Your Construction and Operating QRP Sourcebook

QRP Quarterly

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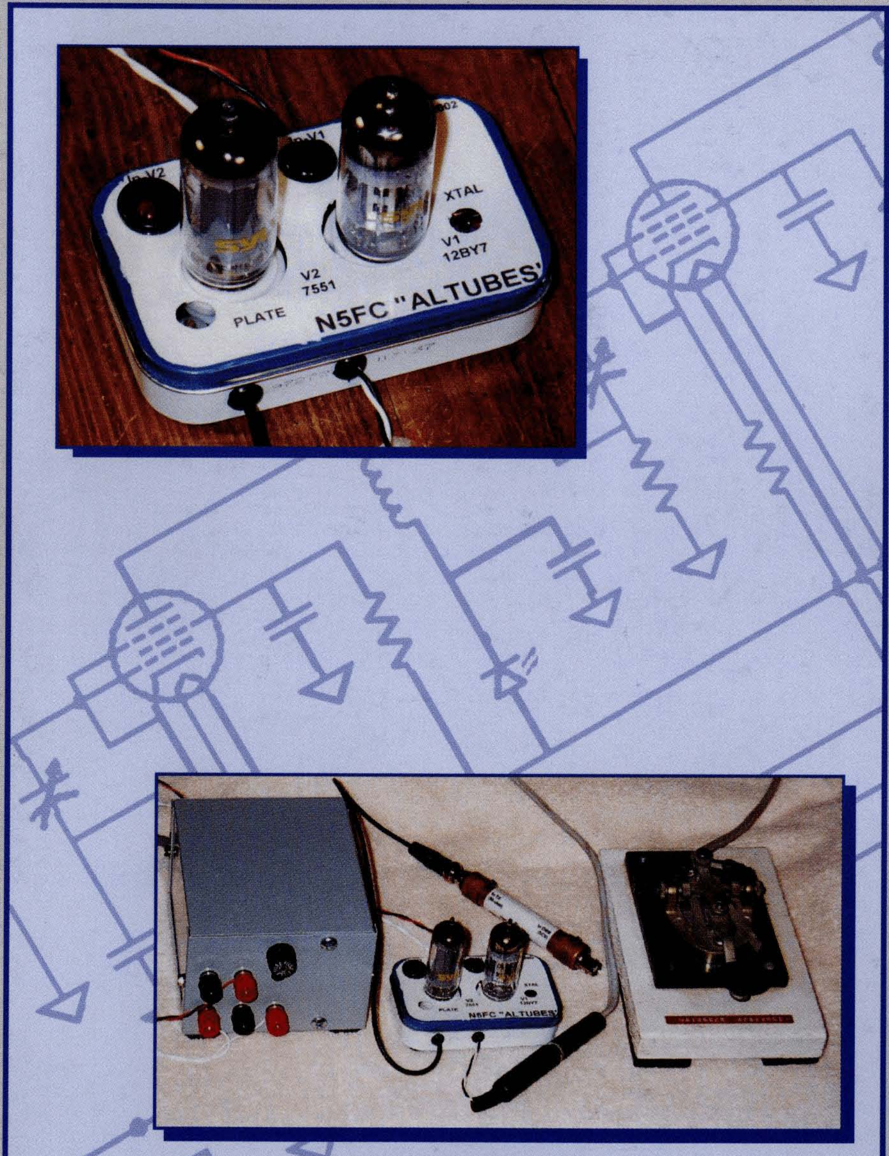


N5FC Shows us How to Build a Vacuum Tube Transmitter

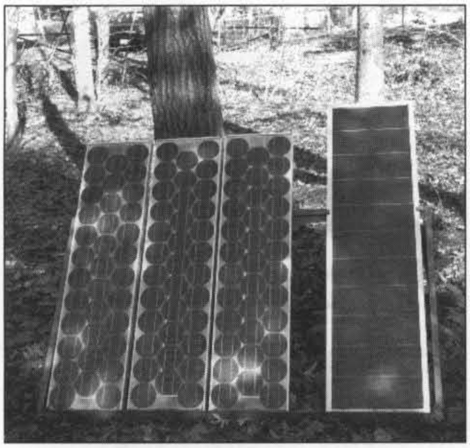
- An Interview with Joe Spencer, KK5NA, QRP ARCI President
- Solar Power for Amateur Radio Operations
- Test Topics and More: All About "Q"
- W4RNL Examines the Vertical Doublet for 30-10M Operation
- Contest Results—Summer PSK-31 Sprint

QRP ARCI is a non-profit organization dedicated to increasing worldwide enjoyment of radio operation, experimentation and the formation and promotion of QRP clubs throughout the world.

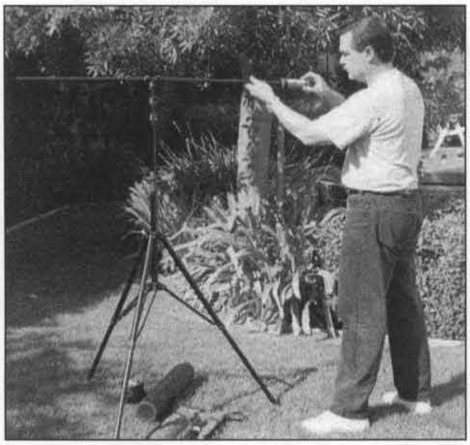
Table of Contents

QRP Quarterly

Volume 44 Number 1 — Winter 2003



page 28



page 34

page 42

Across the Editor's Desk

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

It's January, and Christmas has come and gone once again. Hopefully you got one of the low power whatever-it-was you wanted that you dropped hint after hint about to loved ones.

Myself, I finally got the entire home station solar powered and everything rigged back up so I can run mobile CW and SSB again. Commuting here in the Houston area requires at least an hour to and from each day, and I just couldn't waste that time listening to regular FM radio. I bought a new Ranger pickup a while back and I really couldn't wait to get everything all set back up again.

On a sad note, a good friend is leaving his long-term position with QRP-ARCI. Mark Milburn has been the club Secretary for a long time, and he's always been a stalwart supporter of low power operation. I first "met" Mark when I took over the position of managing editor with the April 2002 issue of *QRP Quarterly*. I say "met," as Mark and I have never been in the same room at the same time, although we have done our fair share of emailing back and forth between Iowa and Texas. The club is going to miss him, but there comes a time where all of us have to make decisions about the amount of time we have available to volunteer.

Speaking of time limitations, this is my last issue of *QRP Quarterly* as the managing editor. I teach special education at a private school fulltime, freelance edit nearly fulltime, and I'm still trying to finish that big novel I'm working on. And did I mention that I also teach college classes a couple of nights a week? The QQ takes a pretty fair amount of time to get ready each quarter, and time is the one thing I am short of at the moment (well, that and money, but that's another thing altogether!). I signed on for four issues and to try and get things back on track. Those of you reading this likely have no real idea of the amount of work that a multitude of people do each quarter to get this magazine put together. My thanks to Joe Spencer, President of QRP-ARCI, and all of the terrific staff of this outstanding magazine. As I stated earlier, I write professionally and I have been seriously impressed by the talent associated with *QRP Quarterly*. Thanks to all for the help and the outstanding work. I sincerely appreciate it.

If you didn't really look the cover over carefully, you might not have noticed that this is the very first "Winter" issue of *QRP Quarterly*. The QRP-ARCI Board of Directors recently decided to change from the four previous month indicators to the standardized use of Winter, Spring, Summer, and Fall to describe all future issues.

Hope you like what you see in this issue. We've certainly enjoyed putting it together for you.

—Mike, WB5YJX

Your QRP ARCI Membership

The QRP ARCI financial statement is published on page 61 of this issue. It is provided here so you can see where your dues have been spent.

Your membership in QRP Amateur Radio Club International is more than a subscription to *QRP Quarterly* (although it is understandably the single biggest item in the club budget). Your membership dues also support many other club activities — Promotion of QRP at hamfests and other ham radio gatherings, recognition of prominent QRPers through the QRP Hall of Fame, QRP contests, the exhibit hall booth space at the Dayton Hamvention (a major QRP gathering place), and soon, an edition of *QRP Quarterly* for the visually impaired, offered with no additional cost. It should also be noted that the Four Days in May (FDIM) symposium in Dayton is nearly self-sufficient, with attendance fees covering most of the cost.

From the President

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

Well, it has been a great year for QRP, and we appreciate all that you of the QRP community have done to further the cause. QRP is STILL growing and is having a large influence on the hobby today. More and more contests are adding QRP sections, and there are more and more QRP contests.

Many QRPers are bringing the joy and power of QRP into the limelight. Some outstanding examples would have to include John Shannon, K3WPP, with his long running "QRP contact everyday" for over 3000 days (he also has a great webpage at http://www.alltel.net/~johnshan/index.html).

Chuck Adams K7QO (DR QRP) with his great efforts and score in the CQ SS 2002 contest this year (another great website at http://www.qsl.net/k7qo/), Ed Hare, W1RFI, and his work at the ARRL and in general. Combine these fine amateurs and their examples with the many other fine QRP ops and you can see why people are taking notice of the QRP community.

We are also blessed with the many great and innovative kits that have made building fun again and allowed us to build some very powerful pieces of communication gear, useful accessories and accurate test equipment using today's miniaturized technology. The Elecraft K1 and K2 have revolutionized both kit building and amateur radio equipment by raising the bar for all radio manufacturers to try and match as well as providing a kit that is so much fun to build and a radio that is fun to operate. George Heron, N2APB, and the New Jersey QRP club keep providing many interesting, useful, and diverse kits; Doug Hendricks, KI6DS, and the NORCAL QRP club, keep all of us "Zombies" happy with more great kits; Steve Weber, KD1JV, has many inexpensive but useful and fun kits; Jay Bromley, W5JAY, and the FT Smith group, has a new kit to go with the TT2; Dennis Foster, KK5PY, and Doug Hauff, KE6RIE, with their keys; Vern Wright, W6MMA, and his great portable antennas, and many, many others who keep adding to our hobby.

We here at QRP-ARCI have a great staff that keeps everything going pretty smoothly, and I am especially pleased to announce the CD Project for sight-impaired hams beta testing has gone exceedingly well. Beginning with the Winter issue (this issue), *QRP Quarterly* will be available to the sight-impaired. Cost is the same as the paper version of the magazine, and do please note that it is for the sight-impaired only. Thanks to Mike Goins for heading this project and to those who helped make it possible.

Unfortunately, with this issue I have to announce that Mark Milburn, KQØI, has decided to resign as secretary after many years of exemplary service to QRP-ARCI and to the QRP community in general. His dedication to the organization will be sorely missed. We are searching for a new secretary to fill his place.

Hope you all got lots of new QRP radios and kits for Christmas and I wish you a Happy and prosperous New year.

—Joe, KK5NA

Announcements

QRP Hall of Fame for 2003

We are now accepting nominations for possible inductions into the QRP Hall of Fame in 2003. If you feel someone has had a significant impact on the QRP community through outstanding accomplishments (technical, operating, organizational, etc), it's time to nominate them for this honor.

You have until the end of February to get your write-ups in, so please send information on anyone you would like to nominate to Ken Evans, W4DU. Ken is a member of the Board of Directors and his mail and e-mail addresses appear elsewhere in this issue (pg. 64). He'll collect them and pass them on to the voters, a week or so will be allowed to discuss them before voting, and the inductees (if any) will be announced at Dayton. A 2/3 vote is required for induction.

The voting body consists of the Board of Directors (Ken will abstain, since he is the HoF administrator this year), President, and Vice President. Those who were inducted into the QRP Hall of Fame in the last two rounds will also be given the option to vote if they wish.

Nominations may be submitted by anyone, whether a member of the QRP ARCI or not. Similarly, membership is not required for someone to receive the honor, since this is an award to recognize those who have made great contributions to the QRP community, not just to the QRP ARCI.

If submitting a nomination, you must do more than simply toss out a name. We need to have a few paragraphs giving some details of the accomplishments, telling us why the person is worthy of being in the QRP Hall of Fame. Don't count on all of the voters knowing everything about your favorite QRP hero; you think they are worthy of the honor and it's your duty to convince us. In the past, it was not unusual to see comments to the effect that since someone didn't bother to write more than a line or two, then the nominee must not be very worthy of getting the vote.

While we have no list of specific requirements to meet for induction, we do have some guidelines. In general, nominees should be someone who has made significant contributions to QRP in one or more areas, and preferably things benefiting a large number of people. Long term contributions carry more weight than limited, short-term ones. Nominees have a much better chance of induction if they have been actively serving the QRP community for an extended period of time, ie, several years. Naturally, the nomination letters should only include information on achievements that are related to QRP.

If you do not hear back from Ken (W4DU) in a reasonable time, please assume that he never received the nomination and let him know. We'd hate to see someone lose out on the chance to be inducted because a letter or e-mail never got through.

As always, each nominee is judged on his/her merits; this is not a competition to choose the top two or three or whatever. There are no quotas and no limits. If the voters don't feel any nominees truly deserve the honor this time around, none will be inducted simply for the sake of having someone to announce at Dayton. On the other hand, if there are a dozen nominees and all are judged worthy, all will be inducted (and we get a quantity discount on the plaques!). Happily, we have had inductees every year since the program was revived in 1996.

The following, in alphabetical order, are the current QRP Hall of Fame members, with year of induction shown.

Chuck Adams, K5FO (1998)
Brice Anderson, W9PNE (1996)
Rich Arland, K7SZ (2002)
Dave Benson, NN1G (1999)
Michael Bryce WB8VGE (2000)
Wayne Burdick, N6KR (1998)
George Burt, GM3OXX (1996)
Jim Cates, WA6GER (1998)
L. B. Cebik, W4RNL (1999)
Mike Czuhajewski, WA8MCQ (1997)
Tom Davis, K8IF (1996)
Doug DeMaw, W1FB (1992) (silent key)
Rev. George Dobbs, G3RJV (1992)
Joe Everhart, N2CX (2000)
Paul Harden, NA5N (1999)
Wes Hayward, W7ZOI (1996)
Doug Hendricks, KI6DS (1997)
George Heron, N2APB (2001)
Jim Kortge, K8IQY (2002)
Roy Lewallen, W7EL (1992)
Rick Littlefield, K1BQT (1996)
Dick Pascoe, GØBPS (1997)
Randy Rand, AA2U (1992)
C. F. Rockey, W9SCH (1996)
Gus Taylor, G8PG (1998)
Adrian Weiss, WØRSP (1996)
Peter Zenker, DL2FI (2001)

Remember, if there is someone you feel is deserving of being inducted into the QRP Hall of Fame, you have until the end of February, so start working on that nomination letter.

New Members this Quarter:

The following new members have recently joined QRP ARCI:

11308 WØCGJ Jerry Buckner
11309 N2PAQ Frank Kisselbach
11310 W7PZ Pat Marcy
11311 KC7JPA Ray Novak
11312 W9WL Ron Rateno
11313 Agra Radio Club
11314 WA8VDC Thomas Jenkins
11315 K6MMC Michael McCarty
11316 N7HNB Carl Givens
11317 VE2DEQ Serge Hebert
11318 W4SK John Gwin
11319 KB3HAA Hal Clagett
11320 W4TLG Ted Gausmann
11321 N7ZN John Kuklewicz
11322 KT4ZT James Keho
11323 KG4VFV Andrew Stoy
11324 KC2HMM Alex Wiercinski
11325 W5KDJ Wayne Roger
11326 K9LE Leroy Eaton
11327 N7YY Bernie Miller
11328 ABØIQ Gary Clapp
11329 KE1EF David Kreider
11330 W1AMF Robert Munro
11331 KC9BRZ Dave Appel
11332 N7JB James Bradley Jr.
11333 W1AAD Robert Bell Jr.
11334 N7AOB William Painter
11335 WZ2G John Decicco Jr.
11336 KG8VT Victor Berner
11337 WØETT Kenneth Anderson
11338 W9LHG John Lyon
11339 WF5TX Maynard Hawkins
11340 KE6GXF Kevin Fitzsimmons
11341 KBØFSU Mark McQuain
11342 N8YEL Peter Venlet
11343 W7TU Utah's Dixie DX & Contest Club
11344 KB3HAX Jerome Kornaski
11345 WE5O Ron Langston
11346 KG4PUG Dave Magnuson
11347 N8XE Jason Hissong
11348 K2IFE Conrad Schmidt
11349 KA9GEU David Peterson
11350 NØPP Juerg Tschirren
11351 N6VX Robert Beard
11352 VA3STL Alan Steele
11353 N1NW Radio Amateur Society of Norwich
11354 WB4HUX James Strickland
11355 WA2FBH Richard Brody

To join QRP ARCI (or renew an existing membership), you can fill out the form on page 64 and send it to the club secretary. You may also join or renew online at: http://www.qrparci.org/us2signup.html and follow the instructions.

Can't remember your QRP ARCI number or renewal date? You can use the online member lookup to check your membership status: http://www.qrparci.org/lookup.html ●●

Call for FDIM 2003 Presenters!

Planning is underway for the Four Days in May (FDIM) Symposium in conjunction with the 2003 Dayton Hamvention. This will be our eighth year for this "not to be missed" event. FDIM 2003 will start on Thursday, May 15, 2003. On that day, QRPers will gather in Dayton to hear from some of the best minds in QRP. The symposium is an 8-hour event, which covers the gamut of QRP activities.

Please consider sharing your talent and experience by giving a presentation and documenting it for the FDIM 2003 Proceedings. Topics are wide open and may include design; construction projects and techniques; antennas and feedlines; operating techniques or experiences. Be creative and define your own topic! All that is required is that you present your topic at the Thursday Symposium and document it for publishing in the FDIM 2003 Proceedings.

Time slots are limited, so please submit your idea soon. If interested, please send a short description (one paragraph) of the proposed talk to me prior to January 31, 2003. If you know of someone who might be interested in submitting an idea, please forward this Call for Presenters to them. Contact me at:

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Norcross, GA 30092
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Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewski—WA8MCQ wa8mcq@comcast.net

IN THIS EDITION OF THE IDEA EXCHANGE:

VXO-Mate

Years ago when Joe Everhart, N2CX of Brooklawn, NJ, offered to write a series of Technical Quickies for the Idea Exchange, I never dreamed the number would get anywhere near this high. Inexorably closing in on the half-century mark (50 issues, not 50 years!), this month we have Joe's Quickie #44.

The VXO-Mate is a project that was really inspired by a design competition at the 2002 NorCal QRPacificon event. Doug Hendricks and some of his left-coast henchmen once again came up with a really different event. Providing a kit of parts to be used, at a small charge, they specified a voltage-tuned VXO to be built ahead of time and tested competitively during one of the evening sessions. Using a common set of crystals and varicaps the competitors we were able to devise circuits that provided the maximum stable tuning range.

This piqued my curiosity not only in entering the competition, but also by adding some of my own creativity to build a companion piece of test equipment to accompany the VXO. Building on the NJQRP Quickielab described previously in the *QRP Quarterly*, this was actually a rather simple task. Since it is an adjunct to the VXO, and since Dave Benson came up with a catchy new name for his latest rig, the test gadget was dubbed the VXO-Mate!

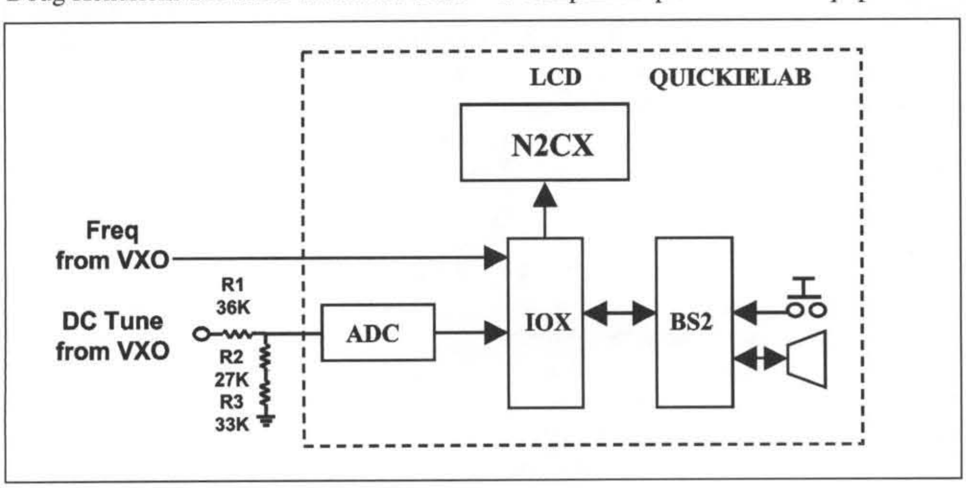

Figure 1—Block diagram of VXO-Mate.

The VXO for the contest is a voltage-tuned crystal oscillator. The test gadget I built monitors the VXO tuning voltage and the oscillator output frequency and displays them both. And building on the QuickieLab projects already described (the October 2002 *QRP Quarterly* has both the N2APB Micro Moments #2 and Joe's Quickie #43 in the Idea Exchange column, and Test Topics and More #13 in the same reference describes yet another QL application) it offers both visual and audible "display" options. The standard display is an LCD device. However, there is also a selectable audible Morse output for both the voltage and frequency readouts.

Configuration

Figure 1 shows the exceedingly simple conceptual block diagram. The heart (well, maybe the brains) of the QuickieLab is a Parallax BASIC Stamp 2 chip. It acts as a controller to run the overall program that coordinates what is going on. Most of the "grunt work," though, is done by a peripheral chip, the IOX or Input-Output Expander. As described in the third reference above, this device, running under control of the BS2, performs the auxiliary functions of frequency counting, analog to digital voltage conversion and running the LCD display. Without the IOX the BS2 would be far too busy minding the Quickielab auxiliary chips to even consider doing anything else. But with the IOX it loafs along and can do its coordination and number-crunching functions.

Ninety-nine percent of what's needed to make the project is already on the QuickieLab board. All of the chip functions, connections, LCD screen and the loudspeaker are self-contained. Literally the only components added are several resistors needed to set the input voltage range for the Analog to Digital Converter. As shown in Figure 1 they are needed to divide the anticipated 8-volt tuning voltage down to the maximum 5-volt input level that the ADC expects. Precision resistors would be best but 5% resistors of the values shown are adequate. Alternatively you could get the same ratio with a 39k resistor for R1, a 56k for R2 and a 10k pot for R3. Best calibration would be done by setting the input to 8 volts and adjusting the pot until the VXO-Mate read 5 volts. Alternatively you could simply use the same input voltage but adjust R3 for a DVM reading of 5 volts at the ADC input.

