTESSENTIAL QRP RIG!! You are going to love this baby. Standard disclaimers --- just a happy camper in sunny Florida.

Elecraft K2 Report from another builder

Lee Bahr (*bahr521@earthlink.net*)

So far I have spent 15 hours working on my Elecraft K2 beta test kit. I have not been rushing this thing as this kit has lots of parts and the board is double sided. If you solder in a part in the wrong place, a lot of time is needed to rectify the problem. So far, I have not put any of the parts in the wrong place and all has gone smoothly.

This rig looks like a Swiss watch inside. My boards are now mounted in the cabinet. The cabinet is the most precision cabinet I have ever seen for any rig. It is made up of many parts yet, I swear, it would almost hold water without leaking. The cabinet is a piece of art. All the buttons, knobs, plugs, jacks, dial, meter, standoffs, cabinet, interface together very well. All the screws fit the mating surfaces perfectly. The mechanical engineering on this rig is awesome.

Tomorrow, I conduct my first electrical tests. These tests checks out the microprocessor circuits in the rig as the rig uses it's own on board computer located on a microprocessor board just behind the front panel board. I am now just starting to stuff the main RF board. As you build up the main RF board you also run tests on each section as you go.

Don Wilhelm (*w3fpr@netzero.net*)

I have not been following the QRP-L digest for the past 2 weeks, 'cause I have been building my K2. I must say that Wayne and Eric are producing a fine rig here. I first had a problem with weak signals when I first got to the "test 40 mtr receiver" stage, but with Wayne provided a lot of support and assistance and pointed me to the mixer - which I had intalled backwards! (I really didn't do that- did I?).

After I corrected my error, I found that this indeed is a HOT receiver. With the default filter settings this K2 was receiving Q5 signals that I could hardly hear on my Yaesu FT-900AT. The receiver is quiet, and will really dig signals out of the mud, and is a pleasure to operate, it just feels natural and intuitive.

After much "Twiddling and tweaking" (not required BTW - just my way) I got it on the air tonight. Got a good 579 report from Long Island, NY at 5 watts. Frank, on the other end had a 'scope to look at the signal, and said it looked great - good keying shape, quick rise times with no trace of a click, and no chirp detected.

I must say, that I am honored to have been a part of this field test team. If the responsiveness of both Wayne and Eric during this test is any indication of the product support that will be offered later, they will be rated better than TenTec for customer service. They have said they will open the reflector we have been using for the test for everyone. What a tremendous way to get quick response for a problem one is having while building a kit.

This is certainly not a beginners kit, but the first pass manual was VERY good. Clear and very few errors in it. In the duration of this test, there has been only 1 errata sheet (a small one) and 12 "Builders Alerts". Not bad to only have 12 problems found in this field test. I believe that anyone who is not intimidated by soldering in slightly cramped spaces can successfully build this kit. It is a good one!

"Apollo Beep" for SSB Transceivers

Arjen Raateland, OH2ZAZ *email: oh2zaz@oh2rbi.fin.eu*

Upon release of the PTT switch on the microphone, the circuit keeps its PTT out terminal high for a short period and simultaneously outputs a tone on its audio out terminal.

In principle PTT input to this circuit is by a switch to ground. If only a positive going PTT signal is conveniently available in the rig, a switching MOSFET like the 2N7000 or BS170 in common source configuration can be used to invert the signal and effectively ground the PTT input terminal of the beep circuit.

The PTT output signal is high (close to the supply voltage) when activated. Otherwise it is low (close to ground). This polarity is suitable for connection to the White Mountain (see below), but for many other rigs the PTT out signal will have to be inverted to simulate a closing PTT switch. The easiest way to do this is a 2N7000 or BS170 MOSFET in common source configuration.

The signal from the audio out terminal is mixed with the voice signal at a suitable point in the modulator chain. The signal level can be set for an appropriate output power. Values of R7 and R6 may need to be changed for a particular application.

Tune function: when the tune terminal is grounded both tone output and PTT output are activated. As long as the tune terminal is grounded the TX will transmit the beep tone which greatly facilitates adjustment of an antenna matching circuit.

If necessary, the beep frequency can be adjusted by changing the value of R4 and/or C1.

The circuit consisting of R1, R2 and C2 causes a slight delay in starting the beep, which was found necessary because some PTT switches produce noise glitches when the operator changes his or her grip on the switch. R1, R2 and C2 also set the duration of the beep.

The circuit was succesfully applied in a White Mountain 80 m SSB transceiver with the component values given. Audio out was connected to U6 pin 2. PTT in from Q8 collector (point C) via a BS170 inverter. The 4k7 resistor between point C and U5 pin6 is disconnected from point C. PTT out then goes to the loose end of this resistor. Supply voltage is +Vr from U9 78L08.

But I have built two of these circuits, so I know it works. One with a CD4093 in a DIP package and another as SMD. Timing and frequency determining components required adjustment from the values published by PAoZR. Perhaps it's the IC characteristics that vary.

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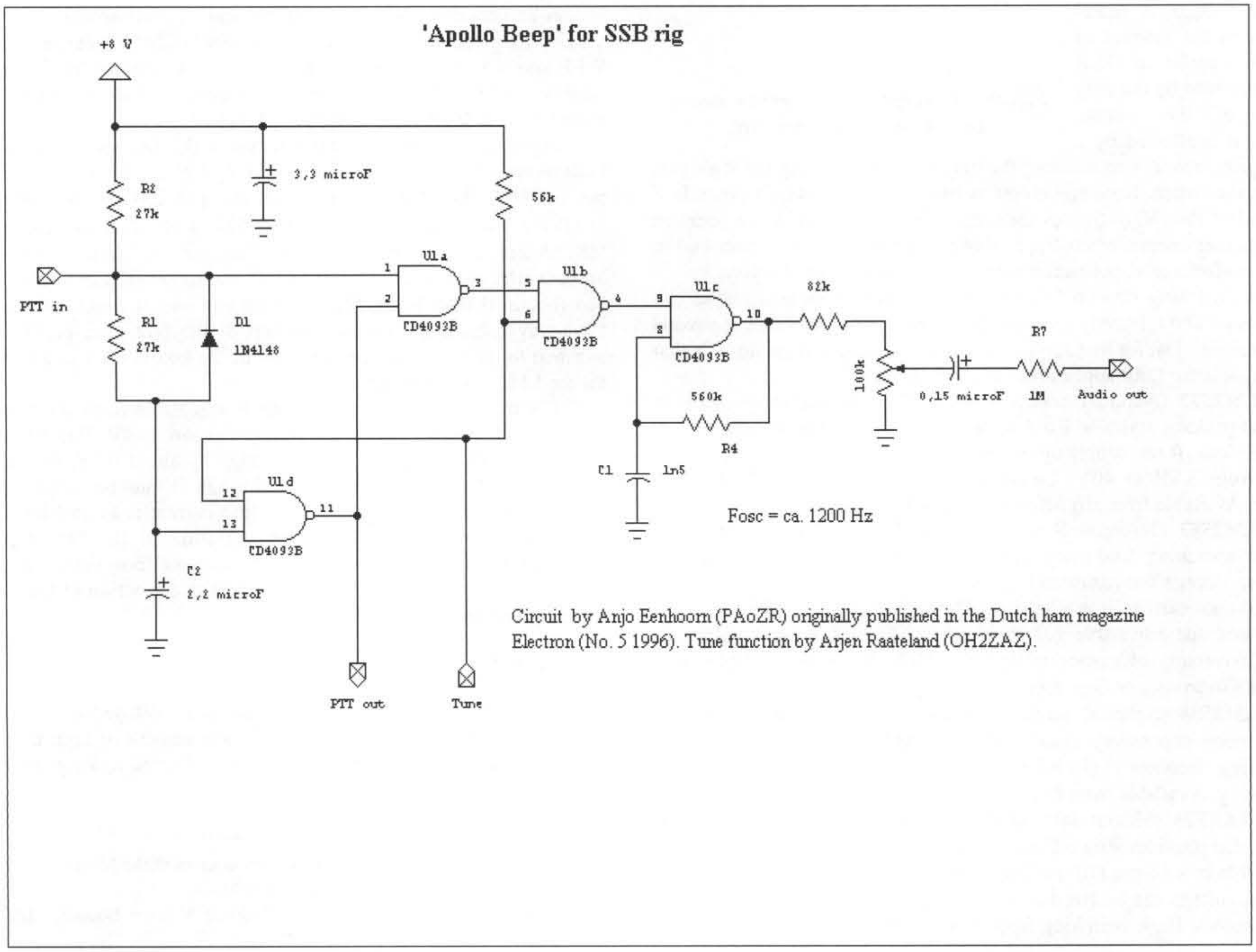

Tired of Low Battery Voltage? Build a Step-Up DC-DC Converter!

Larry East, W1HUE 1355 Rimline Dr., Idaho, Falls 83401 email: W1HUE@amsat.org

Have you ever been annoyed by output power drop-off when operating your portable station due to sagging battery voltage? Have you ever wished that you could power your QRP rig from that spare 7.2V camcorder battery? Or maybe you have a neat piece of surplus equipment that requires 24V and you only have 12V power supplies. If any of these situations apply to you—or you just like to build useful little gadgets—then read on!

The basic idea of a switching DC to DC "step-up converter" is shown in Figure 1. When the switching transistor turns ON, it grounds the "bottom end" of the inductor, L, resulting in current being stored in the inductor. When the switch turns OFF, the voltage at the bottom end of the inductor momentarily increases above V_{IN} and discharges its current through the diode into the output capacitor, C_{OUT}. In other words, energy stored in the inductor while the switch is ON is transferred to the output during the switch OFF time. The output voltage is determined by the amount of energy transferred. That is determined by the duty cycle of the switch, which is controlled by a voltage comparator monitoring the output and controlling the logic that drives the switch. Note that output voltage regulation is only possible if V_{IN} is less than V_{OUT} (minus the drop across the diode). More complex circuits that operate when V_{IN} is above *or* below V_{OUT} are described in the manufacturer's application notes for the devices listed below.

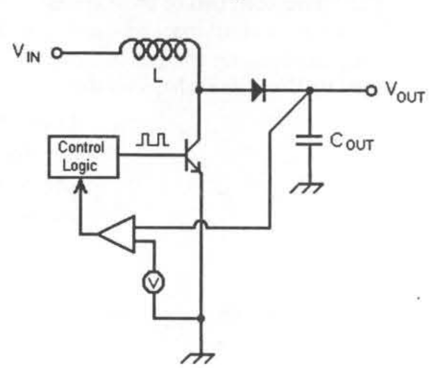

Figure 1. Conceptual diagram of a step-up DC-DC switching converter.

A switching step-up DC-DC converter with regulated output can be easily—and relatively inexpensively—built using any one of several ICs designed just for that application. Some switching regulator ICs that are suitable for QRP applications are as follows:

LM2577 (National Semiconductor). This device is available in several package styles in fixed voltage (12V or 15V) or adjustable output versions. It can supply up to about 2A and operate from supply voltages from 3.5V to 40V. Conversion efficiency is typically 80% or better. Available from ***Digi-Key*** and ***Allied Electronics***.

LM2587 (National Semiconductor). This device operates at a higher switching frequency (~100kHz) than the LM2577 allowing smaller storage inductors and capacitors and is capable of supplying more output current. It is available in three fixed voltage (3.3V, 5V and 12V) and one adjustable voltage versions. Minimum input voltage is 4V. Conversion efficiency is typically 90%. Possibly available from ***Allied Electronics*** or ***Digi-Key***.

LM2588 (National Semiconductor). This is essentially a fancier (and more expensive) version of the LM2587 that has adjustable switching frequency (100kHz to 200kHz) and external shutdown capability. Available from ***Digi-Key***.

MAX773 (Maxim Integrated Products). Step-up switching controller that provides 90% efficiency for loads ranging from 10mA to 1A. Available in a 14-pin DIP package. Input voltage range is 3V to 16.5V. Output voltage can be fixed at 5V, 12V, 15V or can be set using external resistors. High switching frequency (~300kHz) allows use of small storage inductor and capacitor. Very low quiescent current (110μA). Includes input voltage monitoring circuit that can be used to drive a low battery indicator (LED, for example). An external power MOSFET switch (such as an MTP3055EL) is required.

MAX1771 (Maxim Integrated Products). Similar to the MAX773; can supply output currents of 2A or more with high conversion efficiency but does not have voltage-monitoring capability. Available in an 8-pin DIP package. Input voltage from 2V to 16.5V. Output voltage 12V or adjustable. 110μA quiescent current. Requires external MOSFET switch (MTP3055EL or similar). Available from ***Digi-Key***.

Data sheets for these (and other) devices that also contain extensive design information are available from their manufacturers and can be downloaded from the WEB: *www.national.com* for National Semiconductor devices and *www.maxim-ic.com* for Maxim devices. Free software for designing switching regulators using National Semiconductor "Simple Switcher" ICs can be downloaded from *www.national.com/sw/SimpleSwitcher/*. Using this software greatly simplifies the task of designing DC-DC converters.

Although the Maxim ICs require more supporting parts than the National devices, their high efficiency and low "idle current" makes them attractive for use in battery powered applications. They are also less expensive than the National devices.[1]

A kit containing a small PC board and all parts necessary to make a DC-DC up-converter is available from ***Embedded Research*** (see their WEB site at *www.frontiernet.net/~embres* for complete details, or send email to *embres@frontiernet.net*). This device will supply a fixed 12V output at up to 0.5A from an input of 4-12V.

Figure 2 is the schematic diagram of a DC-DC up-converter that I built recently using an LM2577T-ADJ (adjustable output version in a 5-pin TO220 package). A similar circuit using an LM2587 was described in ***QST*** a while back.[2] I used an LM2577 rather than an LM2587 (or '88) because I happened to have an "Engineering Sample". I built my up-converter on a piece of "perf-board" and mounted it in a small metal box (obtained from Radio Shack). Input and output connections are via "five-way terminals" mounted on top of the box. The perf-board is attached to the terminals, and one end of the box is used as a heat sink for the LM2577 (see Figure 3).

The output voltage of my circuit is adjustable from about 10V to 15V and will operate from input voltages as low as 4V. When the input voltage exceeds the preset output voltage by about 0.5V, the input is simply passed directly to the output through D_1 and no output voltage regulation occurs. In this case, the output current is limited by the 3A fuse (chosen to protect D_1). When operating in the "up-converter" domain, the maximum current that can be drawn form the output, I_{MAX}, and still maintain output voltage regulation is a function of the ratio of the input and output voltages:

$$I_{MAX} \leq \frac{2.1 \times V_{IN}}{V_{OUT}} \text{ Amp.}$$

The high-speed transistor switch that is a basic part of the DC-DC step-up converter can generate a significant amount of high frequency noise. The following guidelines should be followed to keep the output as "clean" as possible:

[1] You might even be able to obtain free samples of the Maxim devices! See their WEB site or one of their data books for details.

[2] Sam Ulbing, N4UAU, "My All-Purpose Voltage Booster," ***QST*** July 1997, page 40.

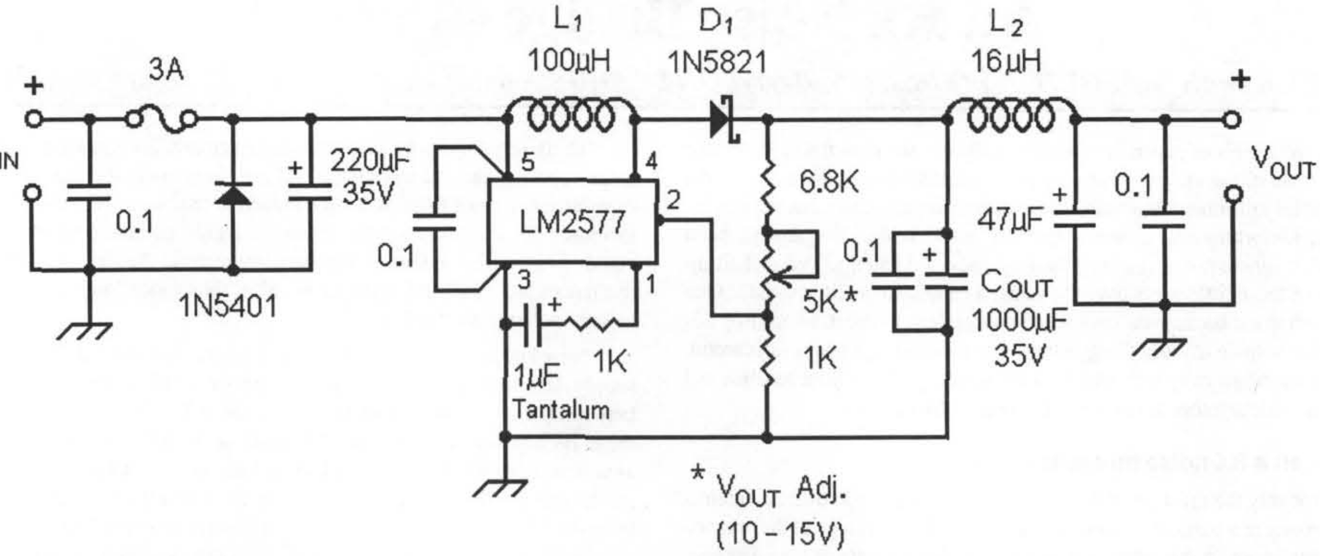

Figure 2. Practical DC-DC up-converter using an LM2577. The diode from the fuse to ground is for reverse polarity protection and must be able to safely pass a current greater than that required to open the fuse. Note the 0.1µF bypass capacitor connected directly between pins 3 and 5 of the LM2577. C_{OUT} should be a low ESR electrolytic (see text). The inductors are as follows:

*L_1 – MagneTec FIT80-1 (**Digi-Key** part number 10577-ND) or 38T #24 wire on an FT82-61 toroid core.*
*L_2 – MagneTec FIT50-4 (**Digi-Key** part number 10567-ND) or 15T #20 wire on an FT82-61 toroid core.*

1. All bypass and filtering capacitors, especially C_{OUT}, should be low "effective series resistance" (ESR) types designed for use in switching power supplies. Low ESR electrolytic capacitors are available from most of the larger mail-order parts suppliers (several types are listed in the ***Digi-Key*** catalog). Physically large capacitors will generally have a lower ESR than a smaller unit with the same capacitance. Capacitors with higher than required voltage ratings (hence the use of 35V rather than 16V electrolytics in the circuit shown in Figure 2) and multiple capacitors in parallel can be used to achieve a low ESR.
2. Wind the storage inductor on a ferrite torid or pot-core. A powered iron core should *not* be used in this application.
3. Use short ground connections; if a printed circuit board is used, use wide ground traces and/or a ground plane. Pay particular attention to the grounding of C_{OUT}. Very important: *Avoid ground loops between the input and output!*
4. Build the DC-DC converter in a metal rather than plastic enclosure. If you simply *must* put one within the cabinet of a QRP rig, shield it completely and use a large amount of filtering on the power output *and* input connections.

The 16µH inductor (L_2) and 47µF capacitor in the output of the DC-DC converter shown in Figure 2 filter the switching frequency (the LM2577 runs at about 52 kHz) and its harmonics from the output. Nevertheless, when I first tested my DC-DC converter, switching spikes (in the form of high frequency "ringing about 200mV in magnitude appeared at the output and input power connectors. No amount of extra bypassing seemed to have much effect. Finally, I cut a ground wire that I had run along the edge of the perf-board between the input and output ground connectors (which were also grounded to the metal case) and the ringing disappeared completely! A prime example of a "ground loop" in action! After eliminating the ground loop, the output appeared quite clean on a 'scope. With an input voltage of 10V and the output set to 13.6V, the 52 kHz ripple as seen on the 'scope was about 5mV peak-to-peak (PP) with a 150mA load and about 40mV PP with a 1.5A load. Connecting the converter output to an HP 403B AC Voltmeter produced readings of about 1mV RMS at 150mA and 10mV RMS at 1.5A load.

I could not detect any noise generated in a NorCal 40A receiver powered from the DC-DC converter when using an outside antenna.

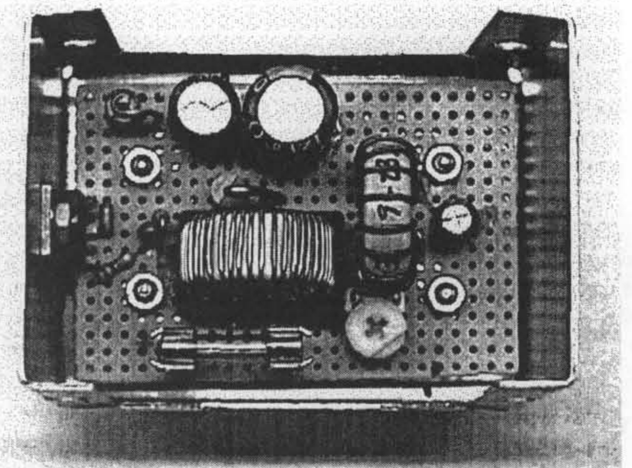

Figure 3. View of the DC-DC converter mounted in its case. The 0.1µF bypass capacitors across the input/output terminals and C_{OUT} (see Figure 2 above) are mounted under the perf-board.

However, when I used a short piece of wire lying on the workbench as an antenna, there was a noticeable band of "hash" around 7.015 MHz. I added a 0.1µF bypass cap directly across the *input* terminals (as shown in Figure 2) and that reduced the noise to a barely perceptible level. Scanning the bands on my QRP+ using an indoor antenna, I could hear weak "birdies" from the converter about every 52 kHz below 15 meters. However, none could be heard when using an outside antenna—something to keep in mind when operating in the field.

The converter that I built can easily supply a small QRP transceiver with well-regulated 13.6VDC from a 6-12VDC power source. It has good (80-85%) conversion efficiency and generates very little RFI. However, if I ever build another one, I will probably design it around a Maxim 1771 to take advantage of its higher switching frequency, greater conversion efficiency and lower idling current. (Maybe an even better choice will come along by then.) A higher switching frequency means smaller inductors and capacitors can be used allowing more compact construction.

An Rx Noise Bridge - Part 1

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In these days of expensive antenna analyzers, we sometimes forget that the old tools still work, and work very well. The RX noise bridge is one of the most useful instruments that the QRPer/antenna experimenter can have in his arsenal. Unfortunately, it seems that the noise bridge has always been somewhat ignored, or even forgotten by today's amateurs. I've picked up several of these little gems over the years, a couple for as little as $15. One was given to me because the owner had no idea how to use it. I hope that this series will help de-mystify things a little. But look out ... if you're not careful, you just might go away with a better understanding of how your feedline and antenna work together to release your signal into the ether.

What can a RX noise bridge tell me?

Probably the most common use of a noise bridge is to trim an antenna to resonance at a particular frequency. By inserting the bridge at the antenna feedpoint (more on this later), and using a tunable detector at the other end, we can adjust our antenna to resonance without the need of a transmitted signal. Likewise, we can place the bridge before our antenna tuner to set the tuner up for a particular frequency, again without transmitting. It's simple, effective, inexpensive, and the tunable detector - the receiver... is sitting right there in your shack.

But wait, there's more! Not only do you get the ability to adjust your antenna and tuner (why do I feel like I'm selling Ginsu knives?), you can also:

- determine the impedance of an antenna
- determine transmission line impedance
- determine the electrical length of a transmission line
- determine the resonant frequency of a series or parallel tuned circuit
- determine the values of unknown capacitors and inductors
- test baluns

No, they do not have fancy LCD readouts. Yes, their use requires a little knowledge of the impedance transforming properties of transmission lines, and some math skills. While not providing lab-quality measurements, they can come quite close. But don't let any of this scare you away from using a noise bridge. We will cover all the bases, and describe how to perform all of the above exercises on a typical antenna system. But first, let's look at how the RX noise bridge came about, and how it works.

A What - stone?

In order to fully understand how the RX noise bridge operates, let's take a look at what the whole thing is based on - the Wheatstone bridge circuit. Referring to Figure 1, the Wheatstone consists of two voltage dividers in parallel. Fixed resistors R1/R2 form one divider, and variable resistor R3 and the unknown resistor RU form the second. Ohm's law tells us that if we have two equal value resistors with a given voltage across them, the voltage across either resistor will be exactly half the supply voltage. Looking at the R1/R2 leg of the bridge, if we use equal values for both resistors, the voltage at point A will be half of the DC supply. By the same token, if we adjust R3 to equal the unknown value at RU, then half of the supply voltage will show up at point B. If we were to put a DC voltmeter across points A and B, we would read zero volts. R3 typically has a calibrated dial, so we can measure the values of resistors by simply plugging them in at RU, then adjusting R3 until our meter reads zero. At that point the bridge is balanced, and we can read the value of R3 off of it's dial, since it is now the same value as RU.

Today we have VOMs to measure resistance, but this was the way it was done way back when. Actually a galvanometer would have been used between points A and B, and R3 would be varied until zero current flowed through the meter.

What's this got to do with my dipole?

Think of your dipole as a series tuned circuit. It contains a resistance, some capacitance, and inductance. At any frequency, there will be some capacitive reactance (Xc), and some inductive reactance (XL). As frequency increases, XL increases and Xc decreases. At some point, both will become equal. This is the antenna's resonant frequency. At that frequency the reactances are equal and opposite in value, thus cancelling each other out, leaving nothing but the resistance.

Now let's use the same Wheatstone bridge, but instead of using a DC supply, let's feed some RF into it. We can use an RF voltmeter to measure between points A and B. Instead of a resistor at RU, let's connect the dipole there. By alternately varying the frequency of the RF going into the bridge, as well as adjusting R3, we'll find a point where we get a deep null reading on the meter. At that point we can read the antenna's resonant frequency from the RF generator. The antenna's radiation resistance is equal to R3.

Now this is all well and good, but in 1967, R.T. Hart, W5QJR (ref 1), came up with an ingenious idea. Instead of a variable frequency generator and a broadband detector, why not use a broadband generator and a frequency selective detector? The result would be much more economical. A broadband noise generator can be built for next to nothing, and most hams already have a calibrated detector in the shack - the station receiver serves this purpose just fine.

A functional diagram of the resulting Resistance noise bridge is shown in Figure 2. A zener diode makes a great noise source. Following the zener is a couple stages of broadband amplification. From there, the noise is fed through a transformer, then on to the bridge circuit itself. the receiver is connected between points A and B, and the antenna connected in place of the unknown resistance. By varying the receive frequency and adjusting R3, we can watch for the deepest null in the S-meter. At that point we have found the antenna's resonant frequency.

Where does the "X" come in?

What we have described so far is a resistance noise bridge. It can tell us the resonant frequency of our dipole, and the radiation resistance. But if we haven't a clue as to the approximate resonant frequency of the antenna, the process of adjusting the bridge and receiver can be a tedious one at best. The off-frequency reactance of the antenna can be inductive or capacitive. The resistance noise bridge cannot differentiate between the two - it can only show us that some reactance is present by indicating a shallow null on the S-meter. In addition, a narrow coverage receiver, such as a typical QRP rig, can only provide a small window to determine if our antenna pruning is resulting in an antenna that is coming closer to resonance, or one that is moving away from our frequency.

In 1973, G. Pappot, YA1GJM (ref 2), modified the resistance noise bridge to enable measurement of reactive properties of the antenna, as well as the resistance. The circuit could then tell us the impedance of our dipole, whether any reactance is capacitive or inductive, and this tells us whether our dipole is too long or too short.

Pappot's circuit is shown in figure 3. Notice the addition of the variable capacitor C1 in the same bridge leg as variable resistor R3. Also note that a fixed capacitor C2 is now included in the unknown, or antenna leg of the bridge. The variable capacitor in this design is 140pf, while the fixed capacitor is half that, or 70pf.

Now back to our dipole. If our antenna is short, it will exhibit capacitive reactance. Conversely, if it's too long, it will have inductive reactance. By alternately adjusting C1 and R3, we will be able to find a deep null without being on the resonant frequency.

With our dipole at resonance, the reactances cancel, and C1 will be set at mid-range, or 70pf, the same value as C2. If the antenna is too long, we will have to compensate for the inductive reactance by increasing the capacitance of C1. Conversely, if the antenna is too short, we must decrease C1 to balance the capacitive reactance in the unknown leg of the bridge. By calibrating C1's dial to read XL or Xc, we can tell whether the antenna needs trimmed or lengthened. Using a general coverage receiver, we can find the resonant frequency of the dipole by tuning the receiver until we reach a point where our deepest null occurs when C1 is set at mid scale. The receiver will display the resonant frequency, and R3 on the noise bridge shows the antenna's resistance.

*** What about setting my tuner?**

To align a tuner, set the receiver to the frequency of interest, and insert the RX noise bridge between the receiver and the input of the tuner. Set C1 on the bridge to mid-scale, and R3 to 50 ohms. adjust the tuner until a deep null is found. When the null is found, we have achieved a 50 ohm resistive match for our rig. Just don't forget to remove the noise bridge before you transmit! Even a QRP rig can smoke a perfectly good noise bridge if it's transmitted into.

Next time we'll look at several other ways to use the RX noise bridge, and discuss how to improve the accuracy of our measurements.

References

R.T. Hart, "The Antenna Noise Bridge", QST December 1967.

G. Pappot, "Noise Bridge for Impedance Measurements", Ham Radio January 1973.

QRP CLUBHOUSE

Bob Gobrick N0EB (VO1DRB) *Email: N0EB@att.net*

Welcome to the **QRP Clubhouse**. What's the secret password? Why "**QRP**" of course! By the time you read this column the first **Atlanticon QRP Forum**, sponsored by the **New Jersey QRP Club**, will have taken place and the **QRP ARCI "Four Days In May" QRP Symposium** in Dayton is just around the corner. One of the more popular events at these forums, next to the great talks, is the QRP building contests where folks bring their latest QRP creations for "show and tell" and maybe even a prize.

The QRP building contests have also spawned what many of us are now quite familiar with – the Club QRP Kit. The **Northern California QRP Club** has lead the way with some great kits, some which were as a result of prize winning QRP building contest entries. We are all familiar with the great NorCal kits like the NorCal 40, the NorCal 20, the Sierra, the K8FF Paddle and the St. Louis Tuner. Other regional QRP Clubs have also put out some great kits that have been made available to the QRP fraternity – **The New England QRP Club** gave us the NE 4040, the first inexpensive QRP transceiver offered as a Club kit, and the famous Colorburst 80 meter transmitter; the **Columbus (Ohio) QRP Club** offered the MRX-40 simple receiver; the **KnightLite QRP Club** and their KnightSMITe surface mounted transceiver; and the **New Jersey QRP Club** with their Rainbow Tuner and their recently released Fireball 40 QRP transmitter are just a few that come to mind.

Other regional QRP Clubs have kitted up a favorite design for local consumption. Later in this column you will read about the **North Georgia QRP Club** "GeorgiaCracker80" transmitter, which has been a big hit in getting folks back into building and CW operating. The **St. Louis QRP Society**, the **ScQRPions,** and the **QRP Society of Central Pennsylvania** are other regional QRP clubs that have put together some neat little kit projects for their members.

The regional QRP Clubs are in the best position to take a design and turn it into a great QRP Club project. All it takes is a few folks to get the ball rolling and the following activity is a good way to pull a club together into a team effort. Whether the Club elects to offer their kit to the general QRP community, or just keep it as a local Club project is immaterial – the fun is in the Club building and operating. So if your Club is thinking of kitting a design, then go ahead and start networking with the Clubs listed above for some ideas on how to make your project a success. And don't forget to bring your building projects to the **QRP ARCI "Four Days in May" QRP Symposium** Building Contest held on Saturday May 15, 1999 at Days Inn Dayton South. There will be some great prizes for those winning events. So go and have some fun!

MINNESOTA QRP SOCIETY TO HOT FOR "FYBO 99"

The **Minnesota QRP Society** got off to a rocky start in defending its covenant award winning **ScQRPion sponsored "Freeze Your Bxxx Off"** operating contest title. It turns out that Minnesota was having an unexpected February "heat wave" on operating day, thus dampening the chances for that ever needed low temperature multiplier. But that didn't stop this gang of northern ice fishers – it just meant that they would have to make up the score with some "hot" operating. And "hot" they were, they didn't break last years score, they SHATTERED it!

So what's their secret – teamwork of course (and healthy portions of chili and Arizona hot sauce for lunch). **Claton Cadmus, KA0GKC** reports that the hearty team of **Mike N0DWM, Jim N0UR, Bill N0BSN and Craig AA0ZZ** met at 6 AM to get the ball rolling. Dispensing with the "normal" arctic-like shelter a 40-10m multiband vertical and a Kenwood TS-850 were set up out in the "open". After an hour the gang switched to a Yaesu FT-747, as it was easier for unfamiliar operators to quickly understand and take over. Over the course of the day an operator/logging crew of ten members manned the station and everyone had a great time. A great effort by a great bunch of QRPers. Now, you may ask what drives these guys to spend over 14 hours out in the cold operating a QRP station. It turns out that **Jim N0UR** made a posting on the QRP-L that **MNQRP** was offering a case of Cream of Mushroom Soup (a Minnesota winter staple) to the winners. How could one pass that up…?

For more information about the **Minnesota QRP Society** check out their monthly newsletter on the MNQRP Web site at http://www.qsl.net/mnqrp

NEW JERSEY QRP ROCKETS WITH THE FIREBALL 40

George Heron, N2APB reports in early February that the big and exciting event with the **NJ-QRP Club** continues to be the **Atlanticon QRP Forum** they organized for March 26-27, 1999 in Timonium, MD. **Dave Maliniak, N2SMH** reports that over 98 QRPers were pre-registered in February and the two-day extravaganza of QRP talks and fun is bound to have been a great success by the time you read this.

The other activity that has been keeping the Jersey Gang quite busy this winter is their family of 'Fireball 40' QRPp Tx club kits. The initial FB40 transmitter kit started shipping before the Christmas holidays and was very well received. They are now in the third round of board orders to fulfill the kit requests. The revised RF power amp on the FB40 pcb also generated a great deal of interest with the club's offer to provide this as a stand-alone and general purpose 1.5 Watt amplifier kit, and NJQRPer **Ken Newman, N2CQ** is spearheading that club kit. And there is a follow-on projects in the mill by club elmer **Clark Fishman, WA2UNN** for a VFO to replace the FB40 oscillator can, thus giving complete frequency freedom; and a companion Fireball receiver from another other club elmer **Joe Everhart, N2CX**.