Software

The program is too long to include in this Quickie, but you can find it on the NJQRP web site at www.njqrp.org/quickielab. While you're at it check out the other projects listed there.

A simple flow chart for the VXO-Mate is provided in Figure 2. The VXO voltage and frequency are monitored and displayed on the LCD screen each time through. After the LCD screen is checked, one of the built-in QuickieLab pushbuttons is checked. If it is depressed, a mode change is made. In this mode, the same voltage and current readings are annunciated in Morse code on the QuickieLab loudspeaker. The cycle starts over again with new readings and once more the pushbutton is checked after the LCD display. If it is depressed the mode toggles back to the LCD only mode. If not, the program remains in the "sight and sound" mode.

The voltage display on the LCD shows three digits with a decimal point and the units of "V" for volts. The frequency display has a total of 8 digits, tens and units of megahertz and six more to go down to one hertz resolution. Since the display has only 16 digits, the frequency unit is abbreviated from "Hz" to "H."

The Morse output mirrors the visual display. The volt output has three digits with an "R" for the decimal point and a trailing "V" to identify the voltage "display." Frequency is always 8 digits. The first two (Tens and Units of Hz) are zeroes if the measured frequency is below 10 MHz. Again, an "R" is sent as a separator after the megahertz digit, then there are six more digits. Since the frequency annunciation has so many digits the "H" is not sent. Also, since the frequency string is so long, "0" digits are sent as "–" (a dash) much as contesters do. This minimizes sending time without sacrificing intelligibility.

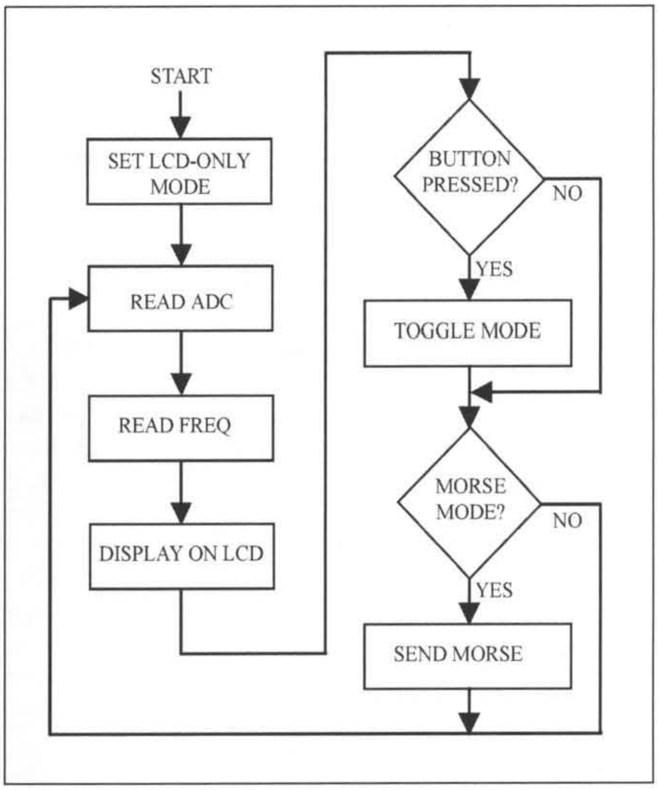

Figure 2—Flow chart for VXO-Mate.

Possible Improvements

The VXO-Mate was brought to life as a quick demonstration of the capabilities of the QuickieLab. As such only minimal additions were made to the basic circuit. As with any project it can be improved at the sacrifice of added complexity.

The first such improvement is to add more accuracy and precision to the ADC. First off, the internal ADC uses the QuickieLab's 5-volt power supply for its reference. Its accuracy can thus be no better than the 5% accuracy of the 7805 regulator. One way to improve accuracy would be to add a precision reference voltage. Yet another would be to retain use of the current 5-volt reference but to augment the operating software with a user-selectable calibration routine. The latter method has the beauty of needing no hardware changes.

The current ADC has only 8-bit resolution, so it is inherently limited to no better than about 0.4% resolution. This means that the granularity of readings is about 0.03 volts (8V/256). Ten and even 12-bit serial-interface ADCs are available quite cheaply and could be interfaced directly to the BS2 chip. This does tie up three additional I/O pins however. A future Quickie will likely detail how to do this.

The frequency counter is similarly not a super-accurate device. Its ultimate accuracy is limited to that of the IOX clock oscillator. There is, as with all devices, a tolerance on the IOX resonator accuracy and no trimmer is provided to set it "dead on." This may or may not be easy to do. However it would be possible to improve the accuracy of frequency measurements by, once again, adding a user-selectable calibration routine in the BS2 program. This could adjust out the static tolerance error inherent in the resonator and would likely be good enough for room temperature applications. The dedicated accuracy freak could remove the 50 MHz resonator and replace it with a calibrated 50 MHz oscillator.

A program enhancement that was originally intended but not implemented due to lack of time is to automate VXO measurement even more. The VXO-Mate can be simply modified to provide a DC control voltage output. With suitable program changes the unit can automatically sweep the entire tuning range while monitoring the output frequency. Using this info it would be a snap to calculate the min-max tuning range and other items such as tuning linearity and tuning sensitivity in terms of kHz/volt.

Even without enhancements, however, the VXO-Mate is a real-world example of how simply the QuickieLab can be put to use. It is not meant to be an aerospace lab quality instrument but instead a handy device that can be quickly adapted for special needs much the same as you would a circuit breadboard.

Stay tuned for yet more examples and check the NJQRP web site for full program listings and details along with the inevitable errata and improvements.

—de N2CX

Some Rules on VFO Stability

Glen Leinweber, VE3DNL, is a regular contributor to QRP-L and he always has interesting posts. He recently passed along some basic rules on VFO stability:

In the May 1984 issue of *QST*, Dennis Monticelli, AE6C, gave his prescription for stable VFO construction. His 30 meter VFO drifted from a cold start only 38 Hz. Wow, that's exceptional!

Here's his (shortened) list of VFO rules:

1) Keep RF power output to a minimum. (Depend on subsequent stages to build it up—WA8MCQ)
2) Feedback to maintain oscillation should be minimized.
3) Shield the Ls and C's of the VFO tank components.
4) DC supply instability and ripple should be minimized.
5) Decouple DC coming into the oscillator carefully.
6) Lightly couple the oscillator to the buffer.
7) The buffer stage should have constant input impedance.
8) The buffer stage should have low reverse gain.
9) The f_T specification of the oscillator device should be at least 20 times the operating frequency.
10) There should be a means of stabilizing oscillator amplitude.
11) Use low-temperature coefficient, low-loss caps such as NPO, silver-mica, polystyrene.
12) Use parallel caps where RF current is high.
13) Use good quality air variables: brass plates, double-end bearings.
14) Use a solid air-wound coil on a ceramic, glass or plastic form.
15) Use Q-dope on home-made coils.
16) For coils with slugs, use low-temperature coefficient iron-powder material.
17) Keep slug penetration into the coil to a minimum.
18) Inductors and capacitors in the VFO tank shouldn't encounter any airflow.
19) Keep stray inductance and capacitance low: short lead length, wide ground return path (big ground plane), no double-sided PC board construction.
20) Reduce mechanical vibration: mount all critical components securely; wiring should be solid, heavy gauge wire.

His remarkable 30 meter VFO operates at 5 MHz, and relies on an external frequency doubler to get to 10.1 MHz. It's a Clapp circuit, with series tuning, using a JFET. This is a slight variation on the Colpitts circuit. It's internal battery powered, using 9V.

His buffer is different, and one that I've investigated too. Clapps, Colpitts and Hartleys have grounded drains (collectors). Here, the drain is loaded with the source (emitter) of the buffer, and fed DC that way too. This makes the buffer common gate (or common base), which has excellent output/input isolation. The whole oscillator-buffer combination looks like a cascade. His oscillator FET only takes 2.5 mW DC power. I've done a 7 MHz VFO this way that drives a +7 dBm diode mixer; only two transistors. His buffer drain is the only lead coming out of the VFO shielded compartment. It carries RF out, and DC in.

—de VE3DNL

Some Interesting Web Sites

Wes Hayward, W7ZOI, passed along this URL:

http://www.qsl.net/ok1dpx

It's by Petr Prause of the Czech Republic, and has a lot of good QRP material. Much is in English although some is still in Czech. However, you can still get a lot of the basic info from the schematics of the latter.

Wes also reported a slight change in his own URL; it's virtually identical to the old one, except that the tilde (~) has been dropped.

http://users.easystreet.com/w7zoi/

The QRP Homebuilder Homepage is maintained by Todd Gale, VE7BPO. This one is mentioned every now and then, both here and in the online QRP forums. This is an excellent web page, and he is a true disciple of W7ZOI, Wes Hayward. We had a bit of a scare recently where someone reported on QRP-L that his web page seemed to have disappeared. It's back again, good as new. My own recommendation would be to go to this one immediately and download everything on it before it disappears again! I guarantee that digesting all the excellent material will take you quite a while. The URL is:

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

Also on my personal list of "download it before it disappears" is the information on the W7ZOI/K7TAU homebrew spectrum analyzer that was described in *QST* a few years back. This material used to appear on the W7ZOI web page, but it was later moved to the page of Kanga US, which is run by Bill Kelsey, N8ET. Although the device is a rather ambitious project, it's a very useful tool for the homebrewer and just reading all the information is quite interesting and informative. You can find it by going to the Kanga US page at

http://www.bright.net/~kanga/kanga/

Click on W7ZOI/K7TAU SA and then click on the various links in that. (The 1998 *QST* articles on the spectrum analyzer can be downloaded from the ARRL web page; go to www.arrl.org and do a search on "Hayward spectrum analyzer").

Not exactly QRP, this one was passed on by Alan Dujenski, KB7MBI. It's a collection of online calculators for just about anything you can think of, and a lot you never dreamed existed! It can be overwhelming at first and take a good while to sift through things and find something of interest; according to the opening page it contains links to over 16,000 calculators. They include topics like food, water runoff, poker, photographic depth of field, fire engine design, band saw feed rate analysis, tipping...you get the idea. But look carefully and you'll find the sections devoted to math, chemistry, engineering, physics, etc.

http://www-sci.lib.uci.edu/HSG/RefCalculators.html

MFJ493 Keyer Mods

Coleman Callaway, N4IM, posted info on a firmware upgrade to this keyer to QRP-L; his web page says that he has permission from MFJ to distribute the modification.

If you are using an MFJ493 Memory Keyer with its serial port, read on. I have reworked the control software to fix some occasional hangs caused by serial port input and to implement some commands to make the keyer easier to use. The mods helped me a lot in using the keyer with my logging software. The modified software implements the following changes:

- Fixes the hangs
- Touching the paddles stops sending CW that came in from the serial port
- Commands can be sent via serial port while the keyer is sending CW. Allows the logging software to change keyer speed while the keyer is sending
- Added a command for each keyer parameter to make it easier to talk to the keyer through the serial port

You can find a complete list of the new commands at www.callaways.org/n4im

The mod requires you to change the 27256 EPROM on the keyer PC board. If you have access to an EPROM burner for a 27256, you can download the new software image at the above site. If you don't have access to a burner and want to try this mod, please mail or email me directly and I can make you one for $10.

Coleman Callaway, N4IM
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—de N4IM

Fixes for Dirty Signal on NC-20

Karl Heimbach, W5QJ reported on QRP-L that the output signal on his NorCal 20 had some purity problems and asked for help.

From W5QJ—Looking at the output on an oscilloscope, I was surprised to find it not as clean as I expected. In fact, the transmitter goes unstable at the slightest tweak of either TC-8 or TC-9. I have VR-6 set for 3.3 watts output at 14.000 MHz and 3.4 watts output at 14.074 MHz and have a reasonably clean and stable output. However, I am concerned that I'm on the "ragged edge" and the slightest change in antenna impedance or battery voltage could put me in no-man's land.

Connected to a 50 ohm dummy load with a 10x probe connected to my scope, and alternately a frequency counter, I've seen outputs from 9.xxx MHz to 28.xxx MHz. I get the cleanest output (beautiful sine wave) at the second harmonic, i.e. 28.000 MHz to 28.148 MHz and similarly, get the more power at the second harmonic with the same amount of drive.

By tediously adjusting both TC-8 and TC-9 and reducing VR-6 drive to about 50%, I can stay within the 20 meter band without chirp and no discernible drift.

I've removed C3, changed L6 to 8 turns, changed L7 to 7 turns, and put 6 turns on the secondary of T2. Otherwise, everything else is per the manual. The receiver is great, the AGC works reasonably well, audible frequency counter perfect, and the TICK-1 keyer working per design. In short, I'm delighted with the exception of output stability.

Has anyone else encountered something similar or have a suggestion of what to check?

Rod Cerkoney, NØRC, replied with this information—A mod that might help is to reduce R80 to 18 or even 15 ohms. This helps to prevent PA over drive. This was posted by Gary Surrency, AA7MY on QRP-L in the NC-20 heyday. Here is how I fine tuned my NC-20 (again from Gary, as documented in *QRPp*, Autumn 1999):

- With power off, solder an 18 ohm resistor from the collector to emitter (ground) of the power amp transistor
- Connect an antenna analyzer, such as an MFJ-259, to the antenna terminal.
- Sweep the band while adjusting the spacing on L6 & L7 windings, aiming for approximately 50 ohms
- Remove the resistor

More detail about this procedure can be found in the Autumn 1999 *QRPp* (from NorCal, published by Doug Hendricks, KI6DS).

I did all this to my NC-20, and get 7 to 8 clean watts with a 13.8 VDC supply.

If your signal is chirpy, that's more likely due to a sagging voltage to the VFO. Things to try: use a stiff power supply, use heavy gauge wire for the supply voltage, change U2 to a more precision device such as L78L08ACZ. Again, more detail is in the referenced *QRPp*.

Steve "Melt Solder" Weber, KD1JV, had this suggestion—Try turning the output low pass filter toroids at right angles to the way they are marked on the board. This will put them at right angles to the transmitter band pass filter toroids and reduce the coupling between them, which can cause oscillations. The usual symptom here is power goes up smoothly to a point while turning VR-6, then suddenly jumps up to full or more power out. (It also makes a rather nasty looking signal on the scope)

Dave Fifield, AD6A, suggested this—Also, try removing C105 (2 pF). This seems to clean up "hot" power amps on some NC20s I have fixed.

A little later, Karl checked back in with an update: Turns out that Rod, NØRC, had the solution to my output purity problem. I soldered a 15 ohm resistor between collector and emitter on the PA transistor, connected an MFJ 259 to the antenna BNC, set the MFJ to 14.040 MHz and then rearranged the windings on L6 and L7 while watching for approximately 50 ohms on the MFJ 259. Initially, it was indicating about 85 ohms and I ended up with between 50 and 60.

I originally had the windings nice and evenly spaced, but the radio is much happier with them bunched together. I have the drive set for 4.6 watts at 14.000 MHz and 4.8 at 14.074 with a nice clean waveform at both ends.

NØRC had a final comment to be sure the source of the info was properly credited—I must give credit where due; the ideas I passed along came from Gary, AA7MY. I was just passing along what was given to me. It is definitely a slick trick. I've used it on K2s, K1s and other rigs with good success. Gary published the idea in his "Blue Printing the NC20" article in the Autumn 1999 issue of QRPp.

From WA8MCQ—Additional info on the NC20 can be found on the NorCal web site, at this URL:

http://www.fix.net/~jparker/norcal/nc20/nc20lead.htm

Varicap VFOs can be Stable

QRP-L isn't the only good source of info; GQRP-L has some gems as well. Someone indicated that they had made several VFOs with varicaps (tuning diodes), that the temperature coefficient of them was the most significant in the circuit and that it was impossible to compensate for it with fixed capacitors of various temperature coefficients.

Dave Fifield, AD6A, replied in defense of varicaps—I have to disagree with this. I, and hundreds of others, have built and continue to use regularly, VFOs based on varicap diode tuning elements that do not drift significantly.

It is entirely possible, using standard

components, to design a VFO that uses a varicap diode for its tuning element along with a toroid core inductor and a couple of other well chosen NPO/C0G and/or polystyrene capacitors as the rest of the tuned circuitry.

For a good example of this, take a look at the NorCal 20 rig. This uses a 5 MHz VFO with exactly this design. This VFO has been reproduced many hundreds of times and is perfectly acceptable for normal ham band use. The NC-20 rig uses an MV209 varicap, a T50-7 core inductor and a few NPO and polystyrene capacitors to achieve a very stable VFO. The temperature coefficients of these parts are chosen to cancel each other out. True, the VFO, like most, will have a slight warm up drift in the first 10 minutes or so, due to thermal equalization across the PCB and components, but most QRPers accept this limitation as part of the compromise of having simple yet effective circuitry.

I don't want to see experimenters discouraged—by all means use varicaps for tuning VFOs. They DO work and work well, as proven by the NorCal 40, NorCal 20, Elecraft K1, etc.

—de AD6A, dave@redhotradio.com

Protecting Buried Coaxial Cable

The subject of buried coax came up on QRP-L, and George "Danny" Gingell, K3TKS of Silver Spring, MD, had this to say about protecting it from the elements:

I used an old garden hose, buried about a foot or so, from the house out about 30 feet to the base of a 5BTV vertical. I used RG-58X if I recall correctly. The feeder outlived the antenna. I also had some RG-59 type "Twinax" LAN cable in it for another antenna at one time.

It is advisable to feed a length of common stranded house wire (#14) or a pull cord through the hose before burial. You can also use a cable "snake" to get the coax in the hose, but it is much easier before burial.

This is a perfect use for an old garden hose. Of course, you can always get coax that is designed to be buried from the Wireman, but that costs real money. My way is free or nearly so, depending on your resources.

The wire is used as a "drag line," a wire or pull string used to install wire in a pipe. Telephone cable installers and electricians generally use a "fish tape" (springy steel tape) to get a line into a pipe. After you fish the conduit, you tie on a drag line and pull it thru the conduit with the fish tape. Finally, you tie on the wire or cable and pull it through. Sometimes they add soap or conduit wire pulling lubricant to prevent damage to the insulation due to friction.

When there are several bends in the conduit, it can be particularly difficult to pull the wire through. This is where using the house wire as a drag line is an advantage since it is not likely to break.

I might add that it can be very difficult to get the fish tape through the hose once you have the initial coax in. Having that drag already in place is a lifesaver if you wish to add a second run of coax later.

It is also a good idea to ground both ends of the drag wire for lightning protection.

Chris Cartwright, N3XRV, followed up with this—While I've used a "fish" in conduit, the best method I've seen is to tie a loosely crumpled baggie or small rag to the pull twine, stuff it in one end of the conduit, then attach the shop vac to the other end. Just be ready for a possible gush of water if the conduit has been under ground for a while. Once the twine is in, pull your wire. Be sure to attach another piece of pull line for the next time.

I've used pull twine for all kinds of temporary antenna supports. If I remember right, it has about 150# break strength, and the 6000' bucket of it cost me about $25.

Homemade Sheet Metal Brake

Here's an old one! I was going to share this one from QRP-L several issues ago, but it slipped through the cracks somehow. This is from Steve "Melt Solder" Weber, KD1JV of Berlin, NH. Steve is well known on QRP-L for his technical postings as well as his long string of limited edition kits. He also has a web page with lots of QRP goodies; the URL is http://www.qsl.net/kd1jv/

From KD1JV—I've always wanted a sheet metal brake to make little custom metal boxes for projects, but never seemed to be able to justify going out and buying one. I finally got around to building a crude but effective brake from some stuff found at the local hardware store.

I bought a 3 foot length of 1" "weldable" steel angle iron, a pair of 1" hinges and some 10-24 x 3/4" nuts and bolts.

Cut the angle iron in half. Place the two pieces together to form a "T." Drill holes to attach the hinges at each end, on top of the "T." Drill the holes in the piece of angle iron which will pivot large enough to allow adjusting the spacing between the two pieces of angle iron for various thickness of material.

Now bolt one of the pieces of angle iron to the edge of a plywood board. You'll need a way to clamp the material to be bent, so, using a jig saw, I cut a slot behind the angle iron bolted to the plywood big enough to put a "C" clamp in. I went back to the hardware store and got a length of 1" x 1/8" flat steel to clamp over the material to be bent.

Eventually I should have someone weld a handle onto the angle iron, but for now, I'm using an 8" adjustable wrench for a handle.

I've bent a few pieces of thin steel and aluminum for practice and it works fine. I was able to do a decent 90 degree bend in 1/8" aluminum and 1/8" soft steel. I should now be able to make boxes like those used for the NC-20 and SST. The total investment was less than $10 and a few hours of time.

—de KD1JV

Broadband Noise Source

Leon Heller, G1HSM, is no stranger to the online QRP forums. He posted an announcement of a simple broadband noise source to his web site, and graciously allowed me to include it here. (I did redraw the schematic, Figure 3. His ugly construction version is shown in Figure 4.) If you want to check out his web page, you can see this and everything else at

http://www.geocities.com/leon_heller/

The web page also includes his PCB layout if one prefers to make one that way. Leon says this about the circuit—

A broadband noise source is useful for testing purposes. This circuit gave a reasonably flat output up to 30 MHz when checked with a general coverage receiver. The output impedance is about 50 ohms.

It's basically a zener diode used as a noise source with a broadband RF amplifier. I think the higher power zeners give more noise, which is why I used a 1W device. The zener voltage isn't critical, of course; use whatever you have around 6V.

The 4:1 transformer is 8 bifilar turns on

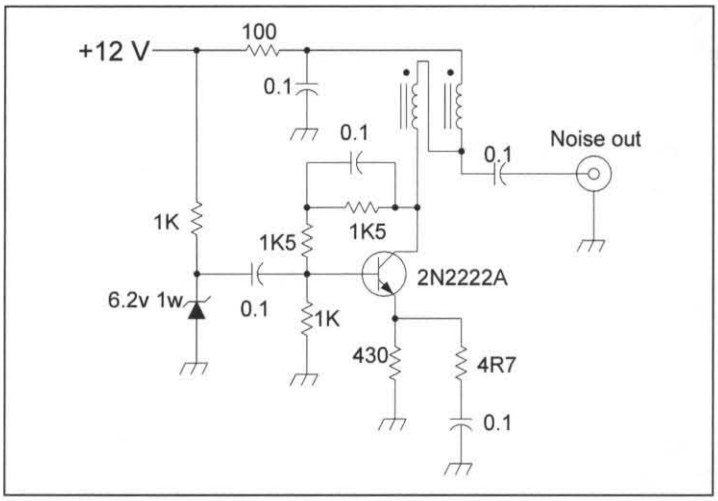

Figure 3—Schematic of the noise source. The transformer is 8 bifilar turns on an FT37-43.

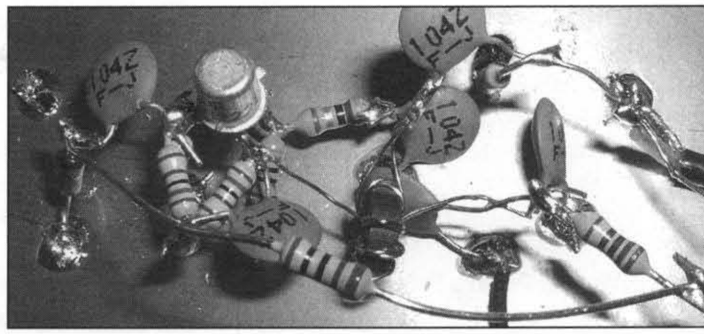

Figure 4—The noise source, built dead-bug style.

a Siemens/EPCOS B64290P37X33 ferrite toroid. An FT37-43 could be used.

—de G1HSM

Jackson Brothers Products are Back

In reply to a query on QRP-L about a source of small variable capacitors, Leon Heller, G1HSM mentioned that Jackson Brothers in the UK appears to be back in production, and their URL is

http://www.mainlinegroup.co.uk/jacksonbrothers/

Although they stopped making things several years back, they were fairly well known among QRPers at one time. In addition to making a number of small air variable caps, they were perhaps most well known for their reduction drives. (In fact, the HW-9 uses one on the VFO tuning capacitor.)

Dual Color LED in an SWR Indicator

Stan McIntosh, KD4BTH, had a QRP-L posting in which he mentioned a dual LED indicator he made for an SWR bridge. He later shared the schematic with me, which differed a bit from some of the description in the posting; the circuit of Figure 5 is my redrawing of the one he sent, and Figure 6 shows his unit. He admitted in his posting that "this was a late-night, from-the-junkbox effort." That puts it pretty much in the same category of a lot of things I've made myself! Here's what he had to say about it—

I've thrown together an LED tuning indicator that I'm really enjoying. The basic circuit is a Stockton-type directional coupler with a couple of transistor amplifiers capacitively coupled to the outputs. I biased the bases just to the point of conduction, and hooked the collectors up to the cathodes of a dual-color red/green LED. A resistor between V+ and the LED (not shown in his schematic) limits the maximum current available to the common anode, which should also help protect the transistors. A 180 mV p-p signal is needed from the coupler to just barely bring one of the LED elements on.

The basic idea of using the dual LED comes from how our eyes respond to color. For those of us fortunate enough to have color vision, we tend to see color shifts more readily than changes in strength. So, we are more sensitive to a green contamination of red (or vice versa) than we are to a comparable strength shift. For a transmitter tune-up, you just have to tune for the cleanest red or green.

Has anyone else been playing with these? Do we have blue/yellow dual LEDs available, yet? I would really like to try a

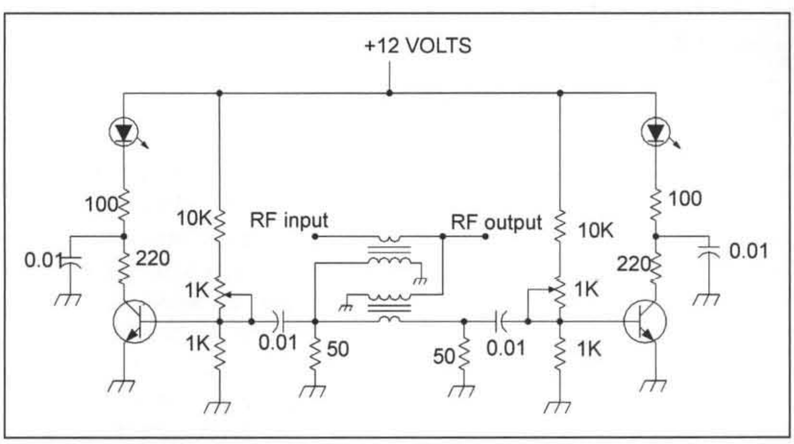

Figure 5—Although shown as two LEDs, they are actually in the same package, sharing a common anode. Transistors are 2N2222 or similar. The coupler is "the usual," such as 10 turns each on a pair of FT37-43 cores, with the secondary being a single piece of wire run through the center of each core.

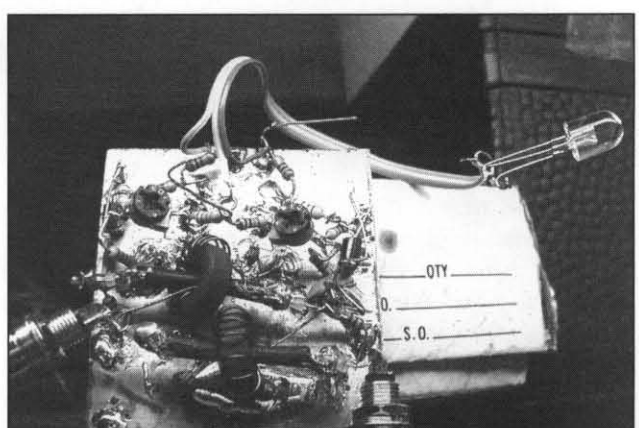

Figure 6—The LED SWR indicator built using "ugly construction."

unit with yellow as the forward and blue as the reflected power; only a hint of blue is needed to visibly green-shift a yellow (*which is why we use blue-tinted vehicles* at work to strength-check yellows).

—de KD4BTH
mcintosh@triad.rr.com

Dimple Washer Makes Spinner Knob

Although it might seem like it from reading this column, the QRP-L mail reflector is not the only source of good homebrew info! Although it's aimed mainly at owners of Elecraft radios such as the K1 and K2, the Elecraft reflector is very active and has a lot of technical discussions on it. One topic was tuning knobs. Stuart Rohre, K5KVH, had this suggestion on adding a dimple for fingertip tuning to this or any other knob. I've always known these as "finishing washers" and saw a zillion of them in my USAF career. I couldn't find one of the plastic ones he describes, although I did have one of the metal washers in my junk box. Figure 7 shows it, with a BNC adapter for reference.

Figure 7—One of the chrome trim washers. Epoxy one of the black nylon washers to the knob to make a dimple for fingertip spinning.

He says—Standard electronic six foot racks and network open frame racks for equipment have 10-32 tapped holes in the frame edges to secure the front panels of rack mounted equipment. All the big distributors carry these racks, (Newark, Allied, etc.) and carry the kits of 10-32 oval head and sloped sided bolts. To make these flush to a panel a cup washer is used, a dished out, bowl-like washer. These come in nylon, white or black, and to cover the nylon is a chrome trim washer. The dish shaped black nylon type makes a good finger spinner for a knob, when epoxied to the knob face.

—de K5KVH

Altoids Tins and an Elecraft Tool

Although he hasn't contributed too much recently, J. Frank Brumbaugh, W4LJD of Bradenton, FL, is certainly no stranger to long time readers of the Idea Exchange, both under his current call and the former KB4ZGC. Here are his latest inputs—

Is there no end to the utility of Altoids *tins? I have been keeping tools, including* my homebrew special wrench for my Elecraft K1 transceiver, fuses, extra cables, spare plugs, hardware, etc in a relatively small box. Pawing through this mess to find the tool, or worse, the tiny, almost *infinitesimal Phillips head screws was a* pain in the gluteus maximus. (Murphy hides at least one screw every time I open up the K1 or its matching power supply built into a blank K1 enclosure.)

The ubiquitous Altoids tins came to my rescue. I epoxied them together, one atop the other, stacked three high. One is labeled TOOLS, the second is for SPARES and the bottom one is for CABLES.

Abracadabra! My dilemma is no more. Now I can find just what I need when I need it. Even replacements for those miniscule screws which Murphy persists in hiding. I have, however, located most of those he hid by stepping on them in bare feet on the tile floor.

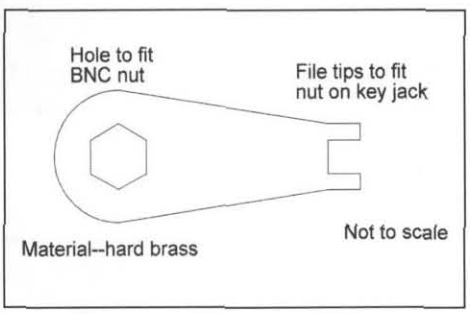

Figure 8—The W4LJD tool. His is about 2" long, but length is not critical.

Figure 8 shows a multipurpose tool I designed for my K1 which reduces the number of special tools, including large pliers or a Crescent wrench, needed for occasionally dismembering the rig for whatever purpose. However, I had no way to add a 000 or 0000 Phillips screwdriver tip to mine so I have to include one of those, which takes up unnecessary room. As a suggestion, a short piece of screwdriver tip could be brazed at the center of the large end of the tool.

The prongs to fit the key jack nut on the K1 have to be thinned from both flat sides with a file; the 1/16" material won't fit the slots in the nut.

Although I specify hard brass as the preferred material I didn't have any so I used fairly hard aluminum, part of a 3 piece clamshell box. The top was painted black and is harder than the gray painted bottom. I used a nibbler and a couple of files to dress up the rough edges.

So now my tool kit for the K1 is small and light without the Crescent wrench or pliers, although I'd still like to get rid of the Phillips screwdriver

I haven't seen the Elecraft K2, but feel this tool would also work well with it.

—de W4LJD

Computer Speakers for the Ham Shack

These things are everywhere nowadays, *inexpensive in the stores and dirt* cheap at hamfests and computer shows. Chuck Carpenter, W5USJ, had this suggestion on QRP-L—

Using a powered PC-type stereo speaker setup for my home station has worked out quite nicely. The speakers are Labtec from Wal-Mart—about 20 dollars. My PC uses a similar type for the sound card output. Any good quality powered stereo speakers should do the job.

They are connected to the headphone jack on the transceiver through a pair of stereo Y adapters. One side of the first Y adapter goes to the powered speakers. The second side goes to the second Y adapter. My headphones connect to one side of the second Y and the sound input to my station computer connects to the other side. This way I can have speakers and headphones and the PC input all connected at the same time.

Separation between the speakers gives a nice "stereo" effect. Listening quality is much better than with a single speaker in front of me. The speakers can be turned off for headphone-only use. And no additional adapters are needed to listen in on any of the various digital modes that MixW will decode.

A switch box wired with stereo jacks would provide even more flexibility. Stereo jacks would be used because you don't want to ground either side of the audio inputs/outputs from the transceiver or the speakers. (The two contacts of the stereo jack would be used for both sides of the speaker lines, allowing them to both be isolated from ground). Works great, less fatigue!

—de W5USJ

Cutting PCB Material Like Glass

When someone on QRP-L asked about cutting PCB material (copper clad fiberglass), John Kirby, N3AAZ, replied with this—

Treat the PC board like a sheet of glass. Cut it the same way, that is, break it. With a straight edge as a guide (I use a metal yard stick), score or scribe both sides of the board with a knife.

Use C clamps to hold the PC board between a stout straight edge and the edge of a workbench, with the board hanging over the edge. With the scribe marks in line with both the straight edge and edge of the workbench, break the PC board by pushing down against the bench edge.

This works for single and double clad board. It also works for both glass and Bakelite material.

The deeper the score, the better the break with PCB material. (Unlike a sheet of glass, you may score the PCB more than once. You only scribe glass one time, or else disaster will strike.)

A flat file will clean up the edges. On fiberglass PC board material, treat those filings like fiberglass insulating material. Keep away from eyes, wash hands, etc after use. (WA8MCQ note—my favorite method for smoothing up the edge of rough PCB material is to sand it down lightly, being careful of the dust, which contains fiberglass. My preferred way is doing it under running water when possible, which washes away the fiberglass poofle dust. It also makes the sanding paper last longer, presuming that it's the wet-sanding type).

—de N3AAZ

Micro Moments #3:
DDS Daughterboard VFO Useful for Many Projects

By George Heron, N2APB, email: n2apb@amsat.org

As any homebrewer worth his/her salt can tell you, the Direct Digital Synthesis (DDS) chip captures the imagination and excitement like no other technology these days. Signal precision, accuracy, stability, programmability and RF output quality are all easily and inexpensively within one's

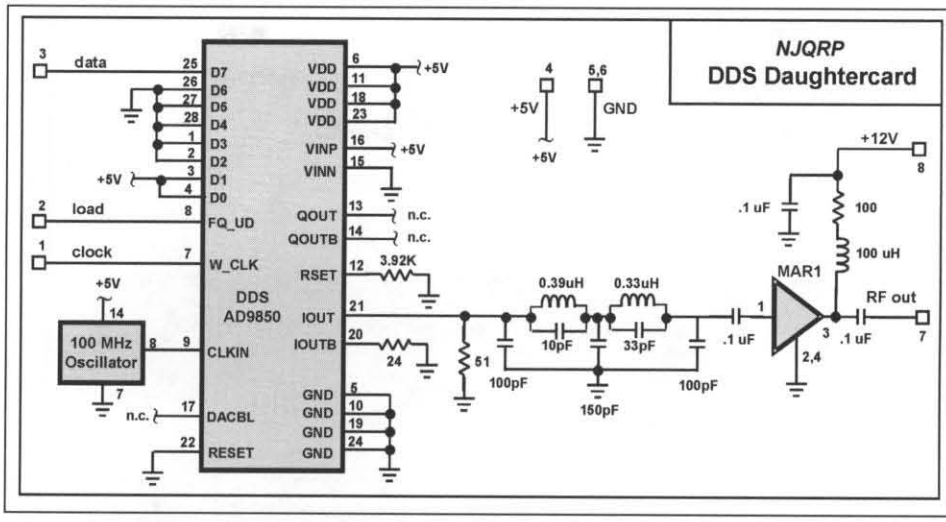

Figure 9—Schematic of the NJ QRP DDS Daughtercard.

grasp. But two quite formidable problems still remain.

The first is that these surface mount chips are so tiny, with lead pitches as fine a 0.65 mm, that it's nearly impossible to homebrew with them using conventional techniques. Have you ever tried tack soldering a fine wire onto one of these small SOIC package leads? Even soldering the chip onto a blank PC board that fans out the leads is going to take some precision soldering and a magnifying lens on your workshop lamp, and you end up with two layers of boards with this approach.

The second problem is that these DDS chips must be interfaced to a microcontroller of some sort for that frequency programmability. There are many projects around that control a DDS chip with a PIC, an Atmel controller, a BASIC Stamp, an SX chip, etc. I don't know about you, but the VFO I will ultimately need is likely to use a controller that I don't technically "know" and cannot program. This makes it tough to use the controller for anything but the DDS, thus raising the cost of the entire project, increasing the amount of board real estate needed and raising the power needs for the entire project.

Solution: We've created a small PC board containing just the bare DDS essentials—an Analog Devices AD9850 DDS chip, a 100 MHz clock oscillator, a 5th order elliptic filter and a MMIC RF amplifier to boost the raw 0.25 Vp-p DDS signal to a more usable 4-volt level. The three control lines, power supply inputs, and the output signal are available on a pin header at the board edge. The simple schematic is shown in Figure 9, and Figure 10 shows the board itself.

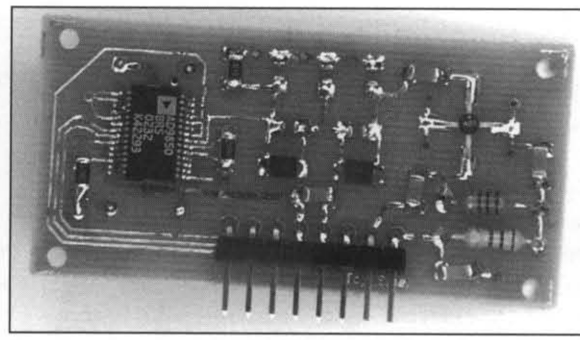

Figure 10--The Daughtercard in the flesh.

The 8-position pin header at the board edge serves to allow DDS Daughtercard to be plugged into whatever project you might have on your bench, regardless of which microcontroller is being used. Thus you are not locked into using an Atmel device if your preferred controller is a PIC. Just provide a single strip socket (e.g., a 16-pin IC socket split lengthwise) on the project board and plug in the DDS pc board. (See Figure 11.) Heck, you don't even need a microcontroller with this approach—just wire the pin header signals over to a cable on the parallel printer port of your PC and use public domain PC software to control the DDS board!

The controller's software just needs to send a 40-bit serial data stream on the DATA line with each bit being clocked by the CLK control line. At the end of the sequence, the LOAD line is toggled to

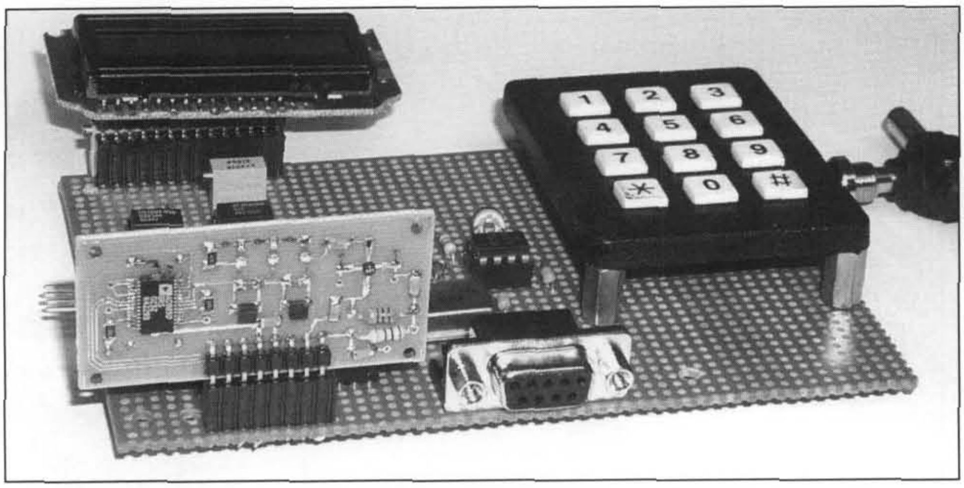

Figure 11—The DDS Daughtercard plugged into a controller with keypad and display module.

instruct the DDS chip to use the new frequency—then *bingo*, the new frequency appears on the output of the DDS board at pin 8.

The programming sequence can be easily accomplished. Joe Everhart, N2CX uses the three lines shown in Table 1 to instruct a BASIC Stamp to produce a 7.040 MHz signal with the DDS Daughtercard on the QuickieLab...

This simple DDS daughtercard project solves both of the problems cited at the beginning of this article, and enables the homebrewer to easily take advantage of the positive attributes of the DDS chip to produce a high quality homebrew variable signal source.

Note: A kit of parts for the DDS Daughtercard may be purchased for $25 from the NJQRP Club. The kit includes a silk screened/solder masked PC board and SMD components for caps and resistors, the oscillator can, pin header and MAR1 amplifier. The AD9850 DDS chip is *not* provided because homebrewers can obtain *two free samples* from the Analog Devices website at

http://products.analog.com/products/info.asp?product=AD9850.

Visit the NJQRP's DDS Kit website at www.njqrp.org/dds for further technical and ordering details, or contact Dave Porter, AA3UR at njqrp-kits@comcast.net. For those unable to assemble surface mount kits, there is an option to purchase the kit assembled and tested.

—de N2APB

```
shiftout 7,8,0,[$02,$BC,$05,$12,$00]   'shift out 40-bit value on port P7 using P8 as clock
out9 = 1                               'toggle the line
out9 = 0                               'going to the DDS load pin
```

Table 1—Three lines of code instruct a BASIC Stamp to program the AD9850.

QRP Online

Regular readers can probably quote this section from memory, since I've been ending the column with this for years now, and most of it is repeated verbatim each time. As I say every issue, there's been a huge amount of QRP info flying around the Internet for years, and it's still there!

QRP-L, which I call the "QRP Daily," is the online QRP discussion forum started in 1993 by QRP Hall of Fame member Chuck Adams, K7QO (K5FO at the time). It continues to run several dozen postings per day on a variety of topics related to QRP. (And, unfortunately, many not related in the least. Since it's an unmoderated list by choice, the noise level inevitably gets a bit high at times.)

QRP-F is an alternative QRP forum started by the QRP ARCI in October 1999 to take some of the load off QRP-L. The activity is much lower than on QRP-L, but so is the noise level.

The Elecraft reflector is dedicated to owners of those products but even non-owners may find it interesting.

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

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

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

Elecraft: http://mailman.qth.net/mailman/listinfo/Elecraft to subscribe; home page at http://www.elecraft.com/

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

The Fine Print

Have something you want to share with our readers? Write it long hand, type it, send a floppy disk, e-mail it, or even post it online somewhere on one of the QRP forums first and let me know about it. All you need to do is get it to Severn and I'll take care of editing, drawing, whatever. The readers await! ●●

LOOKING FOR QRP CONTEST INFORMATION?

K7TQ's "QRP Contests" column starts on page 60!

Coming Events:

Winter Fireside SSB Sprint
February 9, 2003

Spring QSO Party
April 12-13, 2003

Hoot Owl Sprint
May 25, 2003

Interview: Joe Spencer, President of QRP ARCI

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

This issue's interview is a little different than some we had in the past. Joe Spencer, KK5NA, lives and works in the city of Arlington, in the north central part of Texas. Like most of us, he operates as he can and builds when he has time, and although he's not a big-time designer/builder like Steve "Melt Solder" Weber, or an antenna guru, like James "Dr. Megacycle" Duffey, he does have a certain claim to fame.

Joe is mostly just a regular guy, a ham nine years who now holds an Extra class license. He works the bands when he has time, with whatever antennas he has up at the moment, and does a little contesting and a little fox hunting when time will permit.

What makes Joe sort of special is that he's the current president of QRP-ARCI, the club organization that puts out *QRP Quarterly*. Joe was elected president last December, and is also active in the NOR-TEX QRP club in the Greater Dallas/Fort Worth area. He is also a founder and member of the Radio Active Camping and Contesting Club, a QRP group in the DFW area. His wife Barbara is a ham (KK5QA), and together they attend many hamfests around the state of Texas representing QRP-ARCI and QRP in general.

Joe was born in Portsmouth, Ohio, on the 12th of November, 1949. Currently he resides in Arlington, Texas with his wife, Barbara, KK5QA, his son, Steve, and two grandchildren, Johnathan and Jessica.