For more information on the **New Jersey QRP Club** check out their Web site at http://www.njqrp.org

NOGA GROWING IN MULTI-DIRECTIONS

Sam Billingsley, AE4GX reports that the **North Georgia QRP Club (NOGA)** completed its' quarterly meeting on Feb 6th with a record number of attendees. **Randy Joiner N4SX** even traveled 130 miles to make the meeting - now that's QRP dedication. Meetings have now been changed to bi-monthly (first Saturday in the even numbered months) from quarterly. The next meeting will be April 3rd at TechAmerica in Northeast metro Atlanta area and the June 5th meeting will be held at the Atlanta Ham and Computer Fair. The Club will be doing a forum as well as having a working QRP station and lots of toys to display.

NOGA has started a Tuesday night 9:00PM EDT roundtable QRP discussion on 145.41 MHz - in the metro Atlanta area and an 80 meter slow code informal CW net on +/- 3.6864 MHz starting at 0230Z on Tuesdays. Check-ins are welcome by all QRP enthusiasts.

A recent 80 meter QRP transmitter club project created by **Steve Hudson AA4BW**, named the **"GeorgiaCracker80"**, resulted in first time QRP homebrewing activity for many of the NOGA builders and for some has resulted in new CW operating that ended decades of CW inactivity. These simple QRP projects are paving the way to more knowledge and CW activity by NOGA members.

Jim Stafford W4QO suggests checking out the NOGA Web site at http://www.america.net/~w4qo/nogaqrp.html for additional club information.

ARKANSAS QRP NEWSLETTER ARRIVES RIGHT ON TIME

The March 1999 issue of **The Arkansas QRP Newsletter** arrived via email right on time at the **QRP Clubhouse. Bob N9ZZ** and **Jim Hale KJ5TF** have been doing a great job with the electronic newsletter format and if you would like to subscribe check out the Arkansas QRP information below.

The latest issue announces an **AR QRP Club** contest for a Milliwatt WAS award. An article of interest is on the new digital mode called PSK31, developed by **Peter G3PLX** which is causing a lot of excitement in the digital and RTTY world and sure looks like a neat mode for QRP. **Kevin Manzer AC5DK** has a short review on the Ten Tec T-Kit 1208 6-meter transverter. **Bill Cox ZL2BIL** talks about the Grey Line from the eyes of a QRPer. And finally **Jim KJ5TF** reports on Milliwatt DXing during the Hungarian CW DX Contest.

Check out the two Arkansas QRP CW nets on Monday (0130 Z Tuesday) at 3.560 MHz and Wednesday (0130 Z Thursday) at 7.042 MHz. And if would like more information on joining the **AR QRP Club** and receiving the free monthly newsletter contact **Bob N9ZZ** at n9zz@centuryinter.net

IOWA QRP JOURNAL PACKED WITH SUPER ARTICLES

The winter 1999 issue of the **Iowa QRP Club's** IOWA QRP JOURNAL arrived at the **QRP Clubhouse** and this 22-page journal provided some wonderful winter reading. Although the club is limiting its membership to current Iowans, former Iowans, those with strong Iowa ties, and border states (counties) your club may want to consider exchanging newsletters with the Iowa gang (claim that you eat Iowa food – hi). It's a great publication. See below for further details.

The winter 99 **Iowa QRP Journal** has some great QRP articles. **James Covington AA0XJ** starts off with an article of mating a Fox TTL T-Hunt transmitter (from 73 magazine) with a simple timer circuit and an **Embedded Research** Tick2B. An ideal project for JOTA Scout and fox hunting activities. **Larry Stambaugh WB0RMT** then walks the reader through his Complete Homebuilt Station and **Jerry Huldeen WB0T** discusses how to manage a 160-meter antenna with city living. **John Burnley NU0V** follows with a kit review of the **Almost Digital Electronics** L/C Meter IIB. And there is more. **John Stanford NN0F** writes about A Low-Profile 30-M & 40-M DX Antenna: Elevated Ground-Plane Vertical. And finally **John Burnley NU0V** adds some more fuel to the popularity of the St. Louis Vertical with his article on Yet Another Mount For The St. Louis Vertical. Skipped over where all the additional articles on the **Iowa QRP Club** building contest, operating events and just good time QRP activities. Great job Gang!

For more information on subscribing to the Iowa QRP Journal feel free to contact **John Burnley NU0V**; 8204 Sutton Drive; Urbandale, IA 50322 or via email at IowaQRPClub@juno.com Be sure to let John know you are part Iowan by all the food products you eat from Iowa – hi.

COLORADO QRP DOES ONE UP ON THE BRONCOS

The February 1999 issue of the **Colorado QRP Club** "The Low Down" bi-monthly newsletter arrived here at the **QRP Clubhouse** just after the Super Bowl. It appears that the CQC upstaged the Denver Bronco win by having their own QRP Super Star, **Paul Harden NA5N** as keynote speaker for the January CQC meeting. In addition to Paul's excellent presentation on Solar Phenomena and Its Effects on Propagation Paul also awarded CQC President **Marshall Emm N1FN** with a first place award and CQC Secretary **Jan Medley N0QT** with a second place YL award for their efforts in the Halloween Zombie Shuffle operating event.

The February issue of The Low Down had its usual collection of great articles. Lead columnists **Paul Harden NA5N** discusses Working 10 Meter Grayline DX and **L. B. Cebik W4RNL** elaborates in Chapter 14 of his Antennas From The Ground Up column on A Good Match or ATUs, Delta, and Tuner Losses. CQC Treasurer **Dick Schneider AB0CD** also presents a nice article on Travel Cases for QRP rigs.

For more information on joining check in with editor **Rich High W0HEP** at the CQC Web site http://www.cqc.org

SPRAT EDITOR VISITS USA FOR TWO MONTHS

The winter 1998/9 issue of the **G-QRP Club** newsletter **SPRAT** mentions that SPRAT editor, the **Reverend George Dobbs G3RJV** will be on a Study Leave visiting the United States from May 6 to July 8, 1999. Although the **QRP Clubhouse** was not able to obtain a copy of George's itinerary during his visit it would be a great opportunity for regional QRP Clubs to extend George an open hand of hospitality during his stay. The **Reverend Dobbs** will be one of the keynote speakers at the annual **QRP ARCI "Four Days in May" QRP Symposium** held on May 13, 1999 at the Days Inn Dayton South. If you have not had the opportunity to hear one of G3RJVs delightful talks then by all means try to see him at **FDIM**. It is a QRP experience not to be missed.

The winter 1998/9 **SPRAT** comes once again packed with 44 pages of circuits and QRP news – a great issue. The lead article is a **W1FB Memorial Award Winner** by **George Burt GM3OXX** on a 5 watt Junk Box Special (JBS) Transmitter. **Kanga UK** will be kitting this project for G-QRP members.

1999 G-QRP membership and subscriptions to SPRAT can be made in the US for $14 to **Bill Kelsey N8ET**; 3521 Spring Lake Drive; Findlay, OH 45840.

Well, that is it for this issue of the **QRP Clubhouse**. Please mail your club news and photos (JPEG would be great) to **Bob Gobrick N0EB**, PO Box 249, Lake Elmo, MN 55042 or email me at N0EB@att.net. Also drop the **QRP Clubhouse** a note if your QRP Club would like to exchange newsletters with the **QRP ARCI**. Cheers 73/72 Bob N0EB, QRP Clubhouse. **What's the secret password? - "QRP"**

Members' News

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It's that (QRP) time of year

Spring, it seems, has germinated recently into one of the best times of the year for QRP and QRPers. Just listen. We've been abuzz with activity:

March's **Atlanticon** is still a fresh and refreshing memory.

This month's QRP ARCI-sponsored **Spring QSO Party**, April 10-11, is always a great energizer for on-air activity.

Next month's **Four Days in May QRP Symposium** at the Dayton Hamvention is an annual highlight whose energy extended well in advance and after its presentations.

The ARRL's **Field Day** -- bringing scores of QRPers from around the continent out of the woodwork -- is always a dizzying and most satisfying weekend of low power fun.

How fortunate we are to have such motivated and caring QRPers as the backbone of these wonderful activities. QRP ARCI has a long history of sponsoring events that bring us together. Regional groups like **the Northern California QRP Club** and the up-and-coming **New Jersey QRP Club** have taken us to even greater levels of low power activity.

It's these fertile periods -- like the Spring of '99 -- that create the momentum to carry us through long, hot summers before we return to the fall contest season and benchmark events such as the West Coast QRP Symposium at Pacificon in October in California.

We must not take these social, technical and operational events for granted. For every activity there is a ton of work done behind the scenes.

It is incumbent upon us not only to support these contests and symposiums, but to thank those who toiled to put them on and to offer assistance when and where it is possible.

– R.E.F.

DXing, QRP-style, in the CQ WW Contest

Pete Hoover, W6ZH, writes from San Marino, CA that "during the 48 hour period starting about 4 p.m., last Nov. 27, and ending at 4 p.m. Pacific, Nov. 30, I spent a little over 12 hours operating the 1998 CQ WW CW DX Contest.

"I chose the Single Operator, unassisted, single band (10 meters), QRP category.

"After the din died down, I had 129 QSOs with 49 different DXCC countries in 25 CQ-designated Zones. I actually had 141 Q's, but the computer 'ate' 12 of 'em, but that's a different story. Total score: 26,492.

"Included in the 'retained' log were such goodies as G0IVZ (England), EA4ML (Spain), BM0QRP (Taiwan), VK9LX (Lord Howe Island), YE3C (Indonesia), XU2A (Cambodia), EA9EA (Cuetta y Mellia), 6V6U (Senegal), D44BC (Cape Verde Islands), ZS6EZ (South Africa), and dedicated QRPer KH6/WB6FZH (Hawaii).

"Of the remaining 118 Qs were 51 JAs.

"I had operated this contest in years past, but had entered the 'QRP, All Band Category.' Granted, I had contacts from 160 through 10 meters, but I was up at weird times and didn't get much sleep and was competing with the East Coast folk who could run Europe!

"I decided that this time I wanted two good night's sleep during the contest, and since 10 meters is basically a 'daytime here' band, that seemed appropriate. With WWV propagation information and the MiniProp 2.5 forecasting program running on my laptop I had a constant visual indication what areas would be 'open' on 10 — and it worked very well.

"Equipment used: Ten Tec Omni 6+ with all the great filters, choked down to 4.9 watts output (with WM-1 wattmeter in line to make sure), a QRO/LDG tuner, and for antennas a KT34XA at 75' plus a R-5 at 20'.

"I used the shack 386 33 MHz clone running Version 6.26 of the TR-Log program to do the logging, key the rig, and control the frequency. With the exception of the operator error that 'dumped' the 12 Qs as previously mentioned, all worked well. For me, paper logging during contests is a thing of the past!

"I haven't yet checked to see how many QRP 'new ones' I worked, but I'm sure there are a few. It was great fun, the JAs are very good contest operators, and are the key for us "Left Coast" folk to run up a good score — particularly on a band that is occasionally closed to our Right Coast competition. And remember, DX contest operators — particularly those on a contest DX-pedition — are excellent operators and can hear two wires being rubbed together 12.5K miles away! If you're in the right place at the right time, they'll hear you!

"And finally, it all goes to show that you don't really need lots of power to work DX. And a DX contest is a great way to sharpen your operating skills and to build up your DXCC total!

"GL in the test, OM."

More on the CQ WW DX Contest . . .

Bob Kellogg, AE4IC, writes from Greensboro, NC, that "QRPin' with the big boys is a lot of fun!

"Spent 6 hours, 15 minutes working the CQ WW DX Contest. Used my Super Sierra and my Broken Loop(COPYRIGHT) antenna. "I meant to work some on 80 meters and 160 meters early in the morning, but just didn't get up when I should have, so just had contacts on 10-, 15- and 20-meters.

"Made just 49 contacts hunting and pouncing. Broke my usual rule and listened more and called more than three times for some of the DX with pile ups. Also stopped in the middle of contest to replace a choke and realign my BFO, so my rate wasn't too good (except for the rate I was having fun, — that was pretty good!)."

His final tally: 49 contacts, 18 Zones, 24 countries.

"Contacts include: 5V7A (Togo), KL7RA (Alaska), Argentina, Brazil, TL0R (Central Africa), Finland, Germany, Ireland, KH7R (Kure Island — out in the Pacific somewhere), Lithuania, Malta, JT1A (Mongolia, and no wonder there was such a big pile up), 5N0/OK1AUT, Nigeria, Netherlands, UA0SAD (Asiatic Russia), Spain, Sweden.

"Heard a lot of Japan stations, but never got one to hear me." Kellog said he's unfamiliar with many of the DX prefixes, he worked

"EA9EA also, but didn't realize that was an unusual one until someone else mentioned it!"

His "Broken Loop" antenna was just that: "My 400-foot horizontal loop (elevated) at about 50-feet broke this summer. One end fell to the ground and got wound into my lawn aerator, so I lost about 50' of it. Just tied that end to the grandkids yard slide.

"The other end is still up in the trees, but has sagged 'til the ladder line and part of the wire is just laying on my roof. It's actually an unbalanced extended Zepp.

"One of these days I'm going to put up some directional antennas and get serious about DX! If I was having any more fun I'd grow younger each day instead of older."

And even more on CQ's WW . . .

Tim Pettibone, K5OI, writes from Las Cruces, NM, that with all of the great reports he's heard from other QRPers, he's "embarrassed to admit that I really worked hard at this CQ WW DX Contest."

Members of the **Zuni Loop Mountain Expeditionary Force** and their families gathered for their annual pre-Field Day planning picnic last May at the 7,000+ foot level of Table Mountain in the San Gabriel Mountains east of Los Angeles.

He logged 29 QSOs on 40 meters, 12 on 20, 33 on 15 and 72 on 10, with a final score of 37,524 points.

"Worked 22 actual zones and 39 DXCC countries," he writes. "Actually did WAC on 40 meters! Amazing.

"One serious question: Anyone else have a problem with OT8T? — I think he was in Belgium and I worked him on 40 meters. My computer logging program, LOGic, gave me 3 points but didn't give me a DXCC multiplier. Am I missing something?

"Worked BY2A — and, boy was I excited — China! But he gave the zone as 8 —the Caribbean! I went back and listened carefully and he was sending BY2A but he was 6Y2A!

"Worked lots of Japanese on all bands, including 40 meters. Europe was there but slightly more scarce from here.

He was using a TS-140S at 4.5 watts, and a 66 foot zepp up 18-feet fed with 300 ohm line. His keyer was a CMOS II, LOGic software plus keyer interface, and a newly revitalized JM March R-3A brass paddle, serial no. 040, he said.

"This time there were only a couple of speed demons that I couldn't keep up with. Did take a few 'listens' on several to be able to copy what must have been 40 wpm+.

"I'm not convinced that these really fast guys do better because of it — I'm going to watch the listings and see how well they did do. "I didn't keep track of the hours, but many of them were just listening to the huge pileups. Never did break the big ones but I waited around a long time for such trophies as 5V7A, and EA9EA.

QRP DX: What a nice surprise

Jeff Grudin, AC6KW, writes from Santa Cruz, CA, that "it started out to be one of those days.

"First thing this morning, the kids start fighting. Tufts of hair and insults flying. It is a breath of fresh air to close the car door as I leave for work.

"I get to work and sit down to plan out my day. Then nothing goes as planned. Everything takes longer than expected. People show up without appointments. The phone doesn't stop ringing. I just couldn't seem to get anything done.

"As the day starts to wind down, I sit down at my desk with a stack of papers to complete. I turn on the radio. I installed it on my desk so that I could listen in on those evenings when things slow down a bit.

"I have a sort of resonant inverted V in the attic snaked between the heating ducts at about 15 feet. I never expect much from this setup. I tune to an S7 QSO in progress. Now I get started on those papers. Out of the corner of my ear I hear a guy banging away in easy copy CW, "QTH Sitka, AK." Hmm, pretty loud signal for 15M at 5:15 p.m.

"He continues, 'Name John, Pse QSL.' That is strange, usually DX stations don't ask for QSLs. Then he signs, 'JT1KAA de KL7.' What a surprise to hear Mongolia.

"I wait for the reply. He signs with a very weak signal, barely copyable over the noise. The S meter isn't moving at all. There is probably a big pileup. I haven't got a chance. He finishes, then sends, 'QRZ? DE JT1KAA.' There is no pileup. No one is coming back to him! I send my call and listen. Just breaking out of the noise I hear 'AC6KW 559.' I let out a hoot and finish the QSO.

"Hearing my scream, my new employee comes running to see what is the matter. She looks puzzled when she finds me sitting at my desk, surrounded by stacks of papers with a great big smile on my face. I guess it is time to tell her about my radio addiction.

QRP contesting on the Top Band

Monte Stark, KU7Y, writes from Lake Washoe, NV that he had "lots of fun on 160 meters (during the ARRL's Top Band Contest in December). I worked a few other QRPers and want to thank all who came 'down' to play.

"Conditions Friday night were very good here. Almost no noise at all. In the wee hours of Saturday morning I was able to work the East coast! Places like Massachusetts, New Hampshire, Vermont, etc. "Never thought I'd be able to do that. Most exchanges were done at 28-31 wpm without any repeats so my signal must have been OK.

"There were also many who worked like the dickens to pull my signal out of the mud!

"(Top Band) has always been known as the 'gentleman's band,' and that is true. Even during contests there is very little 'pushing and shoving' going on!

"I found that it was easy to hold a run frequency for up to 1/2-hour.

"Most of the time the propagation would change and I would begin to hear someone else on the frequency." Working 160-meter CW, he amassed 250 valid QSOs for 503 points and 57 multipliers. Final score: 29,174 points.

"No one from Alaska was heard," Stark wrote. "Worked Hawaii (KH7R). Worked Mexico for the only DX station.

"Forty states were worked in one night (Friday). No new states worked Saturday.

"If you worked anyone in the contest please send in your log. We need to show all the support we can for the QRP category!

"You might wonder what a good QRP score is this contest. Well, the best QRP score I've seen turned in so far is well over 500 QSOs!

"My antenna is an inverted vee. I took my sloping 80 meter dipole down and added about 65' of wire on each end.

"It is now too long to pull up by one end so I did it from the middle and made an inverted vee out of it. The feed line is 75 ohm CATV drop line.

"The center insulator is made from a small chuck of plywood. I drilled holes in the plywood for the feedline and wire elements.

"All connections are made with wire nuts. (The wire nuts only make the connection. The wires are knotted to hold them to the plywood).

"I checked it with the MFJ and Autek and it's 1:1 at 1830 with no trimming! I think that's the first time I ever got that lucky and didn't have to play with the size, etc.

"The apex is at about 70-75'. One end (West) is tied to some sage brush and the other end is tied off at the barn about 10' up. (The barn has a metal roof about 45' x 70').

"Full size antennas for 160 meters are big, but many people on small lots with a 50' tower will do antennas like this and bend them around their lots and some of them really seem to work well.

"Always remember this: Any antenna is better than no antenna. So try anything and improve it from there!"

Bang for the Buck: Milliwatting the NA QSO Party

Larry Cahoon, WD3P, writes from Upper Marlboro, MD that he "played around in the North American QS0 party (in January) while fighting the flu. I took three naps during the contest.

"Set the Sierra at about 500 milliwatts and switched in the homebrew attenuator to cut it to 30 milliwatts. Ran all this power to my dipoles on 80, 40, and 20.

"I did cheat for one QSO I needed OR QRP on 40 Meters so when I heard him and he couldn't copy my 30 milliwatts I kicked in the big rig and worked him at 5 watts.

"I ended up with 21 QSOs, in 15 states, with 17 multipliers.

"The best QSO was either Arkansas or Wisconsin. I'll have to check the distances.

"They should come in around 20,000 to 25,000 miles to the watt. Best of all I picked up three new states at 30 milliwatts to bring that total to 29 states.

"Total power out for WAS is now down to a total of 11.6 Watts. I still need about 3 or 4 states to have them all at 1,000 miles per watt."

Items for the Members' News column should be sent to **Richard Fisher, KI6SN**, 1940 Wetherly Way, Riverside, CA 92506. Photographs — either black and white or color — are welcomed. Please include a self addressed, stamped envelope if you would like pictures returned. Submissions by e-mail (KI6SN@aol.com) are welcomed. To clarify intent, please state that your e-mail text "is offered for publication in QRP Quarterly."

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Keeping in QRP contact

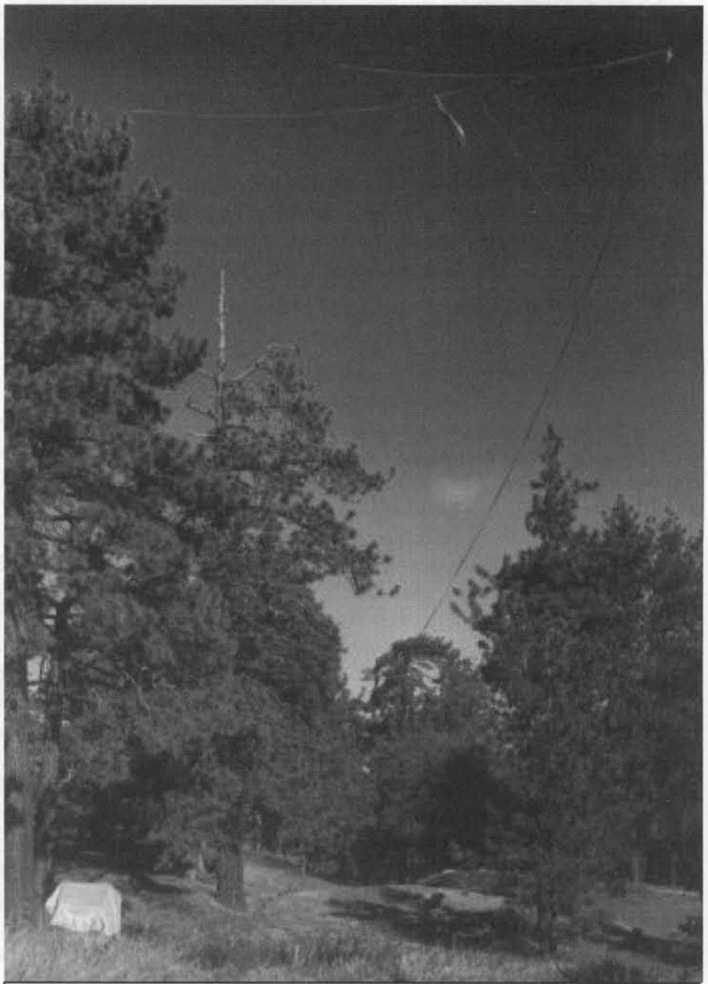
Part of the fun and fascination of QRP comes in hearing of the experiences, challenges and success of others. And telling your story is part of that natural process.

Why not drop a card, letter, photograph or e-mail to Members' News? Sending off a few lines takes only a few minutes. Putting it in the mail or on the wire is painless, and the camaraderie it invokes in the QRP community is a substantial payback.

Here are the only mailing addresses you need:

Richard Fisher, KI6SN
Quarterly Members' News
1940 Wetherly Way
Riverside, CA 92506

(e-mail: KI6SN@aol.com)



The antenna arrays **at K6ZNI's Zuni Loop Field Day operation** are hung between 100-foot pine trees. Monofilament fishing line shot into the top branches with a sling shot prevents operators from having to do any climbing.

A (Dubious) De-Soldering Primer

Wayne Burdick, N6KR *1432 6th Ave., Belmont, CA 94002* *email: n6kr@elecraft.com*

Wayne obviously has a great deal of experience in this field—but don't take his suggestions too seriously! ☺ *--W1HUE*

Removing resistors and other parts from double-sided boards is easy and fun. After years of careful analysis of my own technique, I have documented the process. I start with technique number one below; if that doesn't work, I try number two, etc. Good luck!

1. Turn the board over. With one hand behind your back, a wry smile, and the confidence of a pet surgeon, simply heat the lead in question and listen for the pleasant sound of the component hitting the workbench.
2. Well, that *would* be too easy, wouldn't it? Staying with the solder side for now, locate a large solder sucker (the larger the better; it should frighten smaller pets when brandished). Heat each joint and deftly suck out the solder with a single satisfying *thwop*! Listen for the part hitting the bench.
3. It didn't fall out, eh? No problem; rummage in that tool bin for a shiny new roll of solder wick. Crack open a beer, too, and take a generous swig. Wedge that wick in between the lead and pad, heat until you see the solder flow nicely onto the wick, and pull it out of the way just in time to see a beautiful, black annular ring around your component lead. Nudge each lead with your iron and keep your fingers crossed.
4. OK, so you have a tough customer: Small lead, hole just barely larger, and a bit of off-color solder that can't be bothered with any of the usual techniques. Have another sip of that brew. Vigorously flip the board back to the component side. Now grip the lead professionally with your most elegant long-nose pliers and hold on tight. Give it a playful yank, then pray. It should pop right out. (Sure…)
5. Darn. Finish the beer and get out your brutal, 8-in. electrician's long-nose pliers. Grab the component with gusto this time, buster, then tip the board up at a 45-degree angle. Turn up your soldering station to max and heat that baby up on the backside. Pull down hard with the pliers.
6. No go? Hmmmm – let's get serious! Put the board up directly on its edge and hold it in place vertically with your chin. Since your iron is suspect by this time, test it for several seconds on the nearest exposed skin. (Doing it by accident is just as effective.) Heat the joint with *feeling* this time! Lunge and parry. Don't worry about the pad, traces, or other parts—this is war! With maximal chin pressure exerted to hold the offending board in place, pull the lead out, out, *out*!
7. OK, so you "...couldn't get hold of it...," blah blah blah. You fool! You must risk everything at this stage. Insert a small screwdriver under the part, and white-knuckle that soldering iron on the reverse side. Pry and heat until it pops. (Note: It is important to keep in mind the concept of "kick-back" should you succeed at this. Larger boards are likely to wobble, flop, slip, then fling out of your grasp once the offending little monster finally lets go, taking test leads and soldering station with it.)
8. So, what kind of inept dweeb are you, anyway? Give up! Clip the part. Leave some lead to grab onto and repeat steps 5 and 6. If your face has turned red it is best to shield the work from view with your body, then steal a quick look behind you to be sure no one is suppressing a giggle as they watch this humiliating display.

9A. The lead came out but you *still* have some solder left in the hole? Gads! Find another part that you can sacrifice. Press its helpless little lead into the depressingly small pit you made in the center of the pad. Heat the base of the lead until you achieve punch-through. Yank and heat, yank and heat. Eventually the solder will give up in disgust and the sacrificial component lead will slide smoothly, signaling victory.

9B. To your left is a hand drill; to your right is a #60 bit. You know what you must do.

10. Now—you brute—now that you've overheated the pad, broken the trace, cracked the component, gouged the board, pitted the tip, blistered the skin, wasted a beer, and irrefutably proven once and for all that you should have taken up gardening instead, ***now*** maybe you'll learn the color code!

CONTESTS

Cam Hartford, N6GA

Results: Fall QSO Party
Results: Holiday Spirits Homebrew Sprint
Results: Winter Fireside Homebrew Sprint
Announcing: Spring QSO Party, The Hootowl Sprint, MW Field Day, Summer Homebrew Sprint

UPCOMING EVENTS

ARCI Spring QSO Party	April 10-11
QRP To The Field	*April 24*
Hootowl Sprint	May 30
Michigan Memorial Day Sprint	*May 31*
Field Day	June 26-27
Michigan July 4 Sprint	*July 4*
Summer Homebrew Sprint	July 11
Flight of the Bumble Bees	July 25

Dates of events listed in Italics are tentative. Check with the sponsoring organization for corret details

THIS CONTEST MANAGER IS THROWING THE BIG SWITCH

Sitting here, fingers poised over the keyboard for the last time, and the name of Marvin K. Mooney popped into my head. Never heard of Marvin? He's a character in a Dr. Seuss book I must have read to my kids a thousand times. "The time has come, the time is now, just go go go, I don't care how."

And the time has come for this Contest Manager to turn over the reins. Hang up his spurs. I've enjoyed the ride, but it's time to get off and do other things. My unfinished project list has been growing steadily over the past five years. The pile of swap-meet boxes is now a small mountain, all of them begging to be filled with a new radio.

This is nothing like retiring. Besides the fact that there is no pension, I'll be needing to keep my day job. But I'll be able to do stuff I been putting off for a long time, like re-reading Solid State Design, working on my code speed and thinking up new antennas for Field Day.

It's been a great five years. Those pesky deadlines were a major annoyance, comiong along as they did like clockwork at regular quarterly intervels. But opening up the mail, reading about people's contesting experiences and then massaging those experiences into a complete picture of the event was always an enjoyment.

I'd like to thank Steve Pituch, W2MY, for coming to my rescue early in the game. Steve's been printing the beautiful contest certificates we issue, and without his help I would have been buried alive a couple years ago. I'd also like to thank all of you who sent along your appreciation and encouragement over the years. It was virtually impossible to respond to each of you individually, but I did enjoy your support. It helps to know you aren't toiling in a vacuum, that there really are people out there on the receiving end who appreciate what you are doing.

Picking up the reins will be Joe Gervais, AB7TT. Joe has been doing his on-the-job training by running the AZ SQRPions contests, better known as the BUBBA and the FYBO. He didn't know this was OJT, which was probably for the best. He'll bring renewed enthusiasm and good ideas to the program. I hope you will all give him the same support and appreciation you gave me.

"The time had come, so Marvin went."

72/73, Cam

1998 FALL QSO PARTY

QTH	CALL	SCORE	PTS	S/P/Cs	PWR	BANDS	TIME	RIG	ANTENNA
AB	VE6BIR	144,396	382	54	3	A-4	14	ARGO 509	G5RV
	VE6GK	6804	81	12	5	H-3	3	IC-751	YAGI @ 65'
AL	W4DEC	481026	881	78	5	H-3	15	IC-735	YAGI @ 70'
	NW8G	38745	205	27	5	20M	14	TS-570D	80M LOOP @ 20'
	K4AGT	27566	179	22	5	20M	2.5	OHR-100	DIPOLE
AZ	NQ7X	504889	869	80	5	A-4	?	TS-850S	YAGI
	AB7TT	44254	218	29	3	A-2	?	SIERRA	?
CA	N6MM	1508892	1562	138	5	A-4	18	OHR 400, OHR 100, SI-ERRA	YAGIS
	KN6YD	76176	279	39	5	A-4	12	FT-890, IC 706	ROTARY DIPOLE, INV VEE,
CO	K0FRP	982338	1231	114	5	A-5	?	TS-850	LOOPS, YAGIS
	KI0II	101380	274	37	0.95	H-3	5	OMNI VI	CAROLINA WINDOM
	N0IBT	84665	295	41	5	A-3	7	TS-870	DIPOLE
CT	KA1OX	72618	399	26	3	40M	13	TT 1340	DIPOLE @ 60'
	KA1TQM	59514	218	39	4	A-5	14	HW-9	DIPOLE AND VERTICAL
	N1EI	28620	106	18	0.24	A-3	3.5	SIERRA	20M DIPOLE, 40M DELTA LOOP
DE	K3AS	78638	274	41	5	A-5	11	PATCOM PC-1600	60' WIRE IN ATTIC
FL	N4BP	1203587	1421	121	5	H-3	15.5	FT-1000MP	YAGI @ 65'
GA	K5TF	234950	635	37	0.9	20M	15	VECTRONICS 20M	LOOP
IA	KQ0I	96096	312	44	5	A-3	8	TT 580 DELTA	DIPOLE
IL	N9ZXL	170560	328	52	0.75	A-5	15	IC-720	YAGI, DIPOLE
	W9CUN	19096	124	22	5	A-3	3	TT DELTA 580	GAP VERTICAL
	N9MDK	9996	84	17	3	40M	2.5	TT 1340	G5RV
	KB9LCK	8710	67	13	0.9	A-3	5	SIERRA	VERTICAL
IN	N9DD	385840	689	80	4	A-4	13	IC-735	40M HORIZ LOOP
	AL0A	15540	111	20	5	A-5	?	ARGOSY 525	130' DIPOLE @ 45'
	K9PX	264264	858	44	5	40M	14.5	OMNI 6	80M LOOP
KY	K4AT	70707	259	39	3.5	A-5	4.5	TS-570	VERTICAL, KU3X 80/40 DIPOLE
	K4JMN	16891	127	19	3	A-2	10	HW-8	VERTICAL
	KE4LIA	12600	100	18	2.5	40M	6	OHR EXPLORER II	DIPOLE
MA	K1QM	550746	837	94	4	A-5	20	QRP+	G5RV
	N1QY	279370	141	65	5	A-4	11.5	OMNI 6	R7 VERTICAL
ME	KC1DI	6384	76	12	4	L-3	1	TT SCOUT	160M INV "L", G5RV
MI	K8CV	442680	744	84	5	A-5	?	?	?
	K8DD	158417	427	53	5	A-5	5	IC-751	YAGI-VERT-DIPOLE-ZEPP
	K8BX	76146	259	42	5	A-5	8	?	?
	W8TIM	46860	213	22	0.85	40M	6.5	SW-40	DIPOLE
	AB8DF	38773	191	29	5	A-4	6	TRITON IV, SW40+	100' DIPOLE @ 40'
	N8CQA	11110	101	11	0.9	40M	3	NORCAL 40A	INV "L" @ 25'
	KG5LO	6048	72	12	4	20M	?	TS-850S	VERTICAL
MN	N0UR	1113084	1262	126	5	A-5	16.5	IC-735	YAGI, WIRES
	KB0R	319956	586	78	5	A-4	10	IC-706	2-EL QUAD, VERT
	W3FAF	223600	430	52	0.8	A-3	4	OMNI 6	160M DIPOLE, YAGI @45', 700' HORIZ LOOP
	W0UFO	106491	461	33	4	20M	6.5	MFJ 9020	YAGI STUCK POINTING SOUTH
	WD0HBW	7770	74	15	5	A-3	4	MFJ 9020, TT 1340, IC-735	R7000 VERT, DIPOLE 80
MO	K0LWV	159152	392	58	5	A-5	14	TS-520	100 CF ZEPP @ 17'
	W0GWT	25102	163	22	5	A-3	12	IC-735	VERTICALS
	WA0OTV	960	80	12	20	15M	4	HALLICRAFTERS	
MS	K5HQV	415303	751	79	5	A-5	17.5	FT-1000MP	140' DIPOLE, HAMSTICK DIPOLE 10M
NC	AE4IC	89989	289	43	4.5	A-4	4.5	SIERRA	BROKEN HORIZONTAL LOOP
	AE4EC	52920	216	35	4	A-4	23	TT ARGOSY	20M MINI YAGI, WINDOM
NH	KN1H	194310	381	51	0.9	A-6	5	QRP+	DIPOLES
NJ	N2CQ	373275	675	79	5	A-5	6.5	TS-850	YAGI, CF ZEPP @ 35'
	W2JEK	196686	446	63	3	A-6	11	FT-840	DIPOLE, GP VERT, END-FED WIRE
	N4JS	90280	244	37	0.95	H-3	6.5	OHR400/100, HW9	YAGI, VERT, DIPOLE
	AA2YO	66150	270	35	5	A-2	3	SG-2020	?
	N2YVF	63581	293	31	5	A-2	8	ARK-20, ARK-4	MFJ VERTICAL, DIPOLE
	KA2PQY	38612	197	28	3	A-4	10	HW-8	G5RV @ 45'
	W3BBO	22848	192	17	5	40M	12	MFJ 9040	1/4 WAVE WIRE IN TREES
	KE2KW	3465	55	9	5	40M	2	OHR SPIRIT	DIPOLE
NY	WZ2T	926744	1273	91	5	A-5	?	TS-940S	CAROLINA BEAM 40, TRAP DIPOLE
	N2TO	266700	635	60	5	A-3	13	TS-520SE	40M DIPOLE, 20M INV VEE @ 45'
	AE2T	254,457	577	63	5	A-5	?	TS-850SAT	YAGI, DIPOLE, VERTICAL
	W2QYA	14,000	100	14	0.9	L-2	5	HW-8	90M INVERTED V
OH	NZ8J	111,531	339	47	2	A-4	9	SIERRA	ZEPP, TRIBANDER
	KF8EE	14,700	105	20	5	A-4	2	ARGO II	RANDOM WIRE