He went to school in Columbus, Ohio, and attended college there where he obtained a degree in Electronics Engineering. He decided to expand on his EE degree and obtained further electronics training in the U.S. Navy where he served for twenty years as an Aviation Fire Control Technician working on airborne Radar, missile guidance and bomb directors, and computers. His hobbies besides amateur radio, include robotics and computers.

QQ: Joe, how long have you been operating at QRP power levels?

JS: I have worked QRP from the start. My First CW contact was QRP with W5TB (my Elmer)—he on a Heathkit HW-8 and I on a Heathkit HW-7 (I now own both radios).

QQ: At what level do you do most of your operating?

JS: I operate exclusively at the five-watt level and below. I've also operated Field Day QRP for the last five years with the RACC call sign, K5RAC.

QQ: Tell us about your current station. What equipment do you use, what modes do you operate, what antenna(s) do you use fixed (and/or portable), etc.

JS: I have an Elecraft K2 (#799), an ICOM 746, a Yaesu FT-100D, and a Kenwood TS-450. I operate almost exclusively with my K2 CW, at five watts or less. I have a multi-band dipole up about 35 feet, a Butternut six-band vertical and a Mosley T-33jr for fixed operations. For field operations, I use the Butternut or a simple wire antenna. To launch antennas I use the somewhat infamous KK5NA water bottle method.

QQ: What was your first station? Your first QRP station?

JS: My first station was a Yaesu FT-101. My first QRP station was the Heathkit HW-7 I mentioned earlier.

QQ: When you were first getting started in amateur radio, did you have an Elmer/Mentor? How valuable was the experience?

JS: Doc Drake W5TB was my real Elmer. He got me interested in QRP operation and he was the one who told me about the North Texas QRP club. It's members met on the other side of the Metroplex, and at that time, they had Chuck Adams as their central figure. They were a really great group of guys. This club has since grown and now meets at my house each month. We have a great time.

QQ: Did your interest in amateur radio have any influence on your choice of career paths, or did your career path lead you to amateur radio?

JS: I went to college and received a degree in Electronics Engineering after High School, then worked for Teletype Corporation in Skokie, Illinois, for a while before entering the Navy during Vietnam. Many times I thought about Amateur Radio, but I just never got into the hobby. After I retired from the Navy, I once again found myself interested in Amateur Radio and my wife and I started studying the regulations and code for licenses.

QQ: Do you do any specialized operating, like contesting, DXing, foxhunting, mobile or portable operating? Any specialized gear you use for it?

JS: We have another club—The Radio Active Camping and Contesting club. We do a lot of contests and some DX chasing. We camp out and operate, and many times for Field Day we camp and then operate during Field Day there.

QQ: Do you belong to any radio clubs or organizations? Are you active?

JS: I am a member of QRP-ARCI, NORTEX QRP, RACC, FISTS (I am the presentation manager for them), ARRL, NORCAL, MI QRP, ARS, NOGA Flying Pigs, RU QRP and a couple others.

QQ: One of the greatest things about amateur radio is that there are so many different areas in which to get involved.

What are your primary interests at the moment, and what areas of radio have you been involved with in the past?

JS: My primary interest is in operating QRP CW. I do like Satellite and DXing. I am also very interested in (and work toward) getting other hams on the air. Two radio clubs meet at my house monthly—The NORTEX QRP Club meets on the first Saturday of the month (normally,) and RACC meets on the third Monday (normally). I also enjoy being a VE (Volunteer Examiner) and have a team that works with

...continued next page

a local college and its electronic students.

QQ: What would you like to explore in the future?

JS: I'd like to find time to work on WAS and DXCC QRP.

QQ: Sometimes operating at low powers can be a real challenge. What advice would you give someone just getting started in low power (QRP) radio?

JS: Listen a lot, make sure you have the call of the person you are calling, and then try to make contact. Be patient, and try to remember you are doing this for fun. Practice copying code in your head while waiting your turn to get in.

QQ: Where do you see QRP/amateur radio going in the future?

JS: As I have often said, I fully believe QRP operation is the fastest and most exciting growing part of our hobby. It will continue to flourish, and hopefully its precepts will act as examples to the other areas of our hobby.

QQ: What about the QRP-ARCI? Where do you see it going in the future?

JS: I believe QRP-ARCI will continue to flourish and become more a more international club. We now have Dick (Dick Pascoe, GØBPS) onboard as our Vice-President, and he will probably move to the President position next term. QRP-ARCI is growing and offering more avenues of experience to hams worldwide, as our new *QRP Quarterly* on CD for Sight Impaired Hams demonstrates. There are several other ideas in the works that will benefit amateur radio. Stick around and have a look. I think you'll like what you see. ●●

SK Night—The *Real* Meaning

Carl Herbert—AA2JZ

Perhaps you're one of those hams who have been thinking all along that "SK Night" is an event happening in early January, and that it's an event where only "straight keys" are supposed to be used. Well, while there's nothing wrong with that idea, really, but that wasn't the REAL beginning of SK night!

Many years ago, when radio was in its infancy, SK Night was already evolving into an annual event—and it had nothing to do with January!

Do you remember as a kid, turning on the Philco in the living room on a cool October evening? Remember the crackles and pops coming from the speaker as the unit warmed up, the smell of the dust that littered the air as the tubes heated up? The static crashes, and weird screeches, that made "goose bumps" rise on your skin?

Yep, sure sounds like signs of SK Night to me.

Let me explain. This hobby, which is often the career of many of our members, is in fact an infectious calamity that forever permeates the body and soul of all who pursue it. Radiation infection has long been known to cause damage to body cells, but what the researchers seem to have missed is that the effects remain long after the hobbyist becomes SK (silent key). Hence, the REAL beginning of SK Night!

Even today the lingering effects of this irreversible damage can be witnessed on many bands during the fall and winter periods, and it seems to be most notably centered on October 30th. The "howls and shrieks" from receivers today are actually the noise generated by our predecessors "tuning" their "rigs" in preparation of SK Night. What we call "static" crashes are really "spark gap" Morse being generated by some ancient operator. Just listen closely to the trees around your shack—it's the wind carrying the "over modulation" of those SK hams still choosing to work AM. The wind is in reality saying "CQOOOOOOOOO, CQOOOOOOOO."

October 30th was scheduled as the first SK Night, long before my time, so I can't really say when the first one was actually held. There are, however, some clues to substantiate these phenomena:

Earth or *Ground*—Used on schematics. A direct path to the originating members of the hobby.

Ghosts, or *Image* frequency—you guessed it! These came direct from the old timers.

Lost parts—Just because you can't find them doesn't mean that they're lost, they've just been "repositioned" or borrowed. I suspect that they were much needed for repairs to ancient equipment, and because you have access too much more, they were "borrowed" by the SK crowd.

Key Clicks—Not really a design problem, but just an SK ham trying his "fist" at the same time you are, slightly out of "sync" with you.

Dead Band—Frequencies allocated to SK operators for practice sessions and club meetings.

SHF and *VLF*—Super High Frequency, where I assume we would all like to reside at some time in the future, although some of us stand a very good chance of being assigned to the Very Low Frequency portion for at least a portion of eternity.

LID—Not an improper operator as used today, but a word derived from long ago, describing the entry portal of SK amateurs QTH.

Worm Drive—An SK homebrew amateur using whatever is at hand to complete the project.

Spaghetti—The hollow insulator slipped over bare wire to protect it from shorting was actually invented by Marconi, I'm told. The original "thin" pasta was a success, but the larger specimens were a failure. To avoid embarrassment and retain the good name of the inventor, shorter sections of the device were created and named after the inventor (but due to a spelling error will always be known as "Macaroni").

K SK—Operator practices have suggested that we use K SK, following our final transmission for the evening. I assume that this is a "salute" or wave of the hand to prior earthly amateurs to show proper respect.

Nighttime activity—Why is it that communications seem to be so much better at night? Is it because the previous operators have slept the day away and are now out there communicating? Are all of those stations real? Or are some of them "SK"?

And there you have it! I rest my case. SK Night, as used today to describe a fun filled evening of hand generated Morse code began as something entirely different.

You do believe me, don't you? ●●

Ramblings of a Displaced Cajun Lad in Maine

Joel Denison—KE1LA hamjoel@juno.com

High Y'all. U kneaux, it be cold up heah now...gots sneaux on the ground and averywhare...bout 20 deg F...so it's antenna raising time...and I'm in my yard with my rod and reel tying a small rock to the end of the string...most folks use a rubber casting plug, I highly recommend them now...

Anyhow, ah chunks the line up in this tree and it goes ovah the wrong branch so ah reels in the line and whan it gots about a foot or so below the branch ah jerk on the line like what ah got a big fish on the otherend well, the rock shoots up, hits the branch, and comes right at me...

I tell U, Man, ah watched that rock as it hit on the tip of my nose...hurt like a bunble bee..

Ah went inside the house to have my cajun mama check it out, and while she looking my eyes done crossed and mah head done gone to hurting and I done hyperventelated and couldn't got no air...Having a bad heart history, ah soon found meself in de ambulance and the attendant saying, U kneaux, ah ban doing this a long, long, time, and I ain't never seen a case like U Joel...

Ah said thanks that makes me feel meaux better...

At the hospital the doctor, him, he check me over and wonder 'bout how the eyes done crossed, so I 'splained it to him....

He had me close my eyes and one at a time he put a bright light on each eyelid and had that eye follow it to the opposite side...then he crazy-glued it in place...

U evah try looking both directions at once? Talk about make a headache worse... Anyhow in a little bit he unglued the eyes and they come back straight...what a relief...de headache done gone...ah gots my breath back, and de blood checks come back good...so they throws me out the hospital...

Back home, ah gots my rod and reel and took some 'lectrical tape to wrap around the rock to cushion it a bit should we meet again...

Ah went out into the yard and spotted a good branch and chunked that rock right where it shoulda gone in the first place... cut the rock off and tied the string to my rope and reeled the rope through the tree and attached my antenna...

'Bout this time my neighbor come over wearing his sneaux shoes and carrying a piece of paper...He say, Joel, according to my property, maybe U bees a foot on my side the line so ah thinks U oughta move ur line ovah a bit....

Aw, Pierre, I say...look at that rope it be about a foot on my side...

Nope, said Pierre...

Tell U what we do Pierre....find ur property markers and stretch out a line between them and ah gonna get them tree people to come hold a plumb bob from the tree branch whare the rope is and let's what the plumb bob say...

If U willing to pay for the truck I'm willing to agree to what the plumb bob say...

So ah went back into the house and called one of them tree services and they say they gonna have a bucket truck in my yard in a coupla hours....

Ah told Pierre... He said he would wait up at his house and left...

In the meantime, ah made up a 'lectric magnet, buried it in the sneaux 'bout two foots on my side of the property line and buried the wire in the sneaux 'bout half way back to mah barn whare I hooked it up to a dc power supply and started running about a half amp of current through the thing...

Soon enough, the truck done come, and Pierre done brought down his good steel plumb bob and some new string...

De tree man raised hisself up into the tree and placed the string on the rope and slowly let the plumb bob come down to the ground...straight at dat string Pierre done placed on the ground...

Then, 'bout five foots off the ground, the bob starts moving out towards my magnet...

We had that fella do that three times, and eachtime that plumb bob say ah was two foots inside mah property line... Pierre him, he felt bad 'bout all this and offered to pay for the tree service...but ah told him not to worry as this was between friends and no problem...

So he shook hands and walked back home.

That bucket man come down from the tree and he shook his head, U kneaux he said, it sure looked like that rope was on his property....

Really I say, as ah reach down and pull up the 'lectric magnet...

Oh boy, did he grin...then he got to laughing and almost never got his self outta my drive way...

Meanwhile Pierre him, he saw me pull this thing outta the ground and wanted to kneaux what it was...

So ah told him it was a magnetic field enhancer for the ground around mah antenna...and proceeded to bury it on the opposite side of my yard...

Whatcha doing that for? asked Pierre... Well, ah said...iffin ah can got the ground currents balanced out, it gonna make my antenna work lots better....

Bull, said Pierre...

So ah told him to come back 'bout eleven the next morning...that ah wanted to enhance the ground over night at 1/4 amp and then see what gone happen...

Sure 'nuf, 'leven clock come round and Pierre was right thair sittin next to me working slow scan and he could see how the signals was up and down...

Knowing the band was about to change and geaux short, I told Pierre it's time to geaux put that ground enhancer in another spot and see what happen...

So Pierre and me, we gone outside and move that 'lectric magnet, "ground plane enhancer" to another spot and ah told him I would try 3/4 amp enhansing to start with...

Me and Pierre gone back to the radio, and sheaux nuff the S-2 stations was now S-9, and ah started jumping up and down celebrating and Pierre, him, he asked for a drink of "cajun brew" and he went himself home a happy man and a good neighbor...

Y'all be good now

—ke1la, joel in maine

74HC4053 Mixer Circuit and Receiver

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In the June 2002 issue of ARS's (Adventure Radio Society's) monthly on-line magazine (www.natworld.com/ars), Steve Kavanagh, VE3SMA, published a very interesting rig called the "Spartan Sprint Special." Steve's design used many CMOS logic parts in a unique way. The part of the rig that struck my interest was his use of a 74HC4053 analog multiplexer switch as a mixer. This mixer is based on the 4066 circuit, the use of which as a mixer has been illustrated in various Ham publications over the years. Steve's use of the 'HC4053 simplifies the basic 4066 design, as the 'HC4053 is internally configured as three single pole, double throw switches. This eliminates the need for an external inverter to toggle between switches and reduces the number of external connections needed.

Steve configured his mixer as a single-ended output type and used it as the product detector in a direct conversion receiver. After playing with the circuit a bit, I discovered that the chip worked much better configured as a doubly balanced mixer.

Figure 1 shows the basic mixer circuit. R1 and R2 bias the switch gates to 1/2 the supply voltage, which gives the mixer the best dynamic range. The input transformer, T1, can be a trifilar wound toriod, or it can be wound on a small binocular core. Using a binocular core allows for making a turns ratio different than 1:1. This allows making a step-up transformer for some passive gain. Similarly, the output transformer, T2, can be either a bifilar wound toriod, or wound on a binocular core for a turns ratio different than 1:1. When the circuit is used as a product detector, T2 can be replaced by a resistor and the outputs from pins 14 and 15 differently capacitor coupled to an op-amp to sum the signals (as in Figure 3). If an output transformer is used in this application, it must be an audio type (in my first prototype receiver, I used a small 600-ohm transformer pulled from an old modem board and it worked well). Also, when used as a product detector, 1000 pF caps should be added from pins 14 and 15 of the 'HC4053 to ground to by-pass the RF mixing products.

Figure 2 shows the internal connections of the 'HC4053 switch. The mixer simply works by reversing the connections of the input transformer to the output transformer, at the local oscillator frequency. This is exactly how a double balanced diode mixer works. Note that for proper switching, the LO signal must be a square wave.

Figure 3 shows the schematic of a test receiver for 40 meters that I built using 'HC4053s for the first RF mixer and the product detector. I used my "utility" DDS VFO as the LO, so a VFO is not shown. U7a is used to convert the sine wave from the VFO to a square wave for the mixer LO input.

Since some of the LO switching frequency is transferred to the input of the mixer, using an RF preamp for isolation is recommended. I used a grounded base 2N3866. To save some current, the bias current is set to about 5 mA. For good dynamic range, this should probably be set to 10-20 mA. But stability might become an issue, as the output of the amplifier is lightly loaded. A 220 or 470 ohm resistor could be placed across the secondary T3 to provide some loading on the preamp output. If high dynamic range really isn't much concern, a more common 2N2222A could be substituted for the 2N3866, but this might need some adjustment of the biasing (adjust the value of R3).

I used balun cores for the first mixer's input and output transformers. You could substitute trifilar and bifilar wound toriods for these.

A cascode amplifier is used for the IF amp. Reducing the value of R10 will give the amplifier more gain, but decreases the stability of the amplifier. AGC might be added by putting a transistor on the R10-R9 junction of the IF amp and shunting some bias current to ground. The receiver turned out to be a little "deaf," so some additional IF amplification could be used. Using an IF amp like the MC1350P, instead of the cascode amp shown, would probably do the trick.

The outputs of the 'HC4053 used for the product detector are summed and amplified by an op-amp stage, which then drives an LM386 audio amp. Adding a low-pass filter stage or two to reduce hiss, and/or an audio band-pass filter to improve selectivity would be a good idea. Such "enhancements" were left out of this design, as it was simply a test circuit to check out the use 74HC4053s as mixers.

A sidetone oscillator could be made from the extra inverters, currently unused. The inhibit line of the 'HC4053 (pin 6) could be used to turn off the mixer for muting. Or you could run the audio output from the preamp through the unused transmission switch in one of the 'HC4053's.

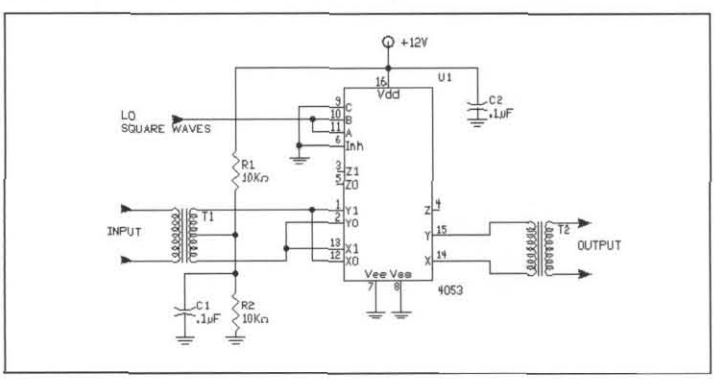

Figure 1—Basic 4053 mixer circuit.

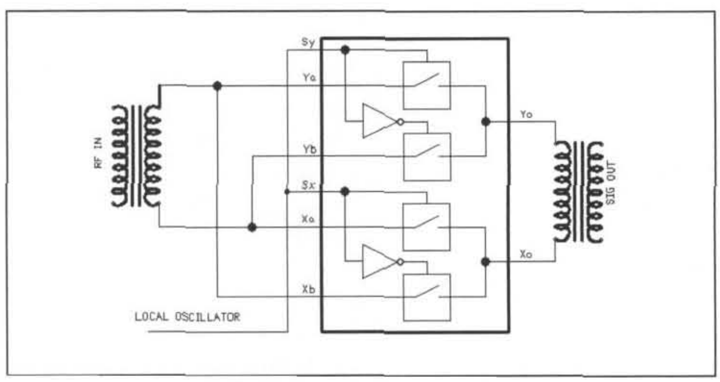

Figure 2—Intenal circuitry of the 4053 mixer.

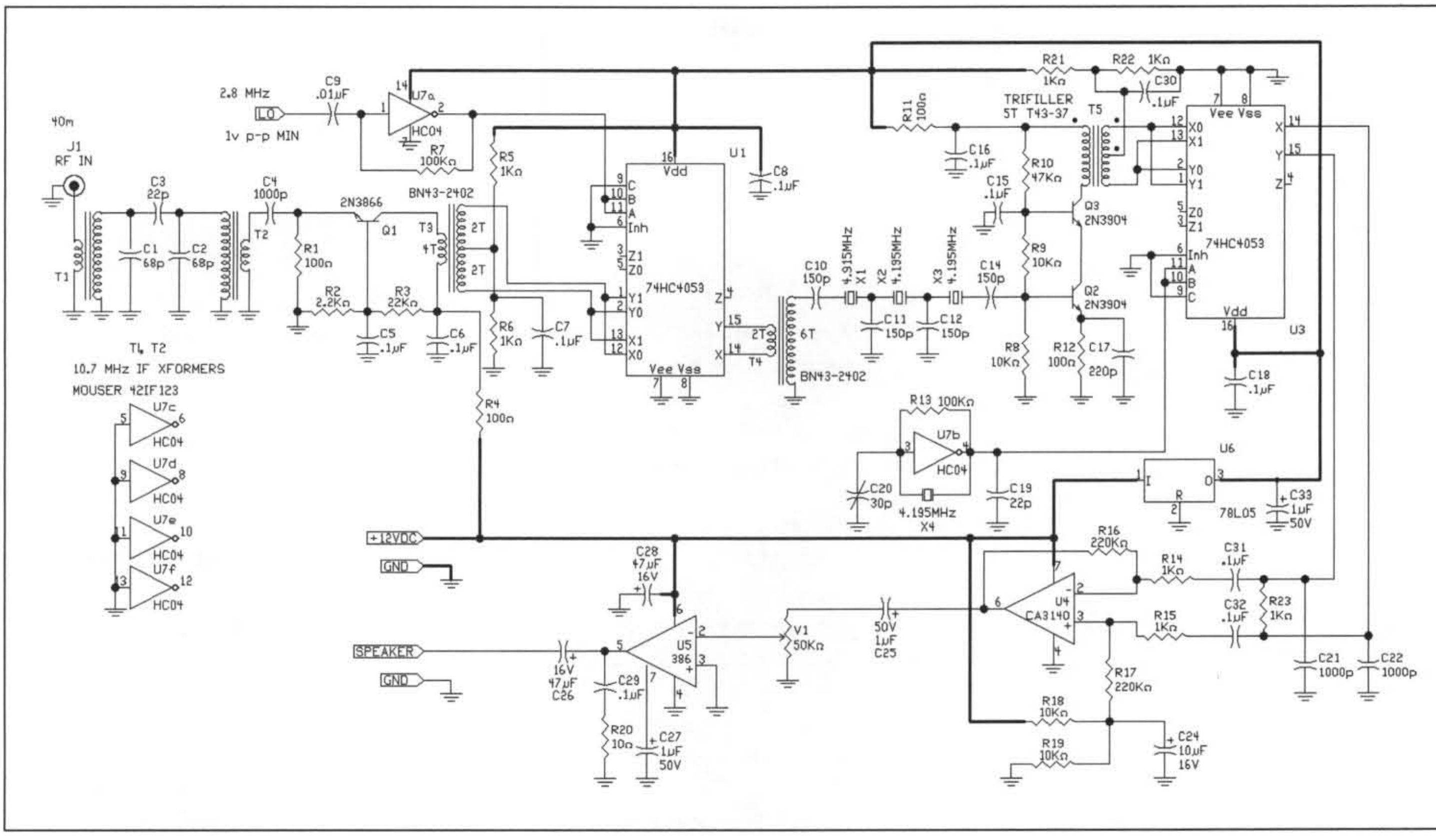

Figure 3—40-meter demonstration receiver using 4053s as the first mixer and product detector.

Correction

Oops! In the October 2002 issue, we somehow left out Figure 10 in N2PK's excellent article, "An HF In-line Return Loss and Power Meter." With apologies to Paul, the figure is included below.

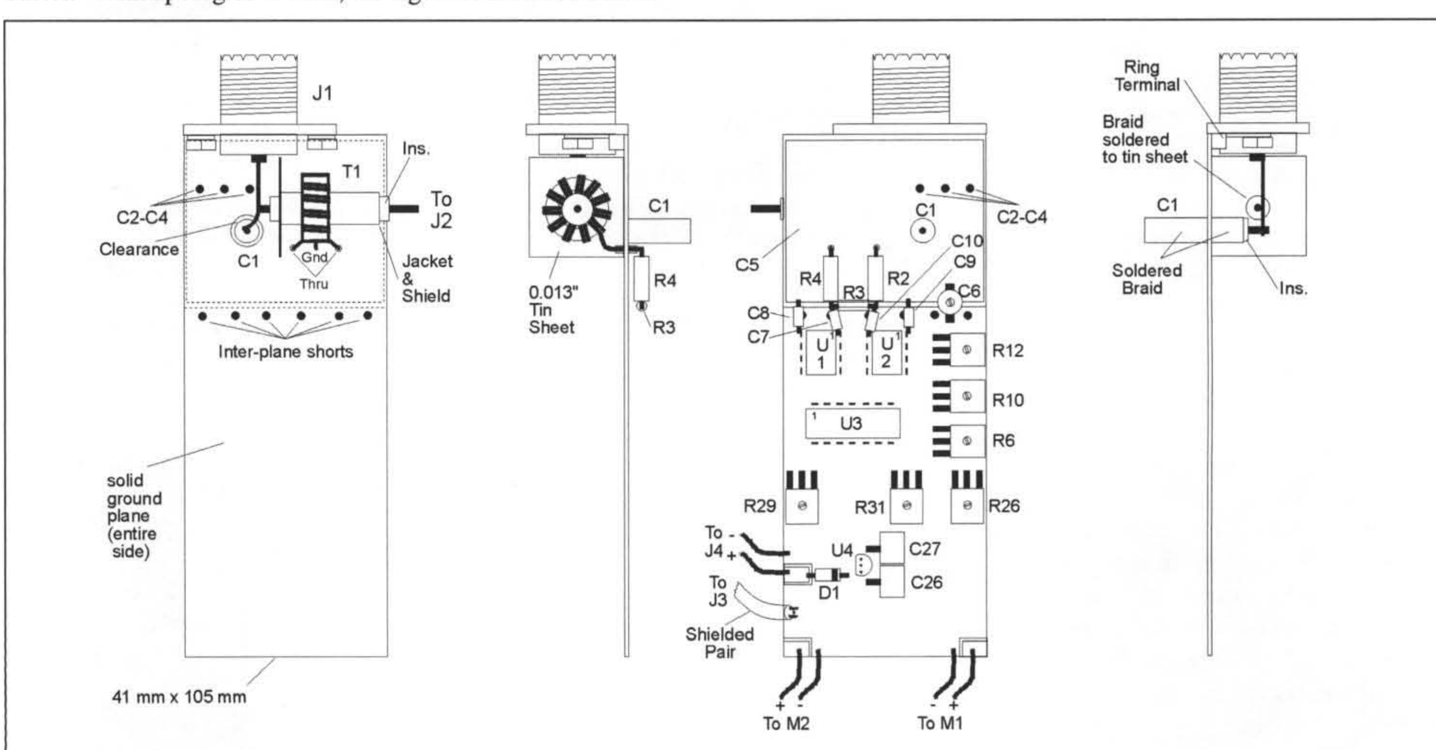

Figure 10—Pictorial diagram of the return loss and power meter.

More Mods for the Index Labs QRP-PLUS

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A few years back I wrote a series of articles for the *QRP Quarterly* describing modifications that I had made to my Index Labs QRP-PLUS [1-5]. These articles are available for viewing on the ARCI WEB site [6]. In between traveling, building an Elecraft K2 and editing articles for the *QRP Quarterly*, I have continued to fiddle with and tweak my little QRP+ — and yes, I've even used in on the air from time to time! In the process, I made some additional modifications that may be of interest to others:

- Stabilization of the transmitter pre-driver.
- Improved SSB ALC.
- Replacement of the MOSFET final amplifier with a bipolar amplifier.

The first two are applicable only to the "original" version of the QRP+, not the later "new improved" version. The third one can be applied to either version.

Pre-driver Changes

These changes are the result of much experimenting and provide improved stability, better looking two-tone SSB waveforms and the elimination of some minor transmitter spurs. These changes are not applicable to the "new improved" version of the QRP+ which uses a different pre-driver circuit. These changes are made to the RF board (the top one in the stack).

1) Change R38 in the emitter of Q10 (2N5109) from 75 ohms to 47 ohms. This change was recommended by Stan Yarema, K7SY [7].

2) Change C19 in the emitter of Q9 (2N5179) from 0.1 µF to 0.022 µF.

3) Change R45 from 510 ohms to 390 ohms.

4) Change C18 from 0.1 µF to a 1.0 µF or 2.2 µF tantalum.

5) Break the +T line between Q9 and Q10 along the edge of the board between R44 and C18. Slip an F43-101 bead over a short piece of wire and use it to make a jumper across the break in the +T line. (This eliminates feedback between Q9 and Q10 via the +T line.)

6) Tack-solder 0.1 µF caps on the bottom of the board between the +T end of L4 and the ground plane and the +T end of L5 and the ground plane. I used surface mount caps, but small monolithic caps can also be used.

7) Change C35 from 0.1 µF to 0.001 µF (Q2-Q3 emitter bypass).

After these changes were make, the 56 pF cap that I had previously added from the collector of Q10 to ground to reduce transmitter spurs [2] was no longer required.

Improved SSB ALC

I had been aware of a slight "raspyness" in the transmitted SSB signal at power levels above about 2W. (This can be seen on an oscilloscope as a small amplitude modulation of the transmitted waveform when a single-tone is feed into the microphone input.) I had attributed this to some sort of RF feedback—possibly into the mic preamp—but I was never able to find the cause. However, when this was still present during tests of a new PA mounted external to the QRP+ and operated from a separate lead to the power supply, I decided that perhaps it originated in the ALC circuit. Sure enough—increasing the "hold time" of the RF detector used to control the variable gain amp before the SSB mixer fixed the problem! While I was at it, I added a small trimpot to set the SSB power level.

The revised RF detector circuit (comprised of D8 and associated components on the XMIT board) is shown in Figure 1. I replaced C38 with a 100 µF electrolytic and R17 with a 1N5711 Shottky diode to provide a low impedance charging path for the capacitor. The 100 µF cap leads were bent so that the body lay parallel to the board. R15 was replaced by a 150 ohm fixed resistor in series with a 500 ohm trimpot. (These components are not visible in Figure 3 because I forgot to make this mod to that board before taking the photo!) I mounted the trimpot so that it is accessible from the side with the cover removed; keep in mind that RF is present across these resistors so keep leads short. Another option might be to mount the trimpot on the bottom of the board and access it via a hole in the bottom of the case.

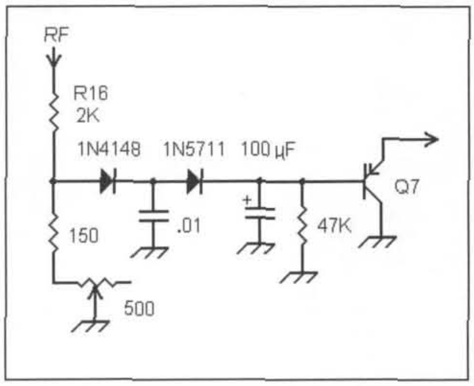

Figure 1—Modified ALC RF Detector (on XMIT board).

The trimpot is used to set the maximum SSB output power. When making this adjustment, you should observe the SSB signal on a 'scope (preferably with a two-tone signal fed into the mike input) to make sure that the PA is not being overdriven thereby causing distortion. Note that this mod applies only to the "original" QRP+ version. The "new improved" version uses a different ALC scheme and both the CW and SSB power levels are set by the "Power Level" control on the rear panel. (The "new improved" version does not have a mic gain control.)

New Transmitter PA:
The "Final Solution"

In its stock configuration, my QRP+ was not capable of producing more than about 3W of undistorted SSB output (less on 10-12M). I replaced the stock IRF510 MOSFET final amplifier with a Motorola MTP3055E Power MOSFET [2,3]. With that mod, I was able to get relatively clean 7W of SSB output on the low bands and 5W on 10M. However, the MTP3055 idling current was quite temperature dependent, which prompted an additional mod [5]. The MTP3055 amp still has some shortcomings that are also present in the original IRF510 amp: the linearity degrades when the supply voltage drops below about 13V [8] and the efficiency is poor.

I should mention that some people have not been able to duplicate my results with the MTP3055 final; apparently not all

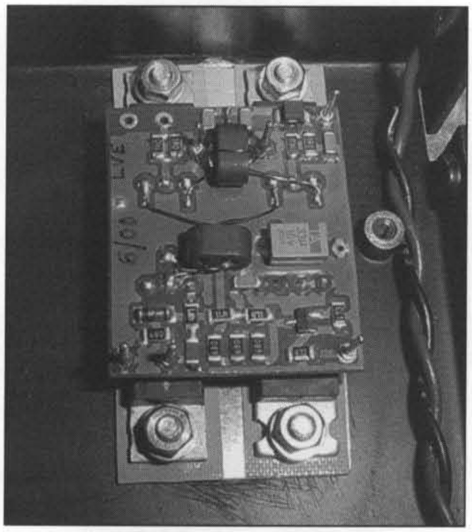

Figure 2—DL-QRP-PA mounted in the bottom rear right-hand corner of the QRP-PLUS case. (See text for an alternate mounting location that does not require XMIT board alteration.)

MTP3055s are created equal! To compound the problem, Motorola quit producing the "E" version and the newer "V" version does not appear to have the same RF characteristics.

A few years back, the German QRP club made available a compact 5-10W linear amplifier "semi-kit," called the DL-QRP-PA [9]. The kit was designed by Helmut Seifert, DL2AVH. It uses surface mounted capacitors and resistors that are pre-mounted on the PC board—all the builder has to do is wind a couple of small transformers and mount the power transistors and a capacitor. The amplifier includes a driver transistor, has about 37 dB of gain, and exhibits very flat response from 2 to 30 MHz. The PC board is only 1-3/8 x 1-3/16 in. The mounting tabs of four TO220 transistors extend a little beyond the board, for an overall length of about 2 in.

I purchased a DL-QRP-PA kit in the spring of 2000 with the idea of possibly using it in my QRP+ in place of the MOSFET PA. The completed QRP-PA will just fit on the inside of the QRP+ rear panel between the RF output connector and the fuse holder. Unfortunately, I was already using this space for a "tune" switch and a rear panel external speaker jack. I was also a bit concerned about possible RF feedback to low-level circuits on the RF board if the PA was located so close to it. That apparently is not a problem as Peter Zenker, DL2FI, has successfully mounted

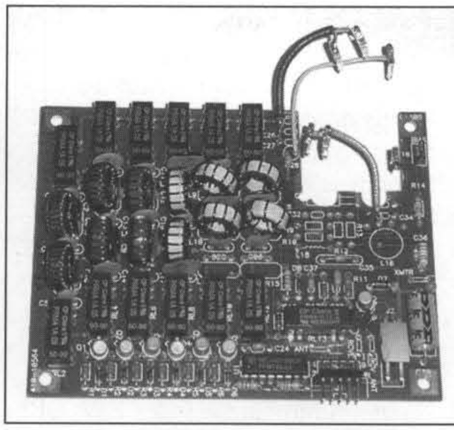

Figure 3—QRP-PLUS XMIT board altered to fit over the DL-QRP-PA.

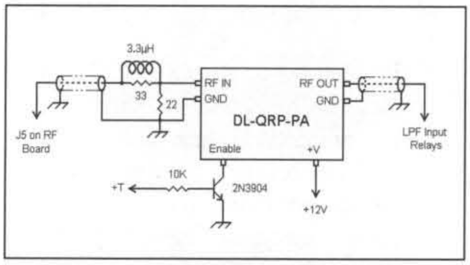

Figure 4—DL-QRP-PA to QRP-PLUS interconnections.

the PA in this location in several QRP+ units. So this is the way to go if you want to try this PA and don't want to make the rather drastic physical changes to the XMIT board described below.

I decided that the "proper" place for the new PA was close to the LP filters on the XMIT board. But there was no place to mount it without doing some major surgery to the XMIT board—like cutting a chunk of it out to fit over the PA mounted on the bottom of the QRP+ case. Well, after procrastinating for a couple of years, that is exactly what I did! I did not have to destroy my working XMIT board with all of its modifications, including the MTP3055E final, as I was able to acquire a "spare" XMIT board. It turned out that this "spare" had been subjected to reverse polarity, and about the only items on it that were still usable were the relays and low pass filters! Yes, there is a reverse connected diode—a 1N4001—on the +12V line on the XMIT board, but the fuse ahead of it is rated at 3A. One guess as to which blows first when polarity is reversed?—The 1A diode or the 3A fuse?! [1]

The PA board is mounted via the tabs on four TO220 transistors (two 2SC1971s used in the final on one end of the board, a 2SC1970 driver and a BD242 power transistor used for bias stabilization on the opposite end). I mounted the PA board on the bottom of the QRP+ case in the rear right-hand corner (see Figure 2). I inserted a thin sheet of aluminum under the PA transistor mounting tabs and epoxied it to the bottom of the case for better heat transfer. Figure 3 shows the modified XMIT board. All components (except the LP filters, relays, relay switching transistors and U1 [10]) associated with the final and driver stages were removed and a section cut from the board to fit over the new PA board.

Connecting the new PA to the QRP+ is quite simple as shown in Figure 4. The 33 and 22 ohm resistors comprise an attenuator to help prevent overdriving the new PA and provide a low impedance load to the pre-driver (Q10) on the RF board. The inductor across the 33 ohm resistor compensates for the reduced output of the pre-driver on 160M and may not be required in all cases. The input attenuator and switching transistor for the PA "Enable" input are mounted in spaces vacated by other components on the XMIT board. Short jumpers provide connections between the XMIT and PA boards (see Figure 3).

With a supply voltage of 13.6V, my new PA is linear to 7-8W output on the low bands and to about 6W on 10M. I set the trimpot in my modified RF detector (see Figure 1) to give 5W PEP SSB output.

The results? Outstanding! The efficiency and linearity of this little amp are definitely better than obtained with either the original IRF510 PA or my MTP3055 PA. An additional benefit is improved second harmonic suppression due to the push-pull configuration of the new PA. With the stock QRP+ output filters, all harmonics are down by more than 40 dB—definitely not the case with the single-ended MOSFET PA [2]. All out-of-band transmitter "spurs" are reduced by a few dB compared to my MOSFET PA; I attribute this to better linearity of the new PA. The spectrum analyzer that I am now using does not have sufficient resolution to see the 12M close-in spurs, but indirect measurements using a calibrated signal generator and my K2 receiver indicate that they are also down by a few dB.

This little PA can, of course, be used

with any version of the QRP+. If used with the "new improved" version, be careful not to overdrive the little amp on SSB. You should initially check the SSB waveform on a 'scope to determine the point at which compression ("peak flattening") sets in and always operate below that power level. You can most easily monitor the SSB output power using a "QRP capable" peak-reading wattmeter [11].

If you are considering replacing the MOSFET PA with a DL-QRP-PA, I suggest that you take the easy way out and mount the PA board on the inside rear panel of the QRP+ between the antenna connector and fuse holder. In this case, the only components that need to be removed from the XMIT board are the driver and final transistors and the output coupling caps, C25-C26. The PA input attenuator resistors can be installed on the RF board between the pre-driver output (Q10) and J5, and a shielded jumper connected directly from J5 to the PA RF input. Connect the PA output directly to the LPF input relay bank on the XMIT board (a blocking cap is not required) using RG-175 or similar shielded cable. The "Enable" input on the PA can be connected directly to the "+R" line on the RF board rather than from the "+T" line via a transistor switch. Power for the PA should be obtained from the +12V bus on XMIT board to minimize voltage drop and the possibility of RF feedback.

Notes and References

1. "Modifications and Enhancements for the QRP-PLUS Transceiver (Part 1—Receiver Modifications)," *QRP Quarterly*, January 1997, page 37.
2. "Modifications and Enhancements for the QRP-PLUS Transceiver (Part 2—Transmitter Modifications)," *QRP Quarterly*, April 1997, page 32.
3. "QRP-PLUS Modifications—Notes and Corrections," *QRP Quarterly*, July 1997, page 29.
4. "Fixing 'Chirp' in the Index Labs QRP-PLUS," *QRP Quarterly*, Idea Exchange column, October 1997.
5. "Temperature Stabilization for the W1HUE QRP-PLUS Final Amplifier Mod," *QRP Quarterly*, July 1999, page. 13.
6. A list of links to the QRP-PLUS mod articles can be found at: http://www.qrparci.org/east/east.htm and you will see 7. I just recently learned that Stan, K7SY, has become a Silent Key. Before he passed away, he made QRP-PLUS repairs and had his own set of modifications, including a backlit display. In addition to the 2N5109 emitter resistor change, he recommended the following changes to the driver stage (Q8) on the XMITR board: 1) Change the feedback resistor, R9, to 100 ohms (from 470 ohms) and move the end of C32 connected to the collector of Q8 to the tap on L15. 2) Change the link on L16 from 1-turn to 2-turns. These changes lower the output impedance of the driver to better match the input of the IRF-510 (or in my case, an MTP3055E—see Reference 2). I made these changes in my QRP+ before I completely replaced Q8 and Q9 with a DL-QRP-PA kit.
8. This appears to be a general problem when attempting to use power MOSFETs as linear RF amplifiers; linearity and dynamic range are much better if they are operated at 24V or above.
9. The DL-QRP-PA kit has been available for the past few years from "FUNKAMATEUR Leserservice" in Berlin, Germany (on the web at www.funkamateur.de). I understand that beginning in the fall of 2002 it will be available from "QRP Homebrew International" on-line at www.qrpproject.de. For further information, contact DL2FI@qrpproject.de.
10. I had to replace U1 because it had been damaged by the reverse voltage incident. If you modify a damaged XMIT board, make sure U1 is OK (if in doubt, replace it).
11. I published a "peak reading" modification for OHR WM-1/WM-2 Wattmeters in the *QRP Quarterly* several years ago and the article is available on the ARCI web site (see 6 above). An article by G3ROO on modifying wattmeters in general to read "PEP" appeared in the July 2002 *QRP Quarterly* (page 37).

Digital QRP Homebrewing

George Heron—N2APB

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The Digital QRP Breadboard has been evolving throughout five issues and 15 months. During that time, many good questions have been asked by readers wishing to better understand and use the project. In this installment we'll address these "frequently asked questions" and shed a little more light on this very cool and flexible accessory for the shack. Then, our "second theme" for this column picks up with the third part of the PIC WX project—the PIC-based APRS Weather Station. Designer NKØE starts adding some real weather measuring horsepower to his PIC design and you'll see how temperature and humidity readings can be easily brought into the system. Enjoy the column!

—73, George N2APB

The Digital QRP Breadboard...Part 6: "Frequently Asked Questions!"

We're going to take a little break from our normal approach of presenting new hardware and software components for the Digital Breadboard, and this time step back to answer many of the good questions that have surfaced from readers over the last five installments of this project. Wow, it really has been over 15 months since the "DigBB" adventure was conceived. Much progress has been achieved along the way and we really hope you've been keeping up with us here in these pages and in the column's companion website.

We now have a complete system and the full kit of parts, pc board, enclosure and software all available, making it easy for the homebrewer to actually use the project. The Breadboard design did evolve along the way, though, with compromises and assumptions being made at various points to help us through technology limitations. These mid-course corrections allowed us to more effectively meet the project goals for packaging, power consumption, and functional completeness.

So, all things considered, this installment of the Digital QRP Breadboard project will deal with "Frequently Asked Questions" that have come in from readers over this period of the design evolution. We'll put them in a logical order and answer them in a comprehensive manner, so you too will be able to better understand just what the Digital QRP Breadboard is and how you can benefit by using it in your shack.

Project Summary

To give everyone a good grounding before we dive into the detailed Q&A format, here's a brief overview of the Digital QRP Breadboard project as it currently exists in its "Generation 1" first release form.

The Digital QRP Breadboard is a flexible and reprogrammable QRP accessory that can be used in a variety of ways in the shack or out in the field. Housed in a handheld enclosure approximately 6" x 9" x 1.5" in size, this microcontrolled project contains a number of peripherals that QRPers find useful in applications around the shack—an LCD, shaft encoder, DDS frequency synthesis chip, audio amplifier, RS-232C serial port, general purpose I/O buffers, and a daughterboard expansion port all provide convenient design flexibility. You're able to download new software from the Internet and reprogram your Digital Breadboard to have it serve as an antenna analyzer, a memory keyer, an audio filter, a keyboard-driven data terminal, a controller for your HF rig, a frequency counter, and more. An inexpensive PSK31 controller is even possible when the DSP daughterboard is used.

Figure 1—Digital QRP Breadboard.

Do I need to be a software programmer to build and use the Digital Breadboard?

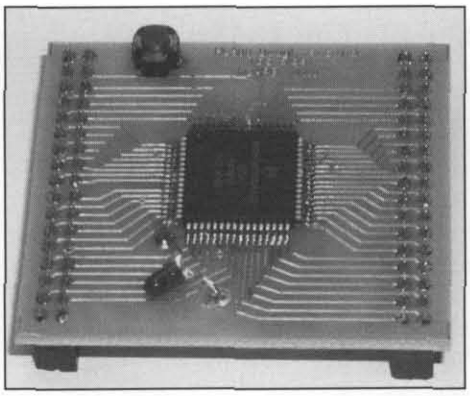
Not at all! You don't have to know how to write software programs to use the HC908 in its basic form. Anyone can just download software programs from the DigBB website and load it into the HC908 Daughtercard. The Digital Breadboard then takes on the behavior of this new program, whether it's a voltmeter program, a "commander" rig controller program, or a VFO program. The kit even comes preloaded with the first program, the DigBB Monitor Application, so you don't even have to perform the software download operation until later on.

How extensible is the Digital Breadboard?

The beauty of the Digital Breadboard is in just how flexible and extensible it is. Using its built-in capabilities with a variety of simply loadable software programs available from the DigBB website, it can operate as any of 22 different test & measurement instruments on the bench. And the list keeps growing! Plus, if you find that the Digital Breadboard doesn't have a specific peripheral device that you happen to need (e.g., a DTMF encoder chip so you can have the DigBB dial a telephone), just add the desired chip in the PCB area reserved for "user expansion," wire it up to some unused I/O pins on the HC908 card connector, and add a software "driver" routine that to control the chip's operation. This is truly a digital QRP homebrewer's dream system.