QTH	CALL	SCORE	PTS	S/P/Cs	PWR	BANDS	TIME	RIG	ANTENNA
OK	AB5UA	145964	401	52	5	H-3	7.5	TS-450	YAGI @ 50'
	K5DP	61690	119	31	0.9	H-2	4	HW-9	40M LOOP
OR	N7OU	829374	1274	93	5	H-3	11	FT 990	WIRE BEAMS @ 85'
	WX7R	62524	319	28	4.8	10M	9	IC 735	LW, MONO YAGI @ 60'
	N7CQR	9380	117	20	5	A-4	6	CORSAIR II	GAP TITAN
PA	NA3V	318500	650	70	5	A-5	13.5	OHR 100, TS-570	WINDOM @ 30'
	AA3GM	93200	233	40	0.95	A-5	7.5	ARGO 556	DIPOLES, HAMSTICKS
	N3IUT	86674	302	41	5	A-3	18	TS-440S, QRP+	YAGI
	W3DP	18480	176	15	5	40M	2.5	OHR-100A	G5RV
	N3CZB	560	20	4	5	10M	2	REALISTIC HTX-100	INDOOR LOOP
RI	K8ZFJ	25921	161	23	3	A-2	10	IC-706	G5RV
TN	N4DD	277620	661	60	5	A-2	9	OMNI V	YAGI, 40M DIPOLE
	N4QZU	20825	119	25	5	A-2	4	TT SCOUT	G5RV
TX	W5TB	40096	179	32	5	A-4	?	OMNI V	?
	W5USJ	38745	205	27	4	A-4	13	TS-430S	HF9V VERTICAL
	WW5XX	16786	109	22	1.5	H-2	4	SIERRA, ARGO 515	280' TILTED DELTA LOOP
	K5EYE	73920	264	40	3	A-4	7	TT SCOUT, OHR 100	DIPOLE, LOOP
UT	KO7X	155498	383	58	5	A-4	3	FT 1000	YAGIS, GP
	NC7X	125440	512	35	4.5	20M	?	TS-570D	80M HORIZ LOOP @ 40'
VA	K4GE	841092	154	114	5	A-6	20.5	FT-1000MP	160M ZEPP, 2-EL DELTA LOOP 40
	K4GEL	109480	340	46	4	A-4	8	HOMEBREW	80/40 LOOPS, 20/15 QUAD
	N4UY	97244	302	46	5	A-3	5.5	SCOUT	40 DIPOLE, 20 LOOP, 20 VERT DIPOLE
	N4ROA	48300	230	30	5	L-2	3	TEN TEC	BOBTAIL CURTAIN
	WA4CHQ	32300	170	19	0.75	40M	10	HB 40M TCVR	RANDOM WIRE
	K3SS	23800	136	25	5	A-3	4	FT-757GX	DIPOLE @ 35'
	KK4R	19656	117	24	5	L-2	2.5	IC 735	DOUBLET
WA	K7NTW	147350	421	35	0.95	20M	10	NN1G MK3 W/AADE DISPLAY	2 EL QUAD @ 50'
	WA2OCG	38675	221	25	5	A-4	5.5	IC 737	R7 VERTICAL
	N7RVD	17493	119	21	5	A-2	?	FT101ZD	100' DIPOLE @ 26', 20M VERT
WI	N9CIQ	290850	554	74	5	A-5	5	?	?
	WA9OVZ	35126	193	26	5	20M	7.5	MFJ 9020	DIPOLE @ 12'
	AF9J	13600	80	17	0.5	A-4	11	QRP+	RANDOM WIRE
	NK9G	5082	66	11	3.5	40M	6	SIERRA	ROTATABLE DIPOLE @ 50'
WV	KA8SYV	76916	268	41	4	A-3	7	OHR 400, SIERRA	70' DIPOLE @ 25'
DX STATIONS									
G3	G3XJS	3850	50	11	5	A-2	1	?	?
JA	JR0BAQ	4620	60	11	5	H-2	3	TS-440V	YAGI @ 50'
JA	JF2AKY	483	23	3	4	H-2	11	TS-820X	4 EL YAGI
OH9	OH9VL	7800	65	12	0.9	15M	?	?	20M DIPOLE
PA3	PA3ASC	18382	101	26	5	H-2	?	ARGO 509	2-EL MINI YAGI @ 50 FT
PAN	HP1AC	165984	416	57	5	H-2	7	K9AY, K1BQT TCVRS	YAGI

Some notes I made to myself while plowing through the entries for this contest:

1) Sunsppots definitely on the rise, we had 2 10-Meter-only entries!

2)The winning 15 Meter Single Band entry was OH9VL!

3) Bob, WAØOTV ran the entire contest using a matched pair of Hallicrafters rigs - the HT-40 and SX-140. This takes real dedication, as anyone who has used this receiver can verify.

4) Yes, Harvey, N6MM's QRP ARCI Number is 51. How Harvey can do as well as he does, all the while having to re-send his number, is beyond my comprehension. Many entrants note that they copied #51, but were sure it was a mistake, and I could deduct the necessary points if it is wrong. It's always been against club policy to publish member's numbers, but this one begs an exception. Next time you work Harvey, believe him.

5) There was one team entry, the NJQRPeaNUTS, who racked up a score of 730,255. Members were N2TO, N4JS and N2CQ. Team Wisconsin made a stab, but only one member could play in the contest, so no team score.

Soapbox: Wish I could have put in a better effort but work schedule didn't allow. My favorite test - KC1DI; I had big plans for this contest, but the weather was just too beautiful to miss - KK4R; First contest with beam raised from 45' to 65'. Highlight was 2X QRP QSO with JR0BAQ - N4BP; My new call made the contest even more fun - N7OU (EX-AA7KF); Great contest but everyone still trying to use 060 instead of spreading out. Highlight was working WA3PTY running 60 mW - W4DEC; The OHR100 I used I had just sold to AB5UA, whom I worked on 15 M. Shipped it right after the contest! - N4JS; Not much time to play - VE6GK; It was

TOP TEN	
N6MM	1,508,892
N4BP	1,203,587
N0UR	1,113,084
K0FRP	982,338
WZ2T	926,744
K4GE	841,092
N7OU	829,374
K1QM	550,746
NQ7X	504,889
W4DEC	481,026

SINGLE BAND		
40M	K9PX	264,264
20M	K5TF	234,950
15M	OH9VL	7800
10M	WX7R	62,524
LO-BAND	N4ROA	48,300
HI-BAND	N4BP	120,358 7

very exciting QSO Party!I enjoyed it from Japan - JR0BAQ; Lots of fun, got my QRP # after about the first 20 Qs - K4GE; The RTTY contest really did a number on 40M. 10M was open - where were all the QRPers? - K1QM (ex-WA1QVM); Conditiond were fair. Great to hear signals on 15 and even better on 10. Still need Montana for my 2 Way QRP WAS - K5HQV; Great activity, especially on 15 and 10. Happy days are here again! - N2CQ; I nominate K0FRP as most potent sig into the East, I worked him on 40, 20, 15 & 10 - NA3V; Always a fun contest. One of these days I'd like to build my own rig - maybe. - N9CIQ; First time I've had 5 bands in a QRP contest - K0LWV; Could only "find" 5 hours to spend in shack! - K8DD; I was amazed that I could make this many contacts on 2/3rds of a watt - AA3GM; New rig with Collins mechanical filters and DSP made copying a lot easier than with DC receiver! - K3AS; Best contest in a long time - KA1TQM; Great fun contest... first venture away from S&P operating and it sure helped the Q rate - NQ7X; I love these events. To me, they aren't so much contests as they are on-the-air gatherings of friends - N9DD; Highlight was calling CQ on 15M with 200mW and having OH9VL answer - NZ8J; Heavy QRN 15, 20 meters both days - K4GEL; I love this contest, and it killed me that I couldn't put full time into it - AE4IC; It's always great fun to work the gang! - KN6YD; I noticed several contesters have short QSOs with stations who did not realize they called a contester - nice bunch of hams - K5EYE; Did not hear as many western station this time, but maybe that's because I went to bed early - AE4EC; There were just too many things to do other than play radio - AB8DF; Really enjoyed the contest, the first one I've participated in in about 10 years - W5USJ; Had fun. Condx seemed to be better on Saturday - AF9J; Great to have 21 MHz open again! - N7CQR; Had a great time, but QRM from digi modes unbearable - N2TO; Sandwiched operating time in between opening ceremonies at a new children's home and the in-law's surprise 75th birthday party all were lots of fun - N4UY; Shoulda stayed with it just a little longer. 40M sure let me down - KQ0I; Was it my imagination, or were the band conditions particularly punk for this contest? - W0GWT; Enjoyed operating - only had a few hours - K3SS; Watered ground around vertical... Will see ya all on SP - KB9LCK; My first contest on QRP. Next time: better ant, better ears and with the blessing of the YL - WD0HBW; Had to do battle with RTTY, FISTS & /MMs all on the same frequency - N4QZU; This is my first contest entry. See you in the next contest! - K4JMN; It was great to be working stations on 10M again - G3XJS; I had a great time in the QSO Party with all homebrew setup - KA1OX; Great contest. Only 18.75% of contacts were non-members - W8TIM; Packed everything up, took the canoe to another very small island, set up and made 1 contact with K4JM - WA4CHQ; Thanks for a very fun event! I hope to make many more - W3BBO; The RTTY contest caused severe interference, hard on the ears - W3DP; Great contest! Worked N6MM on 40M for state #38 with my Tuna Tin 2 - K5TF; I just HAD to put a digital display on a QRP rig! Actually it worked out FB and very helpful in contest - K7NTW; My first QRP ARCI operating event - NC7X; Had a great time. Glad so many great ops showed up for the fun - NW8G; Exciting - Good - contest. Will be back - W9OVZ; A small entry - I really had some fun.First time I'd been

The Great Power Multiplier

The following item was submitted by Al Bates, W1XH, of Chelmsford, MA. Al describes himself as "most recently employed at the Museum of Science in Boston. Ham interests are QRP contests, rag chewing and playing with antennas." And after reading it , I'd add "tweaking his QRO friends". Makes one think...

"Actually, it's more of a power divider, but we'll get to that. Contests Rules handle the problem of power equalizers in much the same way. Above (or below) a certain power level, you multiply your score by a fudge factor. For those of us under 5 watts, you might multiply your score by 4 or 8 or whatever. From 5 watts to 100 watts, a multiplier of 2 might be applied. Above 100 watts the multipler is usually, 1. (Above the legal limit, the power multiplier is zero! Think about it.)

"That never seemed altogether fair to me. It's too random.I mean what's the advantage to running 1 watt or 5 watts if the multiplier is the same? I got to thinking and came up with a different power multiplier. It's the Power Divider.

"It's simple. Take your number of contacts and multiply by the states/countries or other factors and then divide the total by your output power in watts. For example, 100 QSO's times 2 points per QSO times 16 sections gives you a raw score of 3,200. Now apply your "Power Divider" of 5 for five watts to get the final score of 640. See how easy it is? If you run only two watts and make the same number of contacts, your final score is 1,600, a vast improvement. Score equals QSO's divided by power.

"(I actually sold this idea to a not-to-bright QRO type at work. We had our own private competition during a Sweepstakes one year. He ran 100 watts and I ran 5 watts. It doesn't take too much math to realize he had to make 20 contacts for every one of mine. My easy 200 contacts "out scored" his 1000 + total. He bought coffee and doughnuts for a week after the contest.)

"All you contest managers out there might want to adopt my power divider scheme. It is a great equalizer. By the way, the skeptics among you might want to get out your calculators and see what happens if you run less than 1 watt."

Sounds like a angle for a new contest - think we could get any QRO types to join in?

MILLIWATT FIELD DAY

Date/Time: June 26, 1999, 1800 UTC to 2100 UTC June 27.
Exchange: Class/ ARRL Section, per ARRL Field Day rules
Points: Same as ARRL rules, ie: Phone contacts count one point each, CW contacts count 2 points.
Bonus Multiplier: X 1.5 for fully portable setup.
Scoring: Multiply total of contacts by ARRL power multiplier, which would be X5 for an outputpower of 5 watts or less. Multiply this score by Bonus multiplier, if applicable.
Entry classes: One watt, one operator.
One watt, two operators, one transmitter
Five watts, one operator.
Five watts, two operators, one transmitter.
Club class.

Awards: Certificates to the winner of each class.

Entry consists of a duplicate of the ARRL Field Day entry, consisting of Summary sheet and alpha-numeric listing of contacts by band (dupe sheet). All ARRL Field Day rules to be followed. All entries must contain complete name, call, address and must be postmarked no later than 30 days after the contest. Include descriptions of antennas and equipment used. Include an SASE for contest results. Entries may be submitted via e-mail to vole@primenet.com or by

1998 HOLIDAY SPIRITS HOMEBREW SPRINT

QTH	CALL	SCORE	PTS	S/P/Cs	PWR	BANDS	TIME	RIG	ANTENNA
CA	N6MM	165,240	345	56	5	A-6	4	OHR 400, OHR 100, SIERRA	INVERTED L, DIPOLE, BEAMS
	W6ZH	107,860	229	34	0.95	A-6	4	SIERRA	KT34XA, 2EL 40 YAGI, 80/160 VERTICAL
	N6GA	30,480	86	18	0.95	H-3	2	SIERRA	YAGI @ 35'
	KN6YD	7,665	73	15	5	A-2	4	FT-890	INV VEE
CO	N0IBT	62,937	243	37	5	A-4	4	TS-870	DIPOLE
CT	N1EI	52,100	107	20	0.24	A-4	4	SIERRA	20M, 40M DELTA LOOPS
IA	KQ0I	945	27	5	5	40M	1	EMTECH NW 40	DIPOLE
IL	N9MDK	66,495	251	35	3	A-2	4	T-KITS 1340 & 1320	G5RV, R5 VERT
IN	K9PX	61,334	337	26	4	40M	4	OMNI-6	80M LOOP
MA	K1QM	45,353	209	31	4	A-4	4	QRP+	G5RV
MD	K3CHP	30,234	86	17	3	A-4	4	HW-8	YAGI & VERTICAL
	KB3WK	15,682	109	14	5	20M	4	OHR 100A	YAGI @ 40'
	W3MWY	12,495	119	13	3	A-2	4	ARGO 556	LONG WIRE
MI	K8CV	51,550	190	35	5	A-2	2	?	?
	AB8DF	47,714	226	24	5	A-2	4	TRITON IV	105' DIPOLE @ 40'
	N8NRG	26,140	151	20	3	40M	1.5	SIERRA	260' DIPOLE @ 20'
	W8TIM	18,750	125	15	0.85	40M	1.5	SW-40	DIPOLE
MN	KB9LGJ	20,827	133	17	3	20M	2	WILDERNESS SST	DIPOLE @ 30'
	WZ0J	13,918	98	13	2	40M	4	NORCAL 40A	DIPOLE
	WD0HBW	6,237	81	11	5	A-2	2	MFJ-9020, IC-735	R7000 VERICAL
MO	N0OCT	37,044	196	27	5	A-3	3	CORSAIR 1, DRAKE TR-7	HORIZ 66' DIPOLE, VERT 33' DIPOLE
	AA0VE	22,800	65	12	0.95	A-3	3	SIERRA, SW 40	65' DIPOLE @ 25'
MT	N7GS	10390	77	10	5	20M	1.5	NN1G MK II	YAGI @ 50'
	W7BXZ	9,044	76	17	5	A-2	4	TT SCOUT	40M DIPOLE @ 12'
NJ	N2SMH	40,875	205	25	3	40M	3.5	SIERRA	INVERTED VEE @ 50'
OH	W8BD	232,452	478	62	5	A-5	4	HEATH SB-104	YAGI, SLOPING DIPOLE
	W8VQ	14,350	85	11	0.8	40M	2	SWL GM-40	VERTICAL WIRE
	KF8EE	10,040	72	10	1.5	40M	3.5	SWL-40	RANDOM WIRE
	K8UCL	6,120	32	5	1.5	15M	2	HW-8	ATTIC DIPOLE
OK	K5AAR	13,736	96	13	5	40M	3	HB TCVR	DIPOLE
OR	AA7QU	28,400	117	20	0.95	15M	?	SIERRA	TREE MOUNTED YAGIS
PA	W3TS	174,525	235	41	0.25	A-6	2.75	HB SUPERHET TCVR	160M TEE, INV VEE, YAGI @ 55'
	NA3V	59,432	216	36	5	A-5	3.5	OHR100, TS-570	WINDOM @ 30'
	W3DP	34,841	203	21	5	40M	2.5	OHR 100A	G5RV @ 25'
	N3CZB	57	19	3	25	10M	1.5	REALISTIC HTX-100	30M DIPOLE INDOORS

Congrats on the great entry from YC2OK in central Java. He racked up 48 Qs with an HB transceiver running 1.5 watts on 40 M. I'm sure the great DX QTH and 3-el yagi at 70' helped. Only continent not in his log? North America, of course.