What's included in the Digital Breadboard Kit and how much does it cost?

The Breadboard Kit contains a PC board, all board-mounted components (ICs, resistors, caps, etc.), display, shaft encoder, keypad, mini PS2 keyboard, connectors for RF, power and serial port, a potentiometer and a plastic enclosure, as shown in the Figure 1 photo. It also comes with the HC908 Daughtercard, which is fully assembled and tested ... all you need to do is plug it into the pinheaders on the base PC board. A manual is also included to assist with kit assembly and use. At the time of this writing, the Breadboard Kit is priced at $125; however, check the "ordering" section on the NJQRP Digital Breadboard web page (www.njqrp.org/ breadboard) to find the current price, as deals are often discovered on bulk-quantity parts and the club passes these savings on to the customers. Further, options are identified to exclude certain components and thus reduce the price. For example, if you do not wish the keyboard option, or if you separately purchased the HC908 Daughtercard, you can reduce the overall price tag on your Digital Breadboard Kit.



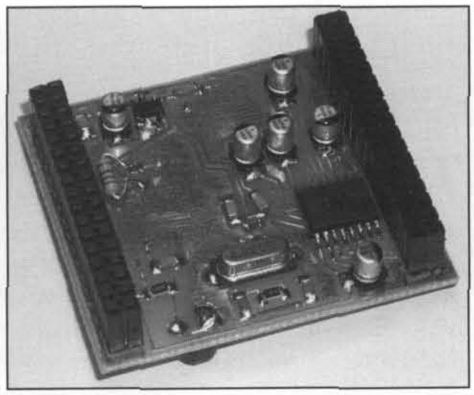


Figure 2: HC908 Daughtercard top view (left) and bottom view (right).

What's the difference between the Digital Breadboard and the Antenna Analyzer?

These two projects use the same hardware platform but just have different software loaded. We started out thinking that a downscaled Breadboard Kit would serve as the antenna analyzer that N2CX and I described at FDIM 2001 and in subsequent magazine articles. But we later determined that nearly each component of the Breadboard would serve us well in the analyzer project too! Thus, the hardware parts plus the dedicated Antenna Analyzer software program constitute the Antenna Analyzer Kit. Similarly, the hardware parts plus the more general purpose software program constitute the Digital Breadboard. This arrangement really is ideal for the owners of the Digital Breadboard Kit, in that all you need to do to turn it into an Antenna Analyzer is download a software program from the website and load it into the unit.

What software comes in the Digital Breadboard Kit?

The software program called "DigBB Monitor" comes preloaded in the HC908 Daughtercard that comes in the Breadboard kit. This is a program that provides simple granular control over the various I/O peripherals in the kit. DigBB software contains various subroutines in its library that allow for reading a shaft encoder, setting a DDS frequency (and thus serving as a rudimentary VFO), reading analog voltages, reading/interpreting signals coming from the reflectometer, reading frequency and other such functions. A "bootstrap loader and programmer" is also provided in the DigBB Monitor to allow the user to load new software programs onto the platform, overwriting the Monitor and thus turning the Breadboard into another useful piece of gear for the bench.

What are the capabilities of the HC908 Daughtercard?

The HC908 card is a 2" x 2" pluggable daughtercard containing the 8-bit 68HC908AB32 microcontroller on the topside; and the clock, voltage regulator and an RS232 serial port driver on the bottom side. The 68HC908 MCU has 32KB of flash memory, 1 KB of RAM, 512 bytes of EEPROM, 51 general purpose I/O pins, an 8-channel 8-bit A/D converter, two 16-bit timer ports, a programmable interrupt timer, and has a powerful CISC instruction set that can be programmed in assembly language of in C. By pressing the pushbutton on the top, the user instructs the HC908 card to load a new software program from a PC connected to the RS232 serial port. The red LED on the topside turns on to indicate that the HC908 card is awaiting connection to the PC. Once a specific software program is loaded, the power can be removed and the HC908 card retains the program. When power is applied again, it starts running the new program. All of the 51 I/O pins on the microcontroller are available for any custom circuit you might have in mind!

Can the HC908 Daughtercard be used in other projects?

Most assuredly! In fact, this universal applicability is why we chose to make the form factor that of a pluggable daughtercard. Because the HC908 Daughtercard is a self-contained controller it could be very useful as the heart of custom projects well before the overall Breadboard became available. One could take the HC908, apply 12V power and use it as a standalone microcontroller unit for a smart terminal, a computing engine for a weather station, the brains of a security system, and more. It has gobs of I/O lines that can be used to control just about anything imaginable.

Can the HC908 Daughtercard be purchased separately?

Sure. You can buy the HC908 separate from the Digital Breadboard Kit and us it in one of the applications mentioned above.

Does an instruction manual come with the HC908 card and the Digital Breadboard?

You bet. Just as with every kit provided by the NJQRP, both the HC908 Daughtercard and the Digital Breadboard Kit come with a manual describing assembly, theory of operation, test, configuration and usage notes. [Note: The HC908 Daughtercard comes fully assembled and tested.] Additionally, because of the user-reprogrammability nature of these products, there are detailed notes on obtaining and loading new/updated software programs. No special or extra programming cable or board is necessary, as it's all built into the HC908 boot loader program.

Can the Digital Breadboard be effectively operated on batteries?

Sure. The overall current requirement is about 180 mA at 12 V. Should you decide to utilize the internal 10 AA-cell battery holder, field operation is possible over an extended period of time.

How can I start learning about programming on the 68HC908 microcontroller?

The HC908 Daughtercard can indeed be a good platform for actually learning about programming. Using the tools freely available on the Internet, you could modify our existing programs to do some special features that you dream up, or you can develop an entire new program yourself to read the A/D converter, send text to the LCD, or control whatever else you might have wired into your "system." Playing around with the HC908 Daughtercard this way is a great way to bootstrap yourself and learn some of the basics of software programming. Besides reading through the early chapters of the good Motorola manuals for the 68HC908 processor, the best way to study up a little is to browse the many application notes listed on the Motorola website. You can get there from the "Motorola Reference Docs" link in the leftmost column of the NJQRP website links page (www.njqrp.org/links.html). Try entering the software examples they present and see if you can understand what's being attempted by following the liberally commented programs and explanation documents.

What tools are available for developing custom software programs for the HC908 Daughtercard in the Breadboard Kit?

Programming your HC908 Daughtercard can be as simple as editing the well-commented source code files provided with the project by using the free editor/assembler from P&E Micro. Just download the free development suite software from the P&E site by following these five easy steps:

1) Go to the P&E Micro website (www.pemicro.com)

2) Select the link called "Motorola M68HC908 Software/Docs"

3) Select link for "Download the most recent versions of our ICS software packages"

4) Enter your name and email address

5) download the HC908ICS08 software package.

Once unzipped and installed, you have a combined editor/assembler/debugger for source code programs. You can then download any source code files you edit and compile to the HC908 Daughtercard via your computer's serial port using the built-in boot loader program.

	Digital Breadboard	QuickieLab
Use	Flexible, reprogrammable measurement instrument	Experimenter's platform -- for "Joe's Quickies", 1-time bench measurements, etc.
Speed	Very fast	1000x's slower
Processor	Motorola 68HC908	Parallax BASIC Stamp
Programming language	Assembly, C, ...	BASIC
Canned programs available?	Yes (Antenna Analyzer, HC908 Commander, PSK31 Controller, Recording Voltmeter & Freq Cntr, Keyer)	Yes ("Joe's Quickies" experiments, Nuts & Volts programs, quick test programs, etc.)
Peripheral devices	LCD, digital pot, shaft encoder, ADC, DDS, Freq Cntr, RF Amp, keypad, serial port	LCD, digital pot, ADC, DDS, Freq Cntr, RF Amp, keypad, serial port
Kit available?	Yes (full)	Partial (pcb + IOX chip)
Enclosure	Yes	No
Price	$125	$25 +$15 (plus user-collected parts, estimated at $80)

Figure 3—Features and capabilities - Digital Breadboard vs. QuickieLab

What's the difference between the Digital Breadboard and the QuickieLab?

Perhaps the easiest way to describe the QuickieLab is that it's a "quick 'n easy" computing platform that has no enclosure, is more expensive, and is lots slower as compared to the Digital Breadboard. Similar operations can be performed on each, but the BASIC Stamp microcontroller used in the QuickieLab is about 1000 times slower than the 68HC908 processor used in the Digital Breadboard. So, although you can output a frequency (for example) from either project, the Digital Breadboard can do much more per unit time, like scan through a range of frequencies, perform complex calculations in a blink of an eye, and be taken to the top of a tower for some antenna measurements in the field. The QuickieLab, on the other hand, is typically going to be desk-bound with rather delicate electronics and wires plugged into its plugboard serving as a test bed for experiments designed by Joe Everhart, N2CX and often outlined in his regular "Joe's Quickies" column. Perhaps an easier way to compare the two platforms is to consider the comparison in Figure 3.

Notes

1) Visit the online version of the Digital QRP Homebrewing column by pointing your browser to www.njqrp.org/digital-homebrewing . Follow the links on the left side of the page to view the progression of the Digital Breadboard project, including color photos, diagrams, additional description and theory of operation, and software listings.
2) The NJQRP provides the entire Digital Breadboard project as a kit. Check the project web pages at www.njqrp.org/breadboard for the latest information, availability and pricing.

Spotlight on ...
The NKØE "PIC Weather Station" Part 3: Temperature and Humidity

Now that we've established the foundation in the first two installments of our PIC WX saga, it's time to get down to the business of actually measuring some weather data! We're going to start by adding a temperature and relative humidity sensor. The sensor is the SHT11 from Sensirion (www.sensirion.com). This is a digital device that, when queried, returns an unsigned 16-bit number that gets converted into the actual value for temperature or humidity by using simple formulas given in the data sheet. It requires no calibration and is reasonably accurate—for temperature, it's better than ±3.6°F between –40 and 100°F, and ±3.5% for relative humidity. Purchasing information can be found on Sensirion's web site. It's priced at about $20 but you can request a free sample. Mine arrived within a week of my request, which worked out great for reporting my progress in this article installment.

The SHT11 sensor is pretty small - only 0.3" by 0.2", and it's basically a surface-mount package with 0.05" pin spacing. Because of this, I fabricated a small PC board to use in mounting so that it would be easier to handle. Figure 4 shows the PC board before and after the device

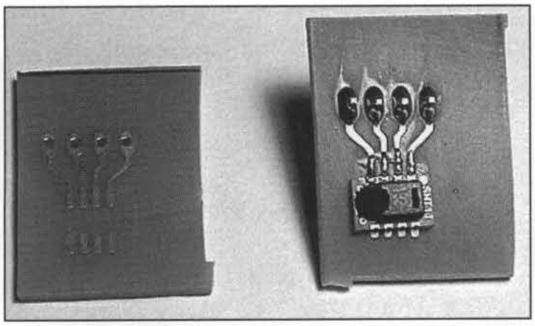


Figure 4. The carrier board for the SHT11 sensor.

Pin	Name	Connection
1	GND	Ground
2	DATA	Serial data bi-directional
3	SCK	Serial clock input
4	VDD	Supply 2.4 – 5.5V
5-8	n/c	Do not connect

Figure 5: Interfacing the SHT11 sensor.

was mounted. I included pads for 0.1" header pins to make it easier to connect the board to the rest of the circuit. I made several extra PC boards for the sensor, so contact me if you're building this project along with us here.

The SHT11 data sheet cautions that care must be taken when soldering the sensor. Contact time must be limited to 5 seconds with an iron at 350°C. In addition, the sensor should be stored for at least 24 hours at a relative humidity of 75% or higher after soldering to allow it to recover (since it's always dry here in Colorado, I stored mine in a small container with a wet sponge).

Although the sensor has eight pins, only pins 1 through 4 are actually used:

You probably figured out for yourself that pins 2 and 3 must be connected to the PIC so the microcontroller can communicate with the sensor. The PIC and sensor communicate using synchronous serial communications because they share a clock line (SCK) to indicate when each bit can be written or read. The PIC controls the SCK line, while the PIC and the sensor take turns controlling the DATA line.

The PIC uses the SCK line to signal when each bit can be written or read. Although it's called a clock line, it doesn't need to have a fixed frequency. When the clock line goes high, a bit can be read from the DATA line. When the clock line goes low, a bit can be written to the DATA line. In other words, the device currently sending the data should set the value of the DATA line whenever the clock line goes low, and the device reading the data should get the value of the DATA line whenever the clock line goes high. The PIC chip controls this line at all times. There is no danger of the PIC chip changing the clock line at too high of a frequency for the sensor - its maximum clock frequency is 10 MHz, while the PIC can change it at a maximum frequency of only 1 MHz, as determined by its own clock rate of 4 MHz.

The SHT11 datasheet covers the operation of the sensor in great detail. In a nutshell, here is the sequence of events for obtaining a reading from the sensor:

1) The PIC sends a "transmission start" sequence. While SCK is high, the DATA line is taken low. While the DATA line is low, the SCK line is taken low and then high again, and then the DATA line is taken high. This signals the SHT11 that a command will be sent to it.
2) The PIC sends an 8-bit command. "00000011" is sent if temperature is desired, or "00000101" is sent for humidity.
3) The SHT11 acknowledges receipt of the command by pulling the DATA line low for one clock cycle then releasing the DATA line (which goes high).
4) After it has completed its measurement (which can take up to 210 ms), the SHT11 again pulls the DATA line low to indicate that it's ready to send data back to the PIC. The data is returned as three bytes (high byte, low byte, checksum). After receiving each byte, the PIC must acknowledge by pulling the DATA line low for one clock cycle.

Figure 6 shows the schematic diagram for the entire circuit. It differs from the schematic for the previous installment only by the addition of the SHT11 sensor. Note that the DATA line for the sensor has a pull-up resistor connected to it. The SHT11 datasheet indicates that the pull-up resistor is necessary.

The operation of the circuit is quite simple. The PIC accepts the 't' command to initiate a temperature measurement and the 'h' command to initiate a humidity measurement. In either case, the PIC returns a five-digit number (as an ASCII string) followed by a carriage return and line feed. Once you've built the circuit and reprogrammed the PIC with the latest hex file on the project website, connect it to the serial port on your computer and start up Hyperterminal, or your favorite communications program. Configure it for 9600 baud, 8 bits, 1 stop bit, no parity, and no flow control. Then type a 'v'. The PIC should transmit a version string back to the PC ("WxPIC v0.3b (c) 2002 by NKØE"). If so, try typing 't'. The PIC should get a temperature measurement from the SHT11 and transmit a five-digit number back to the PC. Also try typing 'h'. Again, the PIC should get a humidity measurement from the SHT11 and return a five-digit number.

To convert the five-digit numbers to temperature and humidity, use the following formulas given in the SHT11 datasheet:

$$T = 0.018N - 40$$

$$H = 0.0405N - 2.8 \times 10^{-6}N^2 - 4$$

Temperature T is in degrees F, and humidity H is the percent relative humidity. N is the number returned by the PIC.

If you examine the PIC software, you'll see that the 't' and 'h' commands reuse the same code that communicates with the SHT11. I wrote three subroutines—to send the command to the SHT11, to get a byte from the SHT11, and to acknowledge bytes received from the SHT11. I also used the code from last time that converts a two-byte binary integer to an ASCII string and sends the ASCII string back to the PC.

Finally, I wrote a simple Windows program (using Microsoft Visual C++) that periodically queries the PICWX for temperature and humidity and displays it on the screen. A screen shot is shown in Figure 3. When you first run it, click the Settings button to select the serial port being used and to set the measurement intervals. When you start the PIC WX program, a small thermometer icon is placed in your system tray. If you hover your

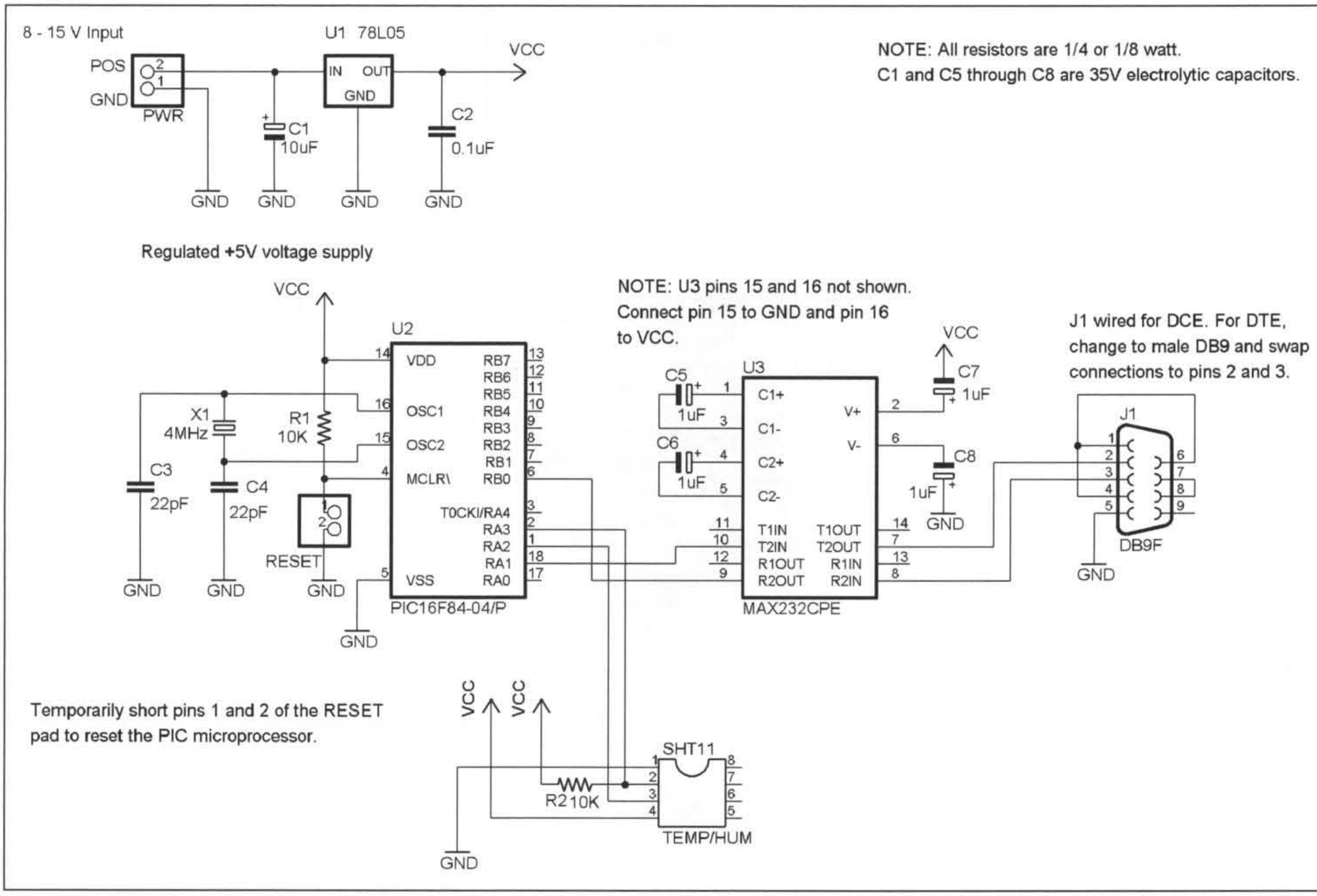


Figure 6—PICWX schematic for Part 3.

mouse pointer over that icon, a small box will pop up that shows the current measurements. If you minimize the PIC WX program, it disappears completely except for the icon in the system tray. Double-click the icon to make the PIC WX program reappear. You can download the PIC WX Windows program from the PICWX project pages on the Digital QRP Homebrewing section of the NJQRP website at www.njqrp.org/digitalhomebrewing.

That wraps up this installment of the PIC WX project. Next time we'll add a sensor for wind speed. That'll probably be a bit more of a challenge as compared to the humidity sensor we did this time!

●●

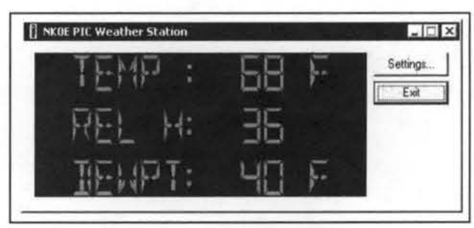


Figure 7—The PIC WX Windows program for reading the PIC weather station.

Solar Power for Amateur Radio Operations

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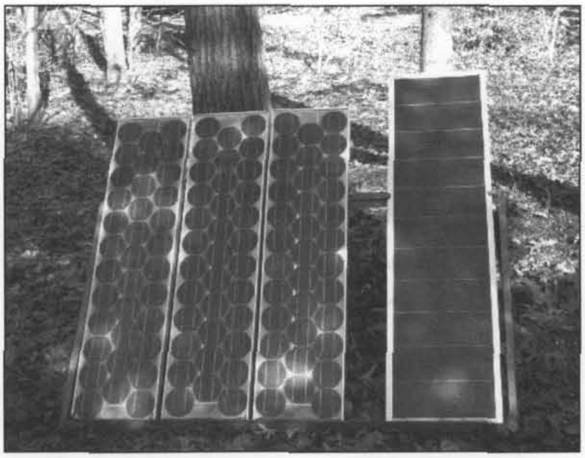
This article originally started out as an extended e-mail on the QRP-L reflector. After some conversation with Mike Goins, WB5YJX, I decided to expand the discussion into a full-fledged *QRP Quarterly* submission. I also expanded the scope to general solar power design topics that are equally applicable to home and portable use.



There are two common types of solar panels—single crystal (3-section panel at left) and amorphous silicon (larger panel at right).

Objective 1: Know your load

This is the most important parameter of the whole design evolution. Load values drive both PV (Photovoltaic) panel and storage battery size. Here are some examples of QRP equipment requirements:

Equipment	RX Current	TX Current
Yaesu FT-817	450 mA	2.0 A
Elecraft K2	190 mA	1.62 A (5W)
SWL DSW-40	37.5 mA	310 mA (3W)

The values listed for the Yaesu FT-817 are from the operator's manual; the ones for the Elecraft K2 and Small Wonder Labs DSW-40 are measured from my personal equipment. The K2 is configured to optimize current consumption for battery operation.

Since storage batteries are typically rated in ampere-hours (AH), it is convenient to determine an Ah value for current consumption. My K2 will consume 0.19 Ah for an hour of receive, and 2.0 AH for an hour of transmit.

For the sake of this article, I'm going to assume that in a given hour, I'll listen 75% of the time, and transmit 25% of the time, so consumption during an hour is:

$$0.19\ \text{A} \times 0.75\ \text{hour} = 0.143\ \text{AH (RX)}$$
$$1.62\ \text{A} \times 0.25\ \text{hour} = 0.405\ \text{AH (TX)}$$

Summing the results gives us 0.548 AH. Since the K2 specification is a key down number, when running CW or SSB the current consumption will be somewhat lower. However, I prefer to err on the conservative side, so I use the continuous transmit value.

Now, perform the same calculations for the rest of the equipment that will be solar powered (e.g. keyers, TNCs, laptops, cell phones, etc.). Record and total the values for all the equipment, that number is the total load.

Objective 2: Battery Sizing

As I mentioned earlier, storage batteries are typically rated in amp-hours, though some of the smaller types will be rated in milliamps rather than amps.

One very commonly used battery is the SLA, or Sealed Lead Acid type. While the details of battery construction (absorbed glass matting vs. gel types) are outside the scope of this article, one very important rule applies to all SLAs; a 100% depth of discharge WILL ruin it. In other words, for a 7 AH cell, you can't take 7 AH out.

Having read literature published by several manufacturers, I use 50% DoD value (3.5 AH discharge from a 7 AH cell) for planning. If long battery life is not your primary consideration, 80% of the cells capacity can be utilized—about 5.6 AHh from a 7 AH cell.

Sometimes, the amp-hour business confuses people—just remember that 5 amps in 1 hour is the same as 2.5 amps in 2 hours, as is 1.25 amps in 4 hours.

Larger batteries can have two capacity ratings, like C/10 and C/20. The Automotive Group 27 cells that I use at home are rated for 86 AH at the C/10 rate, but 103 AH at the C/20 rate. Simply, I have more useable capacity if I pull the energy out at a slower rate.

If I plan on running my K2, which I determined has a 0.548 AH rating, my next decision is how long I plan to operate without recharging. If I use a 7 AH rated battery, of which I can use 3.5 AH, I should be able to run my K2 for about 6.4 hours between charges. Obviously, a larger battery will give me more operating time.

Objective 3: Pick a peck of panels

I've been fascinated by photovoltaic technology since I was a kid. One birthday, my Dad, K2ZA, bought me one of those Radio Shack 101 project electronics labs. It had I solar cell on it, and I was amazed that you could get electricity out of sunlight. I'm still amazed 34 years later.

There are several different types of PV technologies readily available, the most common being single crystal and amorphous silicon. If you can see discrete cells in the panel, usually circles or truncated squares, then you are most likely looking at a single crystal design. Amorphous silicon types appear to be solid black or dark blue, with silver or copper stripes running across the face of the panel. While there are some differences in efficiency, they are not really important to this primer.

While looking at PV panel specifications the two that are most important for our purposes are Isc (short circuit current) and Voc (volts open circuit). Isc represents the maximum current that can be generated by the panel, and Voc is the unloaded voltage of the panel in full sun. The Voc will drop when the panel is connected to a load. My portable panel has a Voc of 18 volts, but drops to about 14.5 when connected to my internal battery equipped K2. To charge a battery effectively, the voltage of the PV panel needs to be a few volts higher than the full charge voltage of the battery. The current available from the PV panel will change based on temperature, battery voltage, and sun angle, but for planning purposes the Isc value can be used directly.

One question that needs to be answered early on in the design process is whether the PV panel will just charge the battery, or will the equipment be running at the same time. The internal battery on the K2 is rated at 2.9 AH, and my portable solar panel will generate about 0.65 AH (650 mAH). While just receiving, the panel will run the K2 and charge the battery simultaneously, but when the K2 is in transmit mode its current draw exceeds the available current from the PV panel, so some energy is taken from the battery. I use this panel arrangement as a "battery extender" as it greatly increases the amount of time I can use the K2. To totally recharge the K2 battery, I should plan for several hours of "off time" to allow the full output of the PV panel to go to the battery.

Similarly, at my home station, I do not have enough PV panel capacity to charge the battery bank and run all the gear at the same time. Fortunately, I'm usually at work when the sun is shining, so my PV array is harvesting energy from the sun while I'm off being gainfully employed. My battery bank is sized to allow me to operate without any solar input for the better part of a week.

Operationally, there are some things to keep in mind when using a PV array. First, the panels will only put out maximum current when the sun is shining directly on them. With an angle of incidence greater than 10 degrees or so, the panel output will drop, though not dramatically. What will cause the output to drop dramatically are shadows. I moved my solar array into the shadows for the above picture to dramatize this point. I was experiencing full sun at my location when the picture taken, while the array was generating less than 1 amp. When I moved the array a few feet to the right, to gain full illumination, it began generating better than 6 amps. Amorphous silicon panels are somewhat shade tolerant; a shadow blocking one cell of a single crystal panel will drop the output to near zero.

For fixed station installations, facing the PV array due south will present a good compromise between power generation and sun angle. There are a few different schools of thought when it comes to the vertical angle of PV panels.

One method is to set the angle of the panels to your latitude. I live at 39 degrees North latitude, so my panels are set to that position from vertical. Another method is to set the panel to your latitude minus 10 degrees in the winter, and latitude plus 10 degrees in the summer. This method works best with ground-mounted arrays. For roof mounted systems, I suggest fixing the array due south at latitude angle.

Objective 3: Do I need a charge controller?

The charge controller monitors the battery terminal voltage, and uncouples the array from the battery when the battery is fully charged. Some charge controllers can generate RFI, so make sure that the vendor you purchase from has a return privilege, in case you get one that is objectionable.

If you have a large capacity solar panel, (>10% of battery capacity) you will probably need a charge controller.

If the PV panel supplies more current than 10% of the capacity of the battery, then a charge controller is highly recommended. I keep the battery on my camper charged all winter with a small panel, with no charge controller. The panel supplies about 350 mA, and the battery has about a 60 AH capacity, so I can run this configuration completely unattended. A charge controller can be omitted if you are monitoring the battery while charging, to prevent over charging.

When using PV panels, if the panel is left in the dark while connected to the battery, a diode is needed to prevent the battery discharging into the solar panel. No, the solar panel doesn't glow when the battery is discharging through it! Some panels, notably UniSolar's small ones, have this blocking diode built in. Larger panels usually don't have this feature built in, but most charge controllers do.

I've had good results with the Morningstar Sun Saver 6, pictured above. It has a few extra features that are handy, like temperature compensation and LVD. The temperature compensation feature changes the charge set point for the battery based on the ambient temperature, so that a full charge is achieved regardless of the temperature. The LVD is a Low Voltage Disconnect, which will switch off the loads connected to the controller if the battery voltage goes too low. This is an excellent way to keep the Depth of Discharge in a safe region.

Sun Light Energy Systems also makes a very nice charge controller. The SunLogic controllers are designed with minimal RFI in mind. One version was described in the October 2001 issue of *QST*. If you're a member, you can download the article from the TIS section of the web site.

When designing your system, take note of the current ratings for the charge controller. The Sun Saver 6 will handle 6 amps from the PV array, and will control a 10 amp load. A large portion of the factory produced charge controllers are potted in epoxy, so if something goes wrong with it, you can only toss it in the trash. One big plus for the SunLogic controllers are the fact that you can repair them if something goes wrong. Kanga US handles the SunLogic charge controllers, and you can get more information at http://www.bright.net/~kanga/kanga.

For more information on solar and other renewable energy sources, I highly recommend Home Power Magazine. The magazine provides and lots of hands-on and build it yourself projects, as well as equipment reviews. You can download the current issue of the magazine at their web site http://www.homepower.com (incidentally, the publisher and a large portion of the editorial staff are hams).

I hope that this article has answered some of the basic questions related to the design of solar powered ham radio stations. PV is not only very environmentally friendly, but it's great for emergency preparedness as well. ●●

"Altoobs" Two-Tube 40 Meter CW Transmitter

Monty Northrup—N5FC

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My homebrew projects tend to progress in stages, spread over time. This one was certainly an example of that process. Being enamored of projects built into the ubiquitous Altoids™ tin, I decided I wanted to see if I could package a two-tube crystal-controlled transmitter onto one of these boxes. I began thinking about it about three years ago, sketched out a paper design six months later, acquired tubes about a year after that, and then finally got around to starting construction. I decided to name it "Altoobs," a play on the trade name "Altoids."

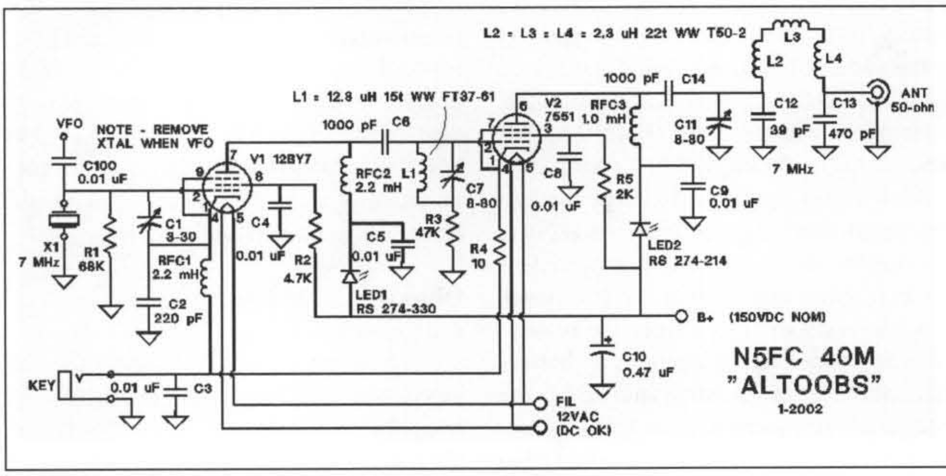

Figure 1—Schematic of the "Altoobs" transmitter.

As you can see from the schematic shown in Figure 1, there is nothing unique about the circuitry in this two-tube 40-meter crystal-controlled transmitter. In fact, it's fairly "cookbook," using a pentode-based Colpitts crystal oscillator, followed by a beam-power-pentode final amplifier with pi-output network, all cathode-keyed.

I selected a 12BY7 as the oscillator tube. The functional characteristics of the 9-pin miniature 12BY7 are nearly identical to the old metal 6AG7 which was popularly used as a crystal oscillator in 50s and 60s novice transmitters. To keep things small, I used a 7.040 MHz crystal in a modern HC-49 holder. I used a separate oscillator so that it does not have to run so much current (to deliver power to an antenna load), thus reducing the chance of damaging the crystal (modern crystals are smaller and more susceptible to damage by excess current than the old FT-243s).

I departed from conventional wisdom in selecting a final amplifier, because almost all the popularly used tubes require plate and screen voltages of 250 V or more (usually more). The 7551 is a special-purpose VHF class-C amplifier tube, most often used in industrial/police service in commercial mobile radio gear in the 60s. Packaged as a 9-pin miniature tube, it is capable of 10 watts output at 30 MHz with a 250 V plate supply, and has a 12.6 V filament. (By the way, the 7558 is an identical tube with 6.3 V filament, and can do the same job). I designed the output circuit for a plate impedance of 3000 ohms, transforming 3000 ohms to 50 ohms at the antenna port. With 150 volts of B+, we might expect a plate current of about 25 mA, and a DC power input of 3.75 watts, nominally. With a projected efficiency of 60%, we should manage something around two watts output. The 7551 is not actually characterized for operation at less than 250 V plate and screen, but its plate curves show significant plate current at 150 volts and lower, so we will assume it will do something useful with a 150 volt supply. By the way, we could get a full QRP gallon (five watts) by running a plate voltage of 225 VDC, but we'll forego the extra power in deference to simplicity, compactness, and reduced stress on the components.

To reduce component count and eliminate one power supply voltage, I opted to use cathode keying. With a grid cutoff voltage of somewhere around 20-25 volts, and total (V1 + V2) cathode currents of

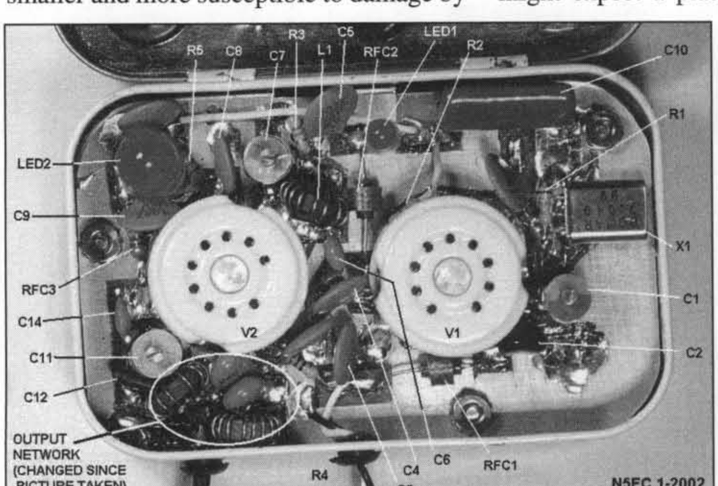

Figure 2—View of the completed PC board mounted in the Altoids tin.

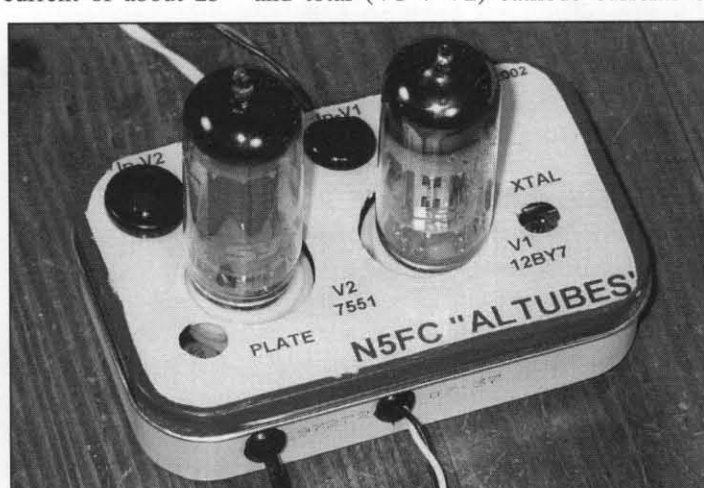

Figure 3. View of the completed Altoobs transmitter.

less than 50 or 60 mA, it should be possible to use a modern solid-state keyer.

In order to package all this circuitry (sans the tubes) into an Altoids box, I needed to deviate from traditional tube construction protocols. First, I decided to use toroid cores instead of air-wound coils in all tuned circuits, as air-wound coils are just too big. And instead of the classic pi-net with variable capacitors for tuning and loading, I decided on a fixed-loaded pi-net, designed to load a 50-ohm antenna. This is quite reasonable in this day and time when almost all solid-state rigs are designed for fixed 50-ohm outputs. If further matching is required, that can be accomplished that with an external antenna tuner. In lieu of meters for plate current indicators, I decided to try LEDs, which are considerably more compact. Finally, in an effort to keep components small, I settled on a plate voltage of 150 V. This allowed me to use regular 1/4-watt resistors, and small-package capacitors. The lower B+ voltage means the final won't put out as much power as the tube is capable of, but if I can get two watts out, I'll be happy. Of course, the lower plate voltage also simplifies power supply design, keeping the cost and size of that to a minimum (see sidebar).

A printed circuit board was used to mount circuitry. I prefer the old "cut-and-peel" method, utilizing a hobby knife to remove unwanted copper and form islands. Caution: When using a hobby knife in this manner, always wear safety goggles!

I used a double-sided board, cut to "just fit" inside the Altoids tin. I used the bottom side as ground plane, and drilled holes as required. I obtained PCB-mount 9-pin ceramic sockets, mounting them through the board, and soldering the pins on both sides. Components were mounted "surface mount" style, on the top of the board, which is also the circuit-side. This board ain't pretty, but it does the job:

Figure 2 shows a picture of the PCB, populated and mounted in the Altoids tin. The output circuit shown (in the picture, just south of the leftmost tube socket), was revised after the picture was taken.

From the picture, you'll notice a few unusual things. The toroidal cores are wound with kynar-insulated wire-wrap wire. Enameled wire probably should not be used, because the insulation will likely breakdown between the core and the wire. Also, the large red LED, rated at 60 mA, was intended to be a plate current indicator for the final amplifier. I say intended because although it works, it's very hard to quantify the current. I kept it because it makes a cool blinking light as you key, and is a good confidence indicator for plate current. The smaller LED, rated at 20 mA, performs the same function for the plate circuit of the oscillator.

Notice that there are three 8 mm poly-insulated trimmer capacitors. The one nearest the crystal allows the crystal frequency to be adjusted somewhat. Adjust this one for minimum chirp and drift (there won't be much, regardless of setting). The other two adjust the final amplifier's grid and plate tanks, respectively.

The completed PCB is mounted inside the Altoids box using three 1/4" high aluminum spacers and appropriate hardware. B+ voltage and filament voltages are brought into the box through rubber grommets in the lower back (behind the cover hinge), via pigtails that connect to binding posts on the power supply. Shorter pigtails, terminated with an appropriate connector, connect the antenna keying line. Holes are drilled in the hinged cover of the Altoids box to allow for mounting of the two tubes, for access to the trimmer capacitors, and to allow the LEDs to been seen.

Figure 4—The entire setup: power supply, transmitter and J-38 key.

I fabricated a label for the cover, which you can see in Figure 3. By the way, this picture was taken early on, before I decided to call the little transmitter "Altoobs."

Figure 4 shows a complete working setup. The gray box on the left is my homebrew 145V regulated power supply (see sidebar), which also supplies the 12 V filament voltage. In spite of being fairly compact, the power supply, with it's two transformers, is considerably larger and heavier than the transmitter. The antenna cable, which exits the Altoobs chassis on the lower left, is connected to a homebrew dummy load. A J-38 keys the transmitter. By the way, I am able to directly key the Altoobs using my homebrew CMOS keyer and the K1EL Keyboard.

For those who might want to duplicate the Altoobs, please visit my web site (www.io.com/~n5fc) for additional construction and tune-up notes in an Acrobat-format (.pdf) printable file.

My first QSO with the Altoobs yielded a distance of 817 miles (Austin, TX to Atlanta, GA), a 549 report, and a good 35-minute ragchew with Jim, AD4J.

Enjoy, good luck, and 73! ●●

Power Supply

A power supply capable of providing 140-160 VDC at 60 mA or more and 12.6 VAC is required to power the Altoobs transmitter. The DC output should be reasonably well regulated to eliminate "chirp" when the rig is keyed.

The power supply shown in Figure 4 is a homebrew general purpose 145 V regulated supply that I built for use with tube-type low power transmitters and receivers. The circuit utilizes a full-wave rectifier following a small (15 VA) 115 V:115 V isolation transformer. After some RC filtering, we have about 165 VDC with moderate ripple. A simple but effective solid-state regulator circuit, utilizing two sweep-amplifier transistors, reduces ripple to less than 0.1 %, and provides about 145 VDC regulated output at up to 75 mA. Load regulation (no load to full load) seems to be around 2.5%. This is an excellent supply for a cathode-keyed transmitter (the regulation should help minimize key clicks and "chirp"), and is quite adequate for a simple tube-based receiver. The schematic and construction details are available on my web site (www.io.com/~n5fc), or you can send me an SASE for a printed copy.

Test Topics and More

Joe Everhart—N2CX n2cx@arrl.net

This installment of Test Topics and More has a single theme resulting from a query by a perceptive reader. Because of this, the normal order of sections will be shuffled around. The question is a good example of how a familiar concept can described simply but getting measuring it accurately can be awfully difficult.

Stimulus and Response

The question is quite simple—how do you measure the Q of an inductor? (For brevity hereafter, I will simply call the inductor a coil.) Ham references talk rather blithely about how to measure Q. Three commonly seen methods are:

1. Connect a capacitor across the coil and use a grid dipper to check the sharpness of the resulting dip.

2. Resonate the coil with a capacitor and connect it to a signal generator. Vary the sig gen frequency and note the frequency of the peak voltage across the resulting resonant circuit. Then measure the frequencies either side of the peak where the response is down to 70.7% of the peak. The Q is the center frequency divided by the difference in the two side frequencies (the latter is called the 3 dB bandwidth.)

3. Use a Q meter.

In practice all of these present some difficulties:

1. If you've read my earlier columns, you know that this really grates on my nerves. It is not a quantitative measurement. You can't get a numerical value from the "sharpness" of a dip. The best you can do is to observe that some coils appear to have sharper dips than others do but this is at best a seat of the pants measurement. Grid dippers are fine for finding resonant frequencies and telling when a circuit is tuned on frequency but nearly useless for measuring Q.

2. This method sounds plausible until you actually try to do it! Just how do you connect a signal generator to the resonant circuit? As we will see shortly, a signal generator connected directly to a resonant circuit will load it down very badly. Not only will this make finding the resonance peak tough, but also the loading spoils the in-circuit Q so badly that we can't tell what the real Q value is. Fortunately there are ways of measuring Q this way if things are done just right.

3. This is really the best method. A Q meter is carefully designed to perform the measurement and will give accurate readings. The problem is that most of them are much too expensive for any but very well equipped hams to have on their bench. Some lucky individuals have found and reconditioned older Boonton Q meters. Most of us, though, don't have that opportunity or the resources to keep those boatanchors (and I say that affectionately) running. Those of us in the electronics industry do have the luxury of using nice modern ones in labs at work, but most homebrewers cannot.

Coming To Terms—What is Q?

To delve further into Q measurement it's first necessary to understand what the term "Q" really means.

Quite simply Q means 'Quality Factor.' Technically, it is the ratio of stored energy to dissipated energy in a reactive component, a capacitor or a coil. But that's boring and not too useful...What it really means is how close to perfect the component is, truly its quality in being exactly what you expect. Any imperfections in a reactive component mean that there is loss and that loss results in a reduced Q. So an ideal coil has only inductive characteristics and a perfect capacitor only capacitance

Figure 1 shows the equivalent circuit for a (real-world) imperfect coil. The characteristic we are interested in is the inductance, indicated by symbol L. The associated imperfection is loss resistance indicated by resistor Rs in 1a and Rp in 1b. The resistance is what dissipates energy in a practical coil. By definition the Q is represented by the ratio of the coil reactance to the loss resistance. In series equivalent circuit (1a) the ratio is the coil impedance Xl (Xl = 2*pi*L) divided by the series loss resistance. That is, Q = Xl/Rs.