On the statistical side, of the 57 rigs used by entrants, 38 were homebrewed. It'll be interesting to see if that percentage jumps in the next HB sprint, after all the NC-20s are built. Keep melting solder!

Soapbox: 950 mW was hard work, particularly on the lower bands - **W6ZH**; Golly, this contesting stuff is fun. I'll have to try it some more - **N6GA**; Low QRN on low bands for a change - **N1EI**; Bands were fantastic, the best in several years - **N9MDK**; I had fun. I always enjoy milliwatting - **AJ9F** (And while using his rain gutter for an antenna!! This is true milliwatting! - Cam); Why can't everybody spread out a little bit? - **K3CHP**; Lightning and rain kept me off the air for 2 hours - **K8CV**; Heavy rain made my SWR go all over the place.Spent too much time off frequency tuning up. Bands were good but not as many stations as expected - **AB8DF**; This was my first contest and I had a ball. Impressed with what 3 watts could do - **N8NRG**; Another great contest. Heard lots of new calls, got into the Northeast for a change - **W8TIM**; From about 2315 to 2340 I held the freq on 20M. Man what a feeling. QRP works great. Most fun test I worked in 20 years - **WDØHBW**; Had a great time, as usual, and made more QSOs than any other ARCI contest that I have entered. The sunspots are back, and life is great! - **NØOCT**; I stopped early due to severe storm approaching the area: the temperature dropped 30 degrees in less than an hour - **AAØVE**; Wish I had more time. Band condx were very good I always enjoy this one! - **N7GS**; QRP works in MT too! - **W7BXZ**; Active contest, so nice to hear all the Q5 signals - **W8BD (K8NQC** OP.); Not easy to hold a frequency with 800 mW to a vertical wire - **W8VQ**; Did the 160m contest QRP - but still felt like more contesting - so put in as much time in the sprint as I could (XYL had some plans also!) - **W3TS**; Was making contacts slowly when at 2300 I went to 80m and ran off 11 stations in a row, each in a different SPC. 80 is a good band in wintertime contests! - **NA3V**; Good band condx on 40M except nothing heardwest of MO & IA - **W3DP**; Thought I was on 5 watts but after first 4 Qs discovered I was on 25! - **N3CZB;** It's a great contest anytime you can work the contest manager - **K5ZTY;** (Sure wish that could be more often - Cam); FB conx - thanks to all! - **W5TB**; I used 1/4 as much power as I did in the 1996 Sprint and got about 1/3 as many points. I think it was poorer band conditions - **WØYSE;** "...Ten meter rig is an assortment of modules all over the table - **K4GEL** (Sounds like some rigs I've built - Cam); Nice contest, looking forward to next one - **W9OVZ.**

TOP THREE

W8BD (K8NQC, OP)	232,452
K5ZTY	188,610
W3TS	174,525

WINTER FIRESIDE SSB SPRINT

QTH	CALL	SCORE	PTS	S/P/C	PWR	BANDS	TIME	RIG	ANTENNA
CO	KI0G	5,308	22	2	4	20M	2	NORCAL CASCADE	?
AB	VE6GK	5,252	6	6	3	20M	2	NORCAL CASCADE	YAGI @ 65'
CA	WA6ARA	5,070	5	2	4	40M	1	NORCAL CASCADE	135' CF ZEPP
AZ	NQ7X	3,640	26	20	5	A-2	2	TS-850S	YAGI
WY	AF7E	2,800	25	16	5	H-2	3	ARGOSY	YAGI @ 50'
MN	WA0VBW	1,862	19	14	2	H-2	1.5	ARGO 509	YAGI, DIPOLE @ 16'
OR	N7CQR	756	12	9	5	15M	2	CORSAIR II	GAP VERTICAL
ON	VE3CJ	560	8	7	1	H-2	3	QRP+	YAGI @ 45'
WI	AF9J	210	15	2	2	20M	1	SG-2020	RAIN GUTTER
CA	W6SIY	196	7	4	2	40M	1	TT DELTA	DIPOLE @ 18'
JP	JR0BAQ	28	2	2	5	15M	1	TS-440V	YAGI @ 45'

I haven't gone back through the previous years' results, but I think it safe to say that this is the first year we've had an entry from Japan in an SSB Sprint. JRØBAQ only made 2 Qs, but they were both QRP and both with Stateside stations! Bravo to Kohei, and thanks to KL7H and N7CQR for haning in there to pick up some good SSB QRP DX!

Also interesting to note the first three places in this contest went to Cascade owners. It pays to Homebrew!

Soapbox: Conditions here not so good. I had only two stations...Several stationscould be heard here but I missed - JR0BAQ; I had a ball! Always interesting chatting with the QRO ops and telling them you are running 4 watts! - WA6ARA; Nice relaxed informal contest. 15 Meters was trhe best band at this QTH - AF7E; 10 never really opened up here. Had fun. - WA0VBW; A fun contest; more activity than I thought, and surprised at working JA QRP SSB! - N7CQR; Always interesting to hear "the voice behind the fist" for the familiar QRP operators - VE3CJ; Wish more people would give it (SSB) a try - AF9J; Things started off gangbusters but petered out relatively quickly up here -

1997 SUMMER HOMEBREW SPRINT

Date/Time:
July 11, 1999; 2000 - 2400 Z. CW only.
Exchange: Member - RST, State/Province/Country, ARCI Number
Non-Member - RST, State/Province/Country, Power Out
QSO Points: Member = 5 Points; Non-Member, Different Continent = 4 Points; Non-Member, Same Continent = 2 Points
Multiplier: SPC (State/Province/Country) total for all bands.
S/P/Cs may be worked on more than one band for credit.
Bonus Points: Points awarded for using Homebrew equipment,apply for each band on which Homebrew equipment was used: +2,000 HB Transmitter used; +3,000 HB Receiver used; +5,000 HB Transceiver used
Homebrew Definition: If you built it, it is considered Homebrew.
Power Multiplier: (Power Output)
0 - 250 MW = X 15; 250 MW - 1 Watt = X 10;
1 W - 5 W = X 7; Over 5 W = X 1.
Suggested Frequencies:

	GENERAL	
160 Meters	1810 KHz	
80 Meters	3560 KHz	3710 KHz
40 Meters	7040 KHz	7110 KHz
20 Meter	14060 KHz	
15 Meters	21060 KHz	21110 KHz
10 Meters	28060 KHz	28110 KHz
6 Meters	50128 KHz	

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

Entry may be an All-Band, Single Band, Hi-Band or Lo-Band. Certificates to the top three scores, to the top score in each Single-band, Lo-band and Hi-band class, and to the top score in each SPC. Entry includes a copy of the logs and a separate summary sheet. Indicate total time-on-the-air, and include a legible name, call, QRP ARCI Number (if any) and address.

All entries must be received within 30 days of the contest date. Late entries will be counted as check logs. Members and non-members indicate their output power for each band. The highest power used will determine the power multiplier. Output power is considered as 1/2 of input power.

Include a description of homebrew equipment, commercial equipment, and antennas used with each entry. Homebrew bonus points may not be claimed if a description is not included with the entry.

Send an SASE for a summary and sample log sheets. Include an SASE with your entry for a copy of the results. Results will be published in the next available issue of the QRP ARCI Quarterly.

The final decision on all matters concerning the contests rests with the contest manager.

Entries are welcome via E-Mail to vole@primenet.com, or by mail to:

Joe Gervais AB7TT
PO Box 322
Peoria, AZ 85380-0322

HOOTOWL SPRINT

Date/Time: May 30, 1999; 8:00 PM to 12:00 PM Local Time
Exchange:
Member - RST, State/Province/Country, ARCI Number
Non-Member - RST, State/Province/Country, Power Out
QSO Points: Member = 5 Points
Non-Member, Different Continent = 4 Points
Non-Member, Same Continent = 2 Points
Multiplier:
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 = X 15; 250 MW - 1 Watt = X 10
1 W - 5 W = X 7; Over 5 W = X 1.
Suggested Frequencies:

	GENERAL	NOVICE
160 Meters	1810 KHz	
80 Meters	3560 KHz	3710 KHz
40 Meters	7040 KHz	7110 KHz
20 Meter	14060 KHz	
15 Meters	21060 KHz	21110 KHz
10 Meters	28060 KHz	28110 KHz
6 Meters	50128 KHz	

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

Entry may be All-Band, Single-, High-Band or Low-Band. Entry includes copy of logs and summary sheet. Indicate total time on the air. 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. Send an SASE for sample log and summary sheets. Include as SASE with your entry for a copy of the results

The final decision on all matters concerning the contests rests with the contest manager. Entries are welcome via E-Mail to vole@primenet.com, or by mail to:

Joe Gervais AB7TT
PO Box 322

SPRING QSO PARTY

Date/Time:
April 10,1999, 1200Z through April 11, 2400Z. Work a maximum of 24 hours of the 36 hour period. CW only.

Exchange:
Member - RST, State/Province/Country, ARCI Number
Non-Member - RST, State/Province/Country, Power Out

QSO Points:
Member = 5 Points
Non-Member, Different Continent = 4 Points
Non-Member, Same Continent = 2 Points

Multiplier:
SPC (State/Province/Country) total for all bands.
S/P/Cs may be worked on more than one band for credit.

Power Multiplier:
0 - 250 MW = X 15; 250 MW - 1 Watt = X 10
1 W - 5 W = X 7; Over 5 W = X 1.

Suggested Frequencies:

	GENERAL	NOVICE
160 Meters	1810 KHz	
80 Meters	3560 KHz	3710 KHz
40 Meters	7040 KHz	7110 KHz
20 Meter	14060 KHz	
15 Meters	21060 KHz	21110 KHz
10 Meters	28060 KHz	28110 KHz
6 Meters	50060 KHz	

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

Team Competition: Competition between teams consisting of 2 to 5 members will be a separate category apart from individual entries. Team members will be listed as individuals and the team score will be the total of the members' scores. The team captain must send a list of team members to the contest manager postmarked at least one day prior to the QSO Party.

Entry may be an All-Band, Single Band, Hi-Band (20M, 15M, 10M and 6M) or Lo-Band (160M, 80M and 40M). Certificates to the top 10 scores, to the top score in each Single-band, Lo-band and Hi-band class, and to the top score in each class in each SPC. The contest manager reserves the right to recognize special significant entries with a certificate award.

Entry includes a copy of the logs and a separate summary sheet. Include duplicate check sheets with entries of 100 QSOs or more. Indicate total time-on-the-air, and include a legible name, call, QRP ARCI Number (if any) and address.

All entries must be received within 30 days of the contest date. Late entries will be counted as check logs. Members and non-members indicate their output power for each band. The highest power used will determine the power multiplier. Output power is considered as 1/2 of input power.

Include a description of homebrew equipment, commercial equipment, and antennas used with each entry.

Send an SASE for a summary and sample log sheets. Include an SASE with your entry for a copy of the results. Results will be published in the next available issue of the QRP ARCI Quarterly.

The final decision on all maters concerning the contests rests with the contest manager.

Entries are welcome via E-Mail to vole@primenet.com, or by mail to:
Joe Gervais AB7TT

QRP Transceiver for less than $10

by Jim Larsen, AL7FS

This article is reprinted with permission from Jim Larsen, AL7FS and the Anchorage Amatuer Radio Club (AARC) newsletter. - ed

In the last article I covered QRP basics using your current rig for QRP and discussed useful QRP accessories such as a QRP wattmeter and tuner. This month we will take a look at building a functioning transceiver for less than $10-20 as well as consider a way to use these small QRP rigs for emergency communication in Alaska for hikers and backpackers and just simple fun seekers.

The buzzwords for this month are **Pixie, Tixie, KnightSMiTe, NVIS, Altoids, Snipers** and **Motley**. Clarifications are in the material below.

And remember, at the April 1999 Anchorage Amateur Radio Club (AARC) Club meeting I will be presenting a comprehensive program titled "Why QRP?". The program, along with copious handouts and examples to touch and feel, will give you a very complete overview of QRP operating and equipment.

Pixie 2 Transceiver

The first transceiver that has been very successfully built and used on the air is called the "**Pixie 2**" transceiver. This kit has had a history over the past three to four years and has seen much experimentation and modification. The big kickoff for this rig came from Doug Hendricks, **KI6DS**, and QRPp magazine (The publication of the NorCal QRP Club). It was originally Published: QRPp June 1995 pp. 45-48 and was billed as "The Great Dayton Building Contest 1995" and was sponsored by the NorCal QRP Club.

This building contest was an endeavor to have fun, promote fellowship, and provide a learning atmosphere. Chuck Adams, **K5FO**, came up with the idea and gave Doug Hendricks, **KI6DS**, the job of finding a suitable project that could easily be completed in less than an hour, have readily available parts, and preferably a circuit board. The project that Doug came up with was the Pixie 2, which is a transceiver that can be put on 40 or 80 meters, determined by the crystal frequency chosen and changing one coil. This little rig traces its origins back to where the circuit first appeared in an issue of the G-QRP Club's "SPRAT" (The QRP Club in Great Britain)

Although most of the QRP circuits today have evolved into using superhet receivers, a diversion back to direct conversion is not unusual...since QRP, after all, is a unique part of amateur radio and simplicity is certainly a part of it. The Pixie 2 is a tiny rig, with a standard two-transistor transmitter. It's a Colpitts oscillator, left running, and a keyed power amplifier. There is no external mixer used to feed the audio amplifier. Instead, the mixing is done at the final amplifier itself with the resulting audio taken off the emitter.

There's no Receiver Incremental Tuning (RIT), a simple switch and capacitor in parallel, between the crystal will work as an offset though. You'll lose QSK but, here again lies the call for enhancement. The whole idea here was to make a tiny rig that worked, with LOTS of room for improvements, using a minimum of parts.

Many contacts using a simple end fed quarter wave wire, worked against a good ground, have been made with this rig. Most of them have been over hundreds of miles away. The transmit signal is very clean as the oscillator is always running. There are no key clicks. Just listen to it!! Power output is in the 200 to 300 milliwatt range. You'll be amazed what happens at this power level with a decent antenna.

This rig makes contacts spanning hundreds of miles on 80 meters. Band changing is simply a matter of pi-network and crystal changing. If you build one, I'm sure you'll have fun with it. Construction can be by any method, perfboard, "ugly" and pc board. Complete parts kits are available for those of you who are interested.

KL7H, Bruce Hopkins, (AK QRP #001) has used the Pixie extensively to check into the Alaska **Snipers** SSB net on 3.920 MHz (6 PM daily) and the Alaska **Motley** Group SSB Net on 3.933 MHz (9 PM daily). He has modified his rig to operate at this higher part of the 75-meter band. In his own words, this is what he has done:

Bruce Hopkins - KL7H [kl7h@eagle.ptialaska.net]

"I have used my modified Pixie II for over a year to check in to both the **Snipers** net on 3.920 and the **Motley** Group on 3.933... The only part needed to allow the basic Pixie II, as supplied by HSC Electronics, to work on these frequencies is the proper crystals... I ordered my crystals from JAN Crystal many years ago to use with simple QRP rigs that I used in the bush, they are a standard crystal so if you already have a box full of surplus FT-243 rocks, they will work just fine...

The Pixie front end is quite wide so copying SSB is not a problem...Many folks have put a 50pf variable capacitor in the ground lead of the crystal to allow transmitter offset... You parallel this variable capacitor with a SPST switch and bypass the capacitor for receive... For SSB receive, I do just the reverse... I open the switch in receive which allows me to tune the receiver enough to clarify the voices... When it is time to transmit, I short out the capacitor which gives the Pixie enough offset to be heard by net control... My Pixie runs about 150 mWatts depending on the state of my 9V battery... I have rarely been unable to check in at this power if I can hear the net... To optimize the transmitter, one needs only to replace the molded chokes with inductors wound on toroids, and the output caps to silver mica... The Pixie II is capable of nearly 1/2 watt output with a 12 volt supply...

Another modification that I use, and find very helpful, is the addition of a **TICK** keyer chip... The TICK does two things for me, it gives me a full iambic keyer in an 8 pin Dip package, and it gives the Pixie sidetone... (The Tick is further described later in this article.) A complete 80 meter transceiver, keyer, key, battery pack, and ear buds can be carried in two Altoid tins...

Take care and have fun... "

72 / 73 / oo's - Bruce - KL7H

Remember, all that's needed to change bands on this rig is change one inductor and the crystal, and you have a rig for another band!! You can use Walkman style headphones, with a mono adapter. There is even enough audio power to drive a speaker. It's not very loud but you can hear easily in a quiet room... neat!!

This rig has been packaged in a 35mm film can, a Tic-Tac box, Sucrets box (easy), just to name a few. The enclosure is up to you. One just big enough to hold the rig and the 9-Volt battery will give you a tiny self-contained unit. The most often used case for this rig and battery seems to be the now popular **Altoids** mints box. This is a perfect size for backpacking or even for keeping in a glove box of the car.

This transceiver can be purchased from HSC in California. Detail is at the end of the article.

Tixie Transceiver

The next extension of the Pixie is called the **Tixie.** This is a newly designed board that incorporates a "TICK" keyer chip (microprocessor controlled keyer in an 8 pin package) onto the board itself. A TICK keyer plus a Pixie transceiver equals a "Tixie" transceiver. Now you have a QRP transceiver with built in keyer for under $20. This is a bit large (3 inches square) for an Altoids box but is purposely spread out on the PC board to encourage experimentation. The board is available from FAR Circuits, the Pixie parts are again available from HSC, the standard QRP frequency crystals can be bought from NorCal, and the TICK keyer chip can be purchased from Embedded Research. Your miscellaneous parts can be bought at Radio Shack (Frigid North) or pulled from other sources.

KnightSMiTe - SMT Technology Rig

http://www.waterw.com/~knights/smite.html is the web page of the KnightLites and for a unique version of the Pixie. It is a Surface Mount Technology (SMT) transceiver kit. The board measures 1" x 1-3/4". The circuit is a much revised Pixie II, that is, a Direct Conversion (DC) receiver and about 100 - 250 mW output. It uses a 3.6864 MHz crystal supplied with the kit. The Knight version has a Variable Crystal Oscillator and offset, so the received signal can be heard even when it zero beats the KnightSMiTe signal. A 9V battery supplies power. The price is $10 plus $3 shipping in the U.S. **KL7IKX**, Doug Dickinson, has built and tested one of these QRP rigs and has his mounted with battery in an Altoids box.

NVIS Propagation and Hope

Without some hope of talking to someone, these low power QRP rigs could be a bit frustrating. I would remind you that **KL7H** has added the crystals for both the Snipers and the Motley net to his $10 rig and he uses it to check into the net. At those 6 PM and 9 PM time slots, there are lots of hams listening around the state. This makes for a good chance of being heard with your QRP rig.

In addition, if you are on a campout you could set up a scheduled time for a friend to listen for you. During the daytime, there is a strong signal propagated via **Near Vertical Incidence Signal** (**NVIS**) propagation. Even if you place your antenna only 5 feet up in bushes the NVIS portion of your signal will go straight up and then back down making up to 200 mile contacts very possible. There are QRPers doing tests with NVIS propagation using the Pixie II as the field unit. Each time they move the distance farther and farther out of town and still they are maintaining solid contact. In most tests, the dipole has been strung only 3 to 5 feet off the ground.

This month we have covered information about Low Power, Low Cost QRP rigs and NVIS propagation. These kits can be built easily in an evening and if tuned for the SSB nets in Alaska, can be available as an emergency radio in very little time. The sources are all listed below so that you can order yours today.

Next month I am going to discuss a very educational book recently made available that steps you through building an 80, 40 or 20 meters superhet CW transceiver (2 watts). It also covers all of the theory within the radio. It is called Elmer 101 and was published in the last issue of **QRPp**. In addition, two very small, very good QRP transceivers for under $100 will be described.

QRP-L Mail List

As you find a need for more help in your homebrew endeavors, you should consider subscribing to the ever growing QRP-L mail-list by going to the QRP Internet Club at http://qrp.cc.nd.edu/QRP-L/. Go to member information and subscribe. See you there!

Additional Information

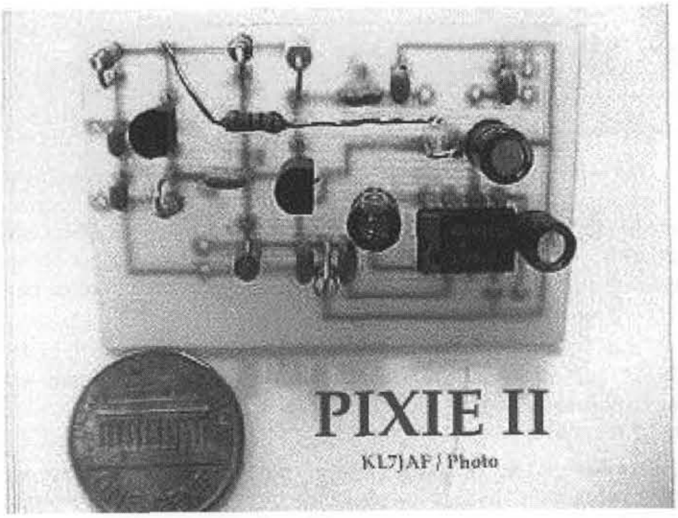
Some material in this article was taken from and thanks go out to:

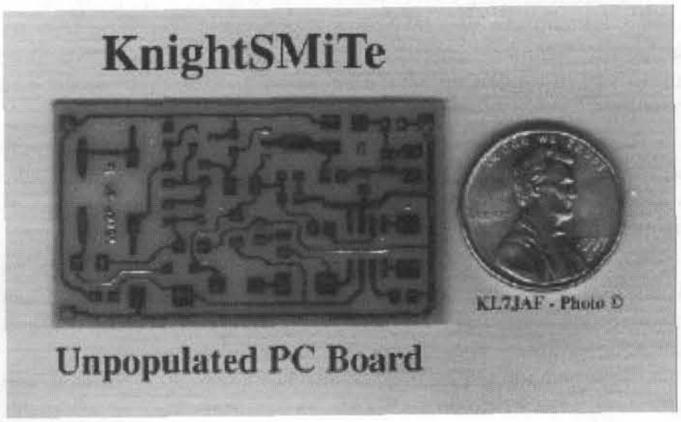
1. **QRPp** June 1995 pp. 45-48 referenced in
   http://www.qsl.net/we6w/projects/pixie2.txt
   With further references: The Pixie 2: An Update by Dave Joseph, **WA6BOY**
2. Embedded Research - Tick Keyers and Tixie
   http://www.frontiernet.net/~embres/tick.htm
   PO Box 92492; Rochester, NY 14692
   Email: embres@frontiernet.net
3. FAR CIRCUITS - http://www.cl.ais.net/farcir/
   Tixie Printed Circuit Board; 18N640 Field Court
   Dundee, Illinois 60118; (847) 836-9148
   Email: farcir@ais.net Note: Do NOT order via email
4. KnightLites WebPage: KnightSMiTe
   http://www.waterw.com/~knights/
5. HSC Electronics - Pixie 2 Kit; 3500 Ryder St; Santa Clara, CA 95051; 1-800-442-5833
6. WE6W HomePage: Pixie 2 Information http://www.qsl.net/we6w/
7. Mouser (for parts): http://www.mouser.com/
8. Norcal crystals: http://www.fix.net/~jparker/norcal/kits/kits.htm
9. NVIS info: http://www.wr6wr.com/Books/NVIS.html
   http://www.gordon.army.mil/acd/tcs/hf/2418xtr2.htm
   http://prairie.lakes.com/~jstanley/NVISPAT/nvispat.html
   http://www.qsl.net/vcars/CARL/NVIS.html
10. Cool links: http://www.njqrp.org/data/links.html
11. Pixie 2 Picture: http://www.ptialaska.net/~bhopkins/akqrp/frpix.html
12. KnightSMiTe Pictures:
    http://www.ptialaska.net/~bhopkins/akqrp/klsmpcbH.html
    http://www.ptialaska.net/~bhopkins/akqrp/klsmppch.html
13. Tixie Picture: http://www.frontiernet.net/~embres/tixie_QRPp.jpg

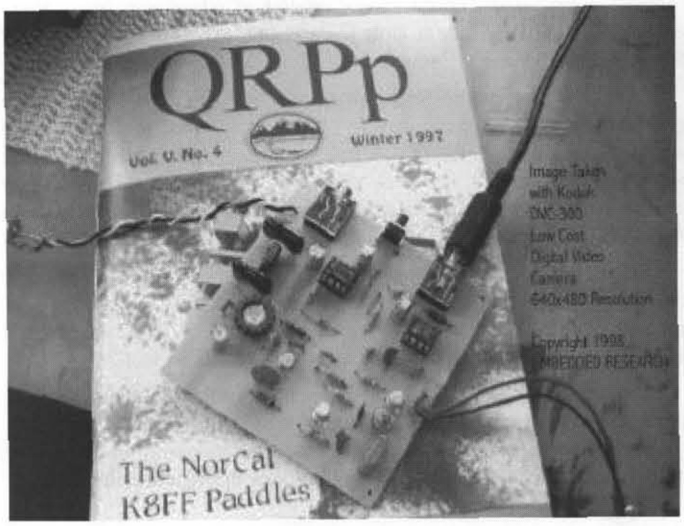
AL7FS was originally licensed as WN0LPK in March 1965 (**WA0LPK** from 1965-1985). Jim is a member of the Anchorage Amateur Radio Club and the South Central Radio Club. He has twice been a radio operator in Shaktoolik, Alaska for the Iditarod Dog Sled Race and was the Race Communications Director in 1987. Jim has participated in HF from 160-10 meters (CW and SSB), packet, satellite, 6 meter, UHF, VHF, ATV, EME (2 meter WAS #36), DX, and QRP. QRP has lasted the longest and the strongest - 1970 to 1999.

AL7FS@QSL.NET

Visit the Alaska QRP Club HomePage at:
http://www.ptialaska.net/~bhopkins/akqrp/







Tixie (TiCK Keyer + Pixie)

QSL Cards: Bane or Blessing?

C. F. Rockey, W9SCH   PO Box 171   Albany, WI 53502

[The opinions expressed in this article are those of the author and do not necessarily reflect those of the ARCI officers or the staff of the ***QRP Quarterly****. "Rockey" is a long time QRPer and member of the QRP Hall of Fame]*

QSL cards are an old ham radio tradition, they are pretty, friendly and a lot of fun to collect. Some may even rise to the level of informal art. They are interesting conversation pieces when non-am friends come visiting. Furthermore, they may serve as personally interesting items for particularly significant contacts that have been made. So it would be rather cruel to suggest the total elimination of these pretty pasteboard rectangles; I would never make such a bitter suggestion.

But do these beauteous bibelots actually do what they are generally intended to do, that is, actually confirm radio contacts? If all of us were as honorable as we pretend to be, this would indeed be the case. But, as a matter of fact, this is often not so.

For instance, a number of us have unhappily known of a situation in which a particularly ardent DXer failed to contact that rare, distant station during a noisy pileup. Needing this rare station's country for a contest or an award, one fills out a QSL card for this station anyway (sans corresponding QSO), perhaps attaches a ten-dollar bill to it, and mails it off. (The writer personally knows of at least one case where this was done.) And how about when one accidentally receives a "juicy" card intended for another station but adds it surreptitiously to his own card hoard? While one hopes that this dishonest practice is not common, there is strong reason to believe that it happens often enough to cast a dark shadow over the validity of the entire DX QSLing process. Let's quit kidding ourselves friends. The card no longer *necessarily* confirms the contact as things stand today.

Entirely disregarding the fact that a number of prestigious awards have been falsely issued under such conditions, it is the ethical temptation associated with this process which seems most disturbing to me. This but brings forward just one more instance of the many opportunities for cheating today, some of which might be increasingly difficult for some weak souled individual to resist.

Whether anyone is actually caught cheating or not is not the point. It is simply that every such instance may further lower the ethical climate of the amateur radio population generally. And it is widely agreed, I think, that further ethical degradation of any part of today's social scene is to be avoided wherever possible.

Along with golf or tennis, amateur radio today is, first of all, an enjoyable socio-human activity, a sport. If it isn't this, what in tarnation *is* it? (It's even called "Radio Sport" in the Russian community, we understand.) When we participate in such we try to do so as humane, self-responsible persons, as ladies or gentlemen, if you please.

Now ladies and gentlemen usually trust each other in such activities. One golfer, for instance, will ordinarily believe a fellow golfer when he claims to have made a highly respected "hole in one" (unless he is a known liar). Considering amateur radio as a similar sport, why should you not analogously believe me when I tell you that I have worked such-and-such a rare country or worked thousands of miles with one watt? I think that I'd believe you – why not? Why not a general return to good old, old-fashioned, gentlemanly trust here?

Again, why is a QSL card here really necessary? After all, it isn't a deposition, sworn under oath in court, is it? It's only a courtesy, at most. (After all, it also can conceal a lie, can't it?) Now if you enjoyed a QSO, or if it represented some special achievement, exchange cards by all means!

But with the facts of life in amateur radio being as they are, why should a pile of expensively obtained QSLs continue to be a requirement for any award or certificate when, with the chips down, QSL cards may truly confirm little or nothing? QSL cards are no longer cheap. And with postal rates constantly rising, this activity may become prohibitively costly for some of us.

In the case of a large, worldly involved organization such as the ARRL, some small claim for something like a QSL card requirement for certificates or awards might arise. But may not we, as QRPers, be largely relieved from such pressure?

We have, or at least used to have, in our QRP organizations, the policy wherein a confirming signature by two fellow amateurs is required upon each application for an award or certificate. I personally highly favor such a procedure. This small requirement would seem to represent a reasonable confirmatory procedure while also being inexpensive and relatively little trouble to carry out. (The only possible loser thereby is possibly the printing industry!)

[Editorial comment – what the author refers to is the GCR, which is actually a signed statement by two local hams that they have examined and verified the QSL cards, so that the irreplaceable cards themselves need not be entrusted to the US Postal Service. GCR does not eliminate the need for QSL cards for awards; it just eliminates the possibility of their loss in the mail.]

Once again, let's remind ourselves that amateur radio is a sport, a hobby, not a legal trial, not a business and is certainly not philosopher Tomas Hobbes' "war of each against all!" Ham radio used to be a friendly, humane, trusting thing – why cannot it still be such?

Sure, if you like QSL cards, go ahead – exchange them! They're interesting, pretty, collectable and fun! But as their being the tight contact-confirming agent as believed in certain quarters – forget it! It just ain't so Rather, let's spend that QSLing money upon better antennas.

Edited by W1HUE

"Four Days in May" 99 QRP Conference

May 13-15, 1999

1 9 9 9
FDIM
Four Days In May™

at the Dayton Hamvention

QRP Amateur Radio Club, International (QRP-ARCI) proudly announces the fourth annual "Four Days In May" QRP Conference commencing Thursday, May 13, 1999 - the first day of four festive days of 1999 Dayton Hamvention activities. Mark your calendar for this extra bonus day and register early for this not-to-be-missed QRP event of 1999.

Thursday: QRP Symposium

Amateur radio QRP presentations, workshops and demonstrations will be the focus of the full day Thursday QRP Symposium to be held at QRP ARCI headquarters at the Days Inn Dayton South. Last year, this sold-out event had a "standing room only" crowd of 175 enthusiastic attendees.

Papers being Presented:

- ✔ "Vertical Antenna Design & Analysis", W4RNL
- ✔ "Constructing QRP Equipment", G3BPS
- ✔ "DSP-based Coherent CW Xcvr", N2APB
- ✔ "QRP Construction Tools & Tricks", G3RJV
- ✔ "Mixer Madness", WA2UNN
- ✔ "PIC-based SWR Bridge/Tuner", N2CX
- ✔ "Distortion Demystified", NN1G

FDIM QRP Symposium attendees will start their day with a wake-up coffee social and then plunge into a full day of multimedia QRP presentations by renowned QRP authors and designers. Copies of the Symposium Proceedings will be provided for all registered attendees. There will be a grand prize drawing for an Elecraft K2 Transceiver during the QRP Symposium. (Winner must be present.)

Thursday eve: Authors Social

Culminating this first day, will be an evening QRP ARCI Author Social for all to meet the QRP presenters.

Friday: ARCI Awards Banquet

The "Four Days in May" QRP extravaganza continues with the annual Friday night QRP ARCI Awards Banquet honoring QRP dignitaries for their service to the Amateur Radio community.

Friday eve: Vendor Social

Following the Awards Banquet, a special evening has been set aside for the FDIM QRP Vendor Social where prizes will be drawn. All are invited.

Saturday eve: Building Contest!

FDIM Saturday features an evening social for QRPers to meet the many regional North American and International QRP Club members - bring your banners! The evening culminates with a BUILDING CONTEST ... the categories are wide open so bring your latest kit, homebrew project, antennas, whatever! Judges will select winners for prizes, a feature article spot in the next QRP Quarterly, and will be candidate for project kitting, courtesy of the QRP ARCI.

The QRP ARCI "Four Days In May" 99 QRP Symposium will be the talk of the Dayton Hamvention! (See **FDIM FAQs** on next page.)

Banquet Reservations

Scott Rosenfeld, NF3I is handling the FDIM Banquet reservations. Follow these simple steps to get on the list to attend the Banquet:

- ❑ Write a check payable to QRP ARCI for the $25.00 for each attendee
- ❑ Provide the name, surface mail address, telephone number and e-mail address of each attendee
- ❑ Provide call sign(s) if available
- ❑ Provide a self-addressed stamped envelope if return confirmation desired.
- ❑ Send to Scott Rosenfeld, 2250 Paterson St 50, Eugene, OR 97405-2988 USA
- ❑ For more information, send e-mail to NF3I at ham@w3eax.umd.edu

Hotel Reservations

Hank Kohl, K8DD has once again arranged a special block of reduced-rate rooms to be held at the Days Inn Dayton South (DIDS) for FDIM attendees wishing to conveniently stay at the ARCI headquarters for the weekend festivities. Rooms are $72/night (+ tax) with as many occupants as desired. Let Hank know if you will be needing one of these special rate rooms. He can be reached at: QRP-ARCI Rooms, 1640 Henry, Port Huron, MI 48060-2523 USA. You can also contact Hank by e-mail at: k8dd@contesting.com

Symposium Registrations

Phil Specht, K4PQC is handling the registrations for the FDIM QRP Symposium. To register:

- ❑ Write check made out to QRP ARCI for the $10.00
- ❑ Provide name, surface mail address, telephone number, e-mail address, callsign of each attendee
- ❑ Provide a self-addressed stamped envelope if return confirmation desired.
- ❑ Deadline for reservations: May 1, 1999 ... seating is limited, first come, first served.
- ❑ Send to Philip Specht, 925 Saddle Ridge, Roswell, GA 30076 USA. e-mail: k4pqc@bellsouth.net

Vendor & Club Registrations

Jim Stafford, W4QO, QRP ARCI Vice President, will be the host this year for QRP vendor and club tables at all three evening sessions of the FDIM weekend. For registration information please write Jim at 11395 West Road, Roswell, GA 30075 or via e-mail: w4qo@amsat.org

FDIM Notes ... from the VP

Jim Stafford, W4QO *email: w4qo@amsat.org*

This will be the second year that I have been "in charge" of the QRP hospitality rooms at the Dayton Hamfest. We are always "tweaking" this to make it better. Here is how we propose to handle the evening activities this year. Again, these evening activities are provided FREE by QRP ARCI, so come join us and invite your friends.

FDIM/Dayton Hospitality Details

As most of you know whether you have been to FDIM/Dayton or not, QRP ARCI has hosted some fun hospitality activities each year for the last several. These are held in two good sized "ballrooms" at the famous DIDS motel. Each evening - Thursday, Friday and Saturday from about 7 til 11 PM (beginning a little later on Friday after the banquet) the doors are open to all comers at no charge. We try to make space available to clubs and vendors so they can display their wares and hype their latest gadgets. For the last two years, NorCal has also had the judging for the Build-It contest and the announcement of winners on Saturday night. This year we are trying something a little different. Read on.

In order to not tie up the vendors with being "on display" every evening, we plan to segment the nights as follows:

Thursday night - Meet the Speakers

We are encouraging the speakers to be on hand at a table we will provide where participants (and even those who couldn't attend the seminar) can chat with speakers and even get more details if appropriate. Speakers will be identified with a recognizable name badge.

Friday night - Vendor Night

The banquet will be, well, shall we say, shorter this year. After the banquet, until 11 PM, we will be encouraging our vendors to hold forth at a table which they should reserve with me. Bring any money left from the first day at the flea market as most vendors will have product to actually sell. If a vendor feels that they must be available on either of the other two nights, please give me the details of your request and we'll see if we can work something out. Otherwise, vendors, take the other nights off and enjoy the activities along with all the other QRPers.

Saturday night - Exhibit and Build-It Contest

We have noted that by Saturday night, there seems to be a number of QRP construction items setting around for people to see but sometimes without much info on who owns it, how it works, or if it can be touched! We also note that the contest entries sometimes are removed from the ballroom as soon as the winners are announced. Well, this year, we are going to try something a bit different to make it more fun for everyone. Contest entrants + *anyone else* who would like to show off their latest pet project, can reserve a small table space to "exhibit" their projects. Here is the point - if you have something no matter how simple or even if doesn't seem to fit a contest category, that you would like to "show off", you will be provided a 30" table space and a tent card to list your name, call, email, and what the project is. You may actually put several items in your space, a display if you will. You can provide a backboard to show schematics, photos, etc. You must provide this but if it will fit in the space (30"-about 3 per table), then go for it. If you forget to reserve, no problem, just come by the "setup" table in one of the ballrooms where we will fix you up. A *special note to contest entrants* - We would like for you to have your items on display from 7 to 10 PM and certainly try to leave your items there for others to see after the judging. Winners will have appropriate signage placed on their display after the results are announced.

We would like to have dozens of displays, so bring out your favorite rigs/gadgets for all to enjoy! Let's make this the best FDIM/Dayton to date.

The 1999 Dayton Hamvention QRP ARCI Banquet

Friday, May 14, 1999, 7:30 p.m.
Days Inn Dayton South, Miamisburg, OH
$25 U.S. per person (CHEAP!)

GREAT FOOD
WILD company
GOBS of prizes (List of prize donors)
QRP ARCI Hall of Fame inductions

What does it add up to???

OODLES of fun

HOW TO ORDER TICKETS:
Send check or money order, made out to QRP ARCI for $25 per attendee to:

Scott Rosenfeld N7JI
QRP ARCI Banquet Tickets
2250 Patterson St. #50
Eugene, OR 97405-2988 USA
ham@w3eax.umd.edu http://w3eax.umd.edu/~ham

Please include
name and callsign of ALL attendees being paid for
your phone number
your mailing address
your e-mail address
a self-addressed, stamped envelope if you want your tickets mailed to you

Milliwatting
10db below QRP

Bob White WO3B
7044 Placid Lane
Shingle Springs, CA 95682
e-mail: WO3B@innercite.com
*http://*http://www.geocities.com/siliconvalley/5582

This column is now brought to you from Shingle Springs, CA. Shingle Springs is located 9 miles West of the infamous Placerville, CA (often referred to as Hang Town in the Gold Rush Days). Nestled in the foothills of the Sierra Nevada's, the area is noted for rural 5-acre residential parcels with spectacular views, *(read* good antenna locations). Well I managed to find a house that my family liked with a good view of the Sierra Nevada SnowCaps to the East and the Sacramento Valley to the West. As my children were checking on how many TV stations were available I was going through the ARRL Repeater guide to see how many repeaters I could key up with a 300 mW HT. Prime antenna real estate at other then normal publicized California prices, and well worth the wait.

The **WO3B** 571-foot horizontal loop of Maryland days is now a 571 off center fed Zepp fed with 450-ohm ladder line. I am still looking for another 900 feet of wire to make it back into an all the way around the property loop. You think that's overkill, my neighbor has 400 acres of wire fenced grazing land that I think I will make into an RF ground. Boy can I load some wires against that. I also have erected the GAP Titan vertical I had purchased last year to allow hamming from the interim residence in Palo Alto, CA. It is nice living in a small town. I have gladly given up the convenience of densely populated living for the low receiver noise I am now experiencing.

Speaking of low receiver noise, if you haven't tried an Elecraft K2 yet then find out where the closest Field Tester lives and ask about the K2. I am sure you will be invited over for a show and tell as everyone I know who has built the K2 is always looking for excuses to show it off.

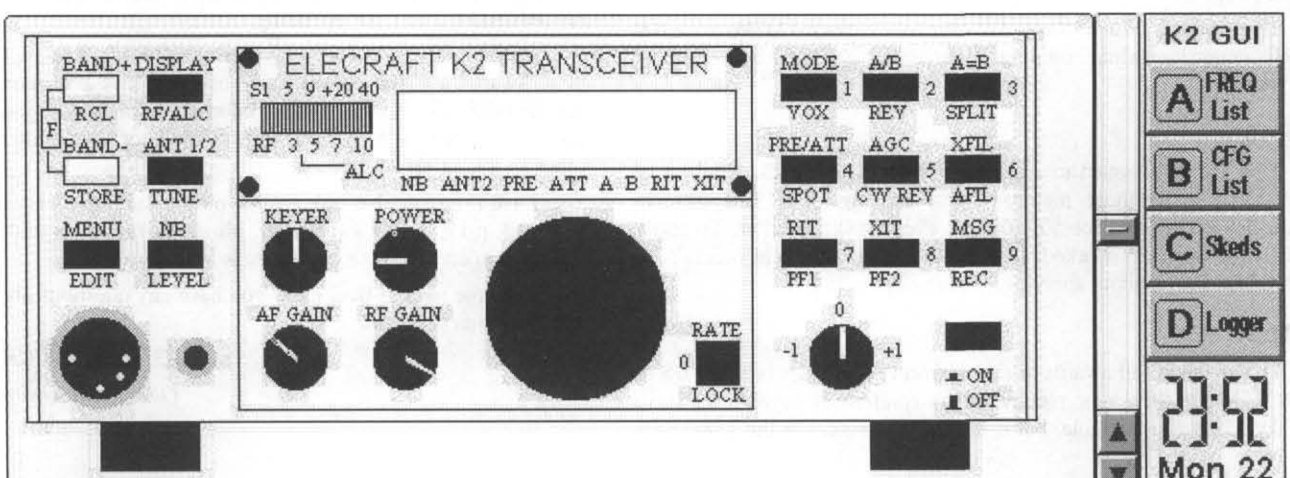
In my opinion the Elecraft K2 kit is a good start at filling the void which was left in the ham radio kit market by the demise of Heathkit. I just finished my K2 and put it on the air for the first time on 20 February. I was still tuning around the bands trying to learn the controls when I ran across **VK4VC** on 40 meters. One quick call at 800mW and the K2's first contact was in the bag. Not bad, Nambour, Australia as the first contact on a newly built rig at a new QTH. That one should weight in at about 8k miles-per-watt. The first contact was not a fluke. For the rest of the radio's first radio day we checked into the **WSN** QRP net at 100mW and received glowing keying reports from all over California, worked **NH7A** in Hawaii on 10 meters at 100mW, **WP3R** in Puerto Rico on 10 meters at 800mW and **JF2QNM** in Japan on 15 meters at 100mW. The K2 sounds good, feels good, was fun to build, is easy on power, and compares well with my

Kenwood TS 940S on receive.

Elecraft will also be offering an AUX I/O for the K2. I have gotten so excited about this radio that I have began to write code for the Psion Series Palmtop again. Below is a preview of the K2 Graphical User Interface I am currently working on.

Anyone owning a Psion Series 5 is welcome to Email me and request a copy of the software. I am always looking for constructive criticism on my programs because it's always nice to have others helping with the R&D. I also plan to include a logger, SKED database, Frequency database and Configuration Database in the program.

Well enough about what I have been doing. What have you been doing? Please share with us all your latest QRPp activities and conquests. Keep those letters and emails rolling. --QRPp--



QRP ARCI Awards

Steve Slavsky, N4EUK *email: w4qo@amsat.org*

As your new Awards Manager, I am happy to announce that I am up and running and awards under the QRP Amateur Radio Club International Awards program. These awards represent real accomplishments on the part of individual QRP operators and I look forward to ratifying each that you apply for. Chuck, K5FO, my predecessor, has done a fantastic job of keeping accurate and complete records of all the awards issued and publishing them in the QRP Quarterly.

I hope to be able to do the same. In case you are unaware of the awards program, a description of the various awards, taken from the QRP ARCI awards page, appears below (full details at http://www.qrparci.org/). While only the application for the 1000 mile per watt award is posted, formats for the other awards appear in various back issues of the QRP Quarterly. I plan to post application forms to the awards page in the near future.

The objective of the QRP ARCI Operating Awards Program is to demonstrate that "power is no substitute for skill". It encourages full enjoyment of Ham Radio while running the minimum power necessary to complete a QSO and thereby reducing QRM on our crowded bands. QRP is defined by the club as 5 watts output CW and 10 watts PEP output SSB. The following awards are available to any Amateur. Requirements are set forth below.

1000 MILE PER WATT (KM/W)

This award is issued to any Amateur transmitting from, or receiving the transmission of, a QRP station such that the Great Circle Bearing distance between the two stations, divided by the QRP stations power output equals or exceeds 1000 Miles per Watt. Additional certificates can be earned for contacts on different modes and bands. See NOTES below about applying.

WAS-QRP

This award is issued to any Amateur for confirming QSOs with stations in at least 20 of the 50 states of the USA while running QRP. Endorsement certificates are issued at 30, 40 and 50 states confirmed. See NOTES below about applying.

WAC-QRP

This award is issued to any Amateur for confirming QSOs with stations in all six continents while running QRP. See NOTES below about applying.

DXCC-QRP

This award is issued to any Amateur for confirmed QSOs with 100 ARRL countries while running QRP. See NOTES below about applying.

QRP-25

This award is issued to any Amateur for working 25 members of QRP ARCI while those members were running QRP. Endorsement certificates are offered for 50, 100 and every 100 thereafter. To apply send list of members worked. List should be in numerical order. Also see NOTES below about applying.

NOTES

1) The fee for all awards or endorsement certificates is $2.00 US or 5 IRCs. Make checks or money orders (preferred) payable to Steve Slavsky. Cash is acceptable, but is sent at your risk. For the 1,000 mile per watt award, if you would like an award certificate sent to the ham at the other end of the QSO (the one with the good ears who made your QSO possible), please enclose an additional $2.00 or 5 IRCs.

2) GCR List (General Certificate Rule): QRP ARCI will accept as satisfactory proof of confirmed QSOs and that the QSLs are on hand as claimed by the applicant if the list is signed by: (a) a radio club official, OR (b) two amateur radio operators, general class or higher, OR (c) a notary public, OR (d) a CPA. If none of the above are readily available, a photocopy of both sides of the QSLs is OK. If you must send QSLs, which I really, really, really, strongly discourage, please include postage for their return. QRP ARCI is not responsible for lost or damaged QSLs.

3) QRP ARCI member numbers are not published. The Awards Program will accept as satisfactory proof for any of the club awards a QSO with a club member giving their membership number and power output in the log data. If the QRP number and power are not given a QSL is required for confirmation. See Note 2 above.

4) Endorsement certificates are available for a) One Band, b) One Mode, c) Natural Power, d) Novice and e) Two-way QRP if log data so indicates.

5) All QSOs for awards requiring multiple contacts - WAS, DXCC, WAC and QRP-25, must be made within a 50 mile radius. This means you can't start WAS in Virginia and finish it in California.

Send Applications to:

QRP ARCI AWARDS CHAIRMAN
Steve Slavsky, N4EUK
12405 Kings Lake Drive
Reston, VA 20191-1611

Please include your e-mail address on any correspondence or applications.

My goal is to turn around your applications in less than 30 days, from the time you send the application to the time you receive the award in the mail (CONUS only, subject to the vagaries of the US Postal Service, contests, foxhunts, etc., etc. :-)). Please be sure to enclose your e-mail address with any application. I want to let you know when I receive your application so you know it got through. It will also be helpful if I have any questions about your application. In the case of the 1000 miles per watt award, please don't forget the ham at the other end of the QSO. Their efforts in detecting our signals makes your award possible. I will be happy to send them a certificate memorializing the QSO for $2.00. It's a good advertisement for the rewards and fun of QRP operating.

You do not need to be a member of QRP ARCI to apply for any of these awards. I know not everyone on QRP-L is a member, so please see the QRP ARCI homepage for information on how to join, if you are interested. I will be writing a short column for the Quarterly restating much of this information.

Last, if anyone has any awards outstanding that were been mailed to Chuck prior to this switchover, please let me know and I will work with him to see that your certificate is issued.

Send me some e-mail me if you have any questions about the QRP ARCI awards program.

73, Steve, N4EUK
QRP ARCI Awards Manager

The Last Word

The QRP Quarterly invites readers to submit original technical and feature articles as a service to their 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 back cover 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 .tif 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 the 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 the 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 they believe it better fits another category.

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

Material cannot be returned unless accompanied by sufficient postage.

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

Opinions expressed 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 acknowledge the source of the material.

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

Copyright of materials published in the QRP Quarterly remains with the author. Although the author retains the right to reuse the material, the QRP Quarterly requests that reprints of the material in other publications acknowledge first publication in the QRP Quarterly.

-- The Editor

New Member/Renewal Application Form

New Member? (Please indicate) Yes No

Membership Fee: USA ($15) ____ Canada ($18) ____ Outside North America ($20) _______

Full Name: ______________________________ **Call:** ______________

Address: ______________________ **City:** __________ **State/Country:** ________

Postal Code (ZIP + 4 for USA): ____________ **New address?** Yes No **New call?** Yes No

QRP ARCI No. (renewals only): _________ **List past callsigns:** ________________

(<u>Note</u>: Do not renew for more than 2 years. Funds that push the expiration date on your subscription more than two years into the future will be returned.)

The following information is optional but helpful ...

Packet Radio Address: ______________ **Email address:** ____________________

Home phone: ______________ **Work phone:** ______________

Please send a check or money order in US funds payable to "QRP ARCI" *(only)* to:
Ken Evans, W4DU, 848 Valbrook Court, Lilburn, GA 30047-4280, USA

If more convenient, a check or money order for 13.50 UK pounds payable to "GQRP" *(only)* may be sent to:
Dick Pascoe, G0BPS, Seaview House, Crete Road East, Folkestone, Kent CT18 7EG, UK

Dick Pascoe can also accept Visa or MasterCard at 14.00 UK pounds. *Do Not Send Cash!*

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