The parallel equivalent in figure 1b circuit is sometimes handier to use. The ratio this time is Q = Rp/Xl since the equivalent parallel resistance is much larger than the coil reactance.

The Q of usable coils ranges from 10 or 20 for a poor one to 250 or so for a very good toroidal inductor. When minimum loss is very important such as in antenna loading coils special construction is used to make coils with Qs of 300 or more. These get large in a hurry. Professionally, I once used a 250 microhenry loading coil with Q of over 900. It was three feet in diameter and about 4 feet high and air-wound!

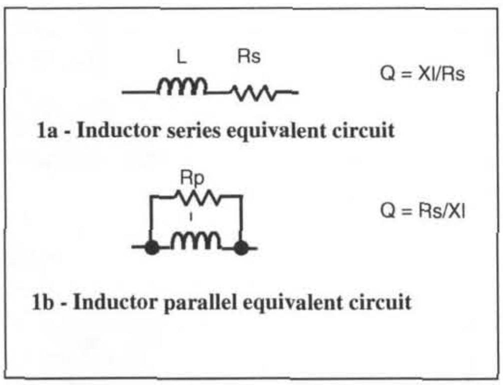

Figure 1—Equivalent circuit for a real-world inductor, with inductance and loss resistance.

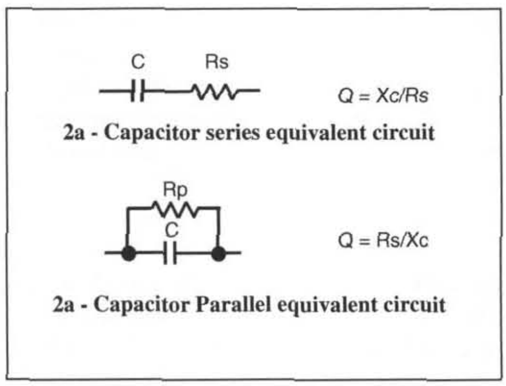

Figure 2—Equivalent circuit for a real-world capacitors, with the same series and parallel representations.

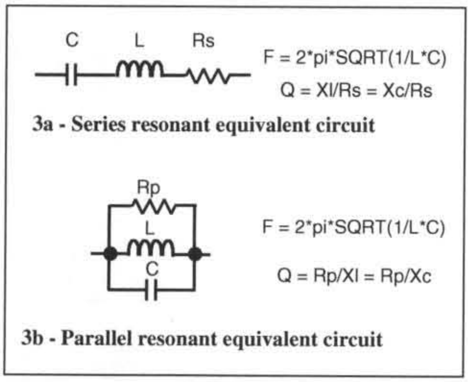

Figure 3—A series resonant (a) and parallel resonant (b) LC circuits, including loss resistance.

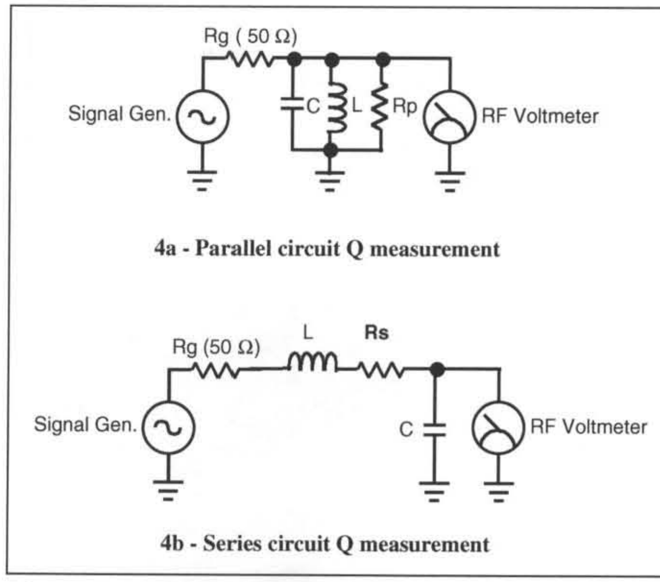

Figure 4—Possible connections for Q measurement using method #2: parallel (a) and series (b).

The corresponding series and parallel equivalent circuits for capacitors are shown in Figure 2 for completeness. If the right type of capacitor is chosen for a particular application, capacitor Q can usually be ignored since it is typically much higher than the associated coil in a resonant circuit. Most mica and NPO ceramic capacitors have Q values of several thousand. The only common exception is voltage variable capacitors used for electronic tuning which bottom out with Q values of 100 or so. The same mathematical relationships hold for capacitor Q as is shown in Figure 2.

Since we can usually ignore the finite Q of the capacitor in a resonant circuit, the unloaded Q is the same as the coil. Examples of this with the coil equivalent circuit are shown in Figure 3. Figure 3a shows a series resonant LC circuit. Its resonant frequency can be calculated using the familiar formula shown. Now recall that at resonance the coil and capacitor are equal in value (but with opposite signs). So the Q of the whole resonant circuit is the ratio of either reactance to the loss resistance as shown.

3b is the parallel resonant circuit diagram. The same resonant frequency formula holds true and Q is calculated by the indicated formulas with either the inductive or reactance value since they have the same magnitude.

OK, now we said that is "unloaded" Q, which begs the question—what is loaded Q? The answer is embarrassingly simple. Unloaded Q is the theoretical maximum Q of a resonant circuit when it is not connected to anything else—but what use is that? Well, not much! The problem is that whenever a tuned circuit is connected to anything else its Q is decreased. The reason for this comes from the original definition "Q is the ratio of stored energy to dissipated energy in a reactive component." A resonant circuit that is not connected to anything is of little practical use but whenever we do connect it in a circuit, that circuit either introduces of extracts energy from the it and that's what loads it down. So the "loaded" Q of the resonant circuit is the resulting Q as a result of energy extraction from it. Too bad, but that's life! The above is really a simplification that is close enough to give an idea of what's going on. Heaven knows, some physicist or scientist is going to correct me!

Designed for Test

Now back to the original question of how to measure Q. Since I summarily dismissed methods 1 and 3 let's look at the problems inherent with method 2. Figure 4 shows two possible connections. For reasons of computation let's use a coil value of 4.7 µH and a capacitor of 110 pF. This will be resonant very close to 7 MHz. The reactive impedance of the coil at that frequency is about 207 ohms (and so is the capacitive reactance.) Let's also use a typical Q value of 100 for the coil and, based on using a very good RF capacitor, a capacitor Q high enough to be ignored.

In the parallel resonant circuit of Figure 4a, Rp is Q*Xl or 20.7k. Using a simple-minded connection the signal generator would be hooked directly across the parallel circuit. This is disastrous! The loaded Q of the circuit is R/Xl where R is the parallel combination of Rp and generator internal resistor Rg. Typically the generator will have an impedance of about 50 ohms. Now 20.7k in parallel with 50 ohms is 49.9 ohms, close enough to 50 that we can ignore the difference. And now the loaded Q of the test circuit can be calculated as Q = Xl/R = 50/207 = .24! Quite a far cry from the unloaded value of 100, and so low that you would be hard pressed to see any resonant action.

Okay, obviously the way around this is to add resistance in series with the generator so that it does not load the circuit down. If we use a resistor 10 times the value of Rp (207k), the loaded Q will be a more reasonable value of 90.9. This is not too bad! One difficulty is that now the RF voltage across the circuit under test is reduced by 10:1. So for a value of 1 volt from the signal generator, the RF voltmeter would see one tenth of a volt.

Unfortunately that ignores the input impedance of the RF voltmeter. If it were also 207k, the loaded Q would drop to 83.3. Now the measurement is off by almost 20%. Not only that, but RF voltmeters with input impedances of 207k at RF are impractical. The usual resistance is (guess what!) 50 ohms—the same as the generator. Not only does this load the circuit down, but also the voltage available for the voltmeter is reduced by a factor of 50/207k or 0.0002. So with a signal generator output of even 5 watts (15.8 volts) the RF voltmeter would see only about 3 mV. Yeah, put it all together, and you need a high impedance RF voltmeter with a sensitivity of better than 3 mV. That's lab grade equipment not available to the average homebrewer.

Now let's look at the series resonant circuit in Figure 4b. Unfortunately we still

continued on the next page

have the same basic sort of problems. The equivalent series loss resistance Rs is now only Xl/Q = 207/200 = 1.035 ohms. But this is directly in series with the 50 ohm generator resistance. The loaded Q now becomes Xl/(Rg+RS) = 207/51.035 = 4.06. That's better than a Q of less than 1 but it is still only 1/50th of the loaded Q. The obvious solution is to make a generator with a very low resistance. To load the Q to 90% of the unloaded value would take a resistance of about 0.11 ohms. That's just as tough to do as it was to make the sig gen with a 207k internal resistance!

And we are still faced with the difficulty of making an RF voltmeter with very high input impedance since it is still in parallel with capacitor C.

Gee, guess what, we're out of space for the column. Next time around we will see several practical solutions to the above problems. We actually can make the sig gen look like a high impedance for the parallel circuit or like a low impedance for the series circuit. And there are ways to augment even a low impedance RF voltmeter to give it a high input impedance. And furthermore there is yet another way to measure coil Q without resorting to heroic measures. ●●

Review: Buddipole Antenna System

Harry Edwards—W6DXO

The Buddipole by W3FF Antennas is the commercial version of the popular portable and "pedestrian mobile" rigid dipole that has been homebrewed by many QRP operators as designed by Budd Drummond, W3FF.

I first saw the commercial version of the Buddipole at the 2002 Pacificon HamFest in Concord, California. Having used the homebrewed version for nearly a year, I knew that this new commercial variant might offer the refinements and accessories I needed for some upcoming portable operations. I took a long look. Budd soon had my money, and I had a Buddipole.

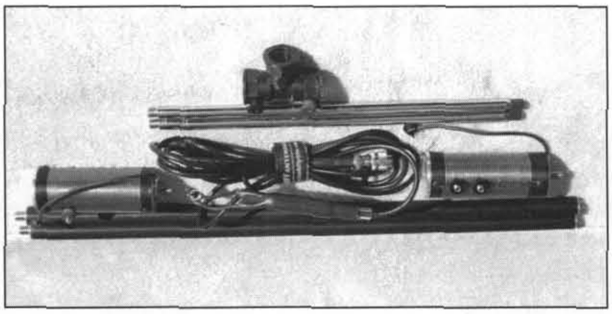

Photo 1—The pieces included in the basic Buddipole.

In reviewing the W3FF Antennas Buddipole, I selected three primary criteria to guide my evaluation: Product Quality, Ease of Use, and Practical Results. Fundamentally, the Buddipole is a rigid rotatable dipole antenna designed to operate on one band at a time in either portable or alternative mobile modes such as "pedestrian mobile" applications. Adjustments to overall antenna length and coil tap positions allow the Buddipole to operate on the 40 through 6 meter bands.

Photo 1 shows the components supplied with the basic Buddipole: Center "T" fitting, (2) Antenna Arms, (2) Coils with Adjustable Taps, (2) Telescoping Whip Ends, and a Pre-Dressed Coax Feed Line. When stowed, the Buddipole is very compact, and stores in a light but durable cylindrical carrying case with a screw on top. A flannel "tool roll" helps keep all the antenna components neat and organized. The carry cylinder and tool roll will hold the optional collapsible mast, but not the tripod.

One of the first things that strikes you when you see the Buddipole is the attention to detail. Fit and finish is outstanding, and little details such as color coding the coils and feed line connectors make assembly and use of the Buddipole just about idiot proof. Construction materials include standard 3/8-24 threaded brass studs and machined aluminum fittings. The supplied feed line is fitted with ferrite beads and quick fittings at the antenna attach point, and a combination BNC / UHF connector at the opposite end. The hook and loop tie wrap that is included helps keep the feed line neatly stowed and doubles as strain relief when mounting the Buddipole on either the optional mast or a painter's pole. Similarly, the fit, finish, and overall quality of the optional collapsible mast and tripod were equally high. Product execution is very well thought out.

Photo 2 shows a comparison of my homebrewed Buddipole and the commercial version—notice the obvious differences such as the coils with adjustable taps and the brass fittings on the commercial version.

As shown in Photo 3, set up is very straightforward. The tripod and mast assembly aid in configuring the Buddipole as you can position the antenna at shoulder height for a very easy one-person process—no XYL required(!)

My initial assembly of the Buddipole, mast and tripod took less that 15 minutes including consulting the supplied one page information sheet.

The one page Buddipole information sheet provides initial settings for operating the Buddipole on 40-6 Meters. Using the recommended settings as a starting point and employing a "maximum 3 tweaks" method, I set out to measure the SWR on the bands and frequency ranges I would most be using. The "maximum 3 tweaks" method simply means that I would allow myself only 3 adjustments for any one band measurement—remember that my evaluation criteria included "ease of use," and I don't consider spending an afternoon tuning an antenna as either easy, or the best use of my potential on the air time!

Generally, I found a broader bandwidth than with my homebrewed version. Here are the SWR results I measured with my MFJ analyzer:

20 Meters:	14.170	14.201	14.270
SWR:	1.2:1	1.1:1	1.2:1
17 Meters:	18.085	18.130	18.240
SWR:	1.4:1	1.3:1	1.4:1
15 Meters:	21.133	21.257	21.303
SWR:	1.3:1	1.2:1	1.3:1
10 Meters	27.903	28.180	28.414
SWR:	1.3:1	1.1:1	1.3:1

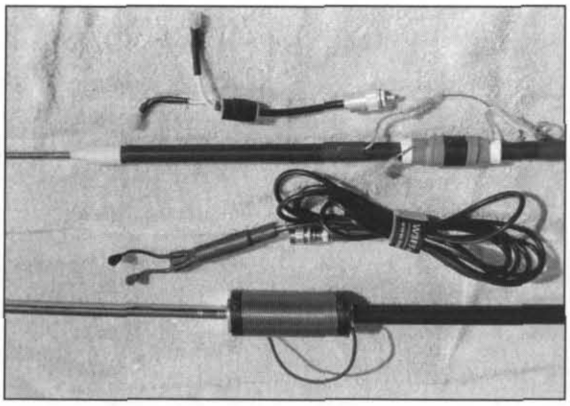

Photo 2—Comparison of homebrew and commercial versions of the Buddipole.

Again, I timed the process for set-up, "tweaking," and measurement. Total time for the entire process including set up, all testing, tear down and stowing the Buddipole, was only one hour and twenty minutes. I mention this because I believe it demonstrates how user friendly this antenna system is in the field. I have learned that when it comes to portable operations I only use those items that are both reliable, rugged, and easy to set up and get on the air.

If you intend to use the Buddipole with the ubiquitous "painters pole" for pedestrian mobile operations, W3FF Antennas has thoughtfully produced a "T" fitting out of the material Delrin to allow you to fit the Buddipole to your painter's pole without having to cross thread as many have dome with the homebrewed version.

All this is well and good, but any antenna is only as good as its real world performance. Knowing this, I set up the Buddipole on the rear deck of my Bay Area suburban home and fired up my trusty FT-817. As some of you may know, I am not shy about stalking DX on 20 Meters with QRP power, and that's what I decided to do. Two hours of casual operation easily yielded contacts with VKs, JA, LUs, VEs, and 8 states. On air signal checks confirmed that the Buddipole exhibited the directionality you would expect from a dipole antenna.

Having used the Buddipole for a while, I believe there are some small areas where the Buddipole could use some minor refinement. One option I tested was the Rotating Arm Kit (RAK) which allows the user to change the position of the Buddipole arms to any number of configurations (i.e. "V," "Inverted V," "L," etc.). I had trouble getting the RAK to hold the Buddipole arms securely. A trip to my local hardware store for a pair of lock washers solved this problem. This was mostly an annoyance (but it would be possible to damage one of the telescopic whip ends of the antenna if an antenna arm unexpectedly became lose during set up, etc.). The second area I would improve is the provision for the placement of the coil taps. These are well executed, however the tap's knurled screw locks limit how closely taps may be placed to one another. Cutting a second tap channel on each coil would correct this limitation. In so doing, very fine adjustments could be set on each coil thus saving the user from having to reposition multiple coil taps every time a band change was made.

Overall the W3FF Antennas Buddipole is an outstanding "purpose built" single-band antenna system that is thoughtfully designed for casual portable or pedestrian mobile type operations, and would likely serve well in apartment or QTH restricted environments. I can tell you that I won't be throwing any more wire dipoles up in trees when I'm operating portable—this is just too easy!

You can learn how to homebrew your own Buddipole by following the links from W3FF's information on QRZ.com. Information on the commercial Buddipole is available at www.buddipole.com.

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Photo 3—Set up is easy.

FDIM is coming May 15, 2003!

CALL FOR PRESENTERS!

Planning is underway for the Four Days in May (FDIM) Symposium in conjunction with the 2003 Dayton Hamvention. This will be our eighth year for this "not to be missed" event. FDIM 2003 will start on Thursday, May 15, 2003. On that day, QRPers will gather in Dayton to hear from some of the best minds in QRP. The symposium is an 8-hour event, which covers the gamut of QRP activities.

Please consider sharing your talent and experience by giving a presentation and documenting it for the FDIM 2003 Proceedings. Topics are wide open and may include design; construction projects and techniques; antennas and feedlines; operating techniques or experiences. Be creative and define your own topic! All that is required is that you present your topic at the Thursday Symposium and document it for publishing in the FDIM 2003 Proceedings.

Time slots are limited, so please submit your idea soon. If interested, please send a short description (one paragraph) of the proposed talk to me prior to January 31, 2003. If you know of someone who might be interested in submitting an idea, please forward this Call for Presenters to them. Contact me at:

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New Life for the Johnson Matchbox

John Meade—W2XS

jmeade@telebytebroadband.com

The Johnson Matchbox is still preferred by many operators who use balanced line to feed their antennas. However, like everything else in life, there are pros and cons to this venerable workhorse.

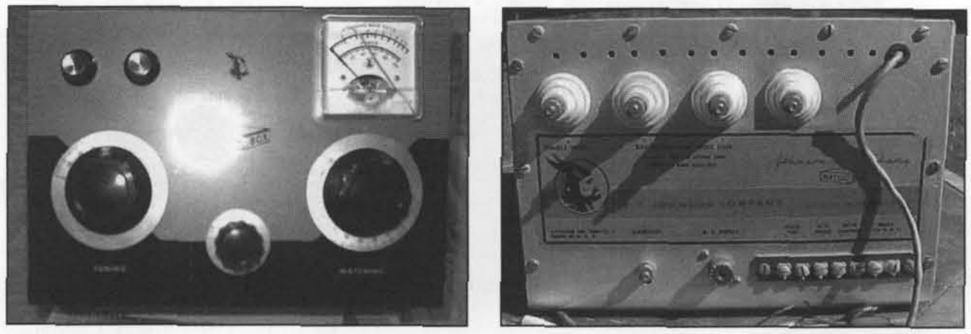

Figure 1—The familiar Johnson Matchbox with an additional ceramic standoff installed on the rear panel.

Pros

- Very good balance
- Low insertion loss
- Conservative power rating of 250W
  - 100 pF 3 kV capacitors
  - No. 12 wire used in the coil
- Solid construction, heavy-duty components
- Easy to change bands
- 15 dB harmonic attenuation
- Coverage of WARC bands (except 5.2 MHz)

Cons

- Somewhat limited matching range compared to the "Ultimate" transmatch
  - 25 to 1200 ohms (balanced)
  - 25 to 3000 ohms (unbalanced)
- No 160 meter position
- No bypass position (useful for SWLing)

A simple addition to the Johnson Matchbox adds some versatility to the unit and allows for experimentation. The addition is a single ceramic standoff that can be used to add additional external capacitors in a variety of configurations.

The Modifications

The modification is the addition of a ceramic post in line with the three existing ceramic posts already there (Figure 1). Look for the dual-differential capacitor C2 that is connected to the existing post marked "single wire." The new post is connected to that same capacitor but at the opposite end. (C2D). See Figure 2.

On the schematic diagram, the connections through the ceramic posts are labeled A, C, B, and D. The reason for this has to do with the way the Matchbox is wired. The first ceramic post on the right rear panel of the unit is A, then B, then C, and then D. In order to add external capacitors, however, the correct posts need to be used in pairs. That is why the first and third are pairs, and the second and fourth.

To get my Matchbox to work on 5.2 MHz (using my Autek RF Analyzer, of course!), I added a 100 pF 1000V capacitor across terminals A and C, and another identical capacitor across terminals B and D. I could then find a smooth match condition for the new band. (I did not do any efficiency or power loss measurements.)

Table 1 is a chart listing my settings for each band. I keep this chart handy to make tune up simple. I pre-set the dials as per the chart, and then fine-tune as necessary.

Figure 3 is a simple circuit that I use to bypass the tuner when I want to use the antenna as a long wire for short wave or AM BCB reception. Keep the leads as short as possible. My Hallicrafters S38 receiver still works great and it is fun to listen to when no one answers my CQ on 40M CW!

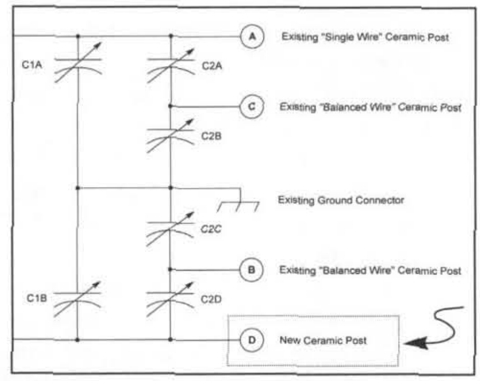

Figure 2—Connect the new post as shown on this diagram.

More Johnson Matchbox Mods and Information

1. "Matchbox Plus Two," *Ham Radio Magazine*, July 1979, pg. 45. Coax to Coax matching and Antenna Switching by K4IHV.
2. Correction for the above article, *Ham Radio Magazine*, Sept. 1979, pg. 92.
3. "Extending the Johnson Matchbox Range," *QST*, Dec 1963, pg. 67.
4. W4RNL's Antenna Website: http://www.cebik.com/radio.html
5. Johnson Matchbox Manual, available at http://bama.sbc.edu/e_f.htm ●●

F	BAND	TUNING	MATCH	External Capacitor (pF) A TO C	External Capacitor (pF) B TO D
3,530	80	42	43		
3,630	80	52	44		
3,677	80	53	46		
5,200	40			100	100
7,030	40	30	82		
10,103	40	91	84		
14,030	20	80	48		
18,070	15	10	58		
21,030	15	65	4		
24,900	10	52	32		
28,030	10	45	26		

Table 1—My tuning guide for the Matchbox.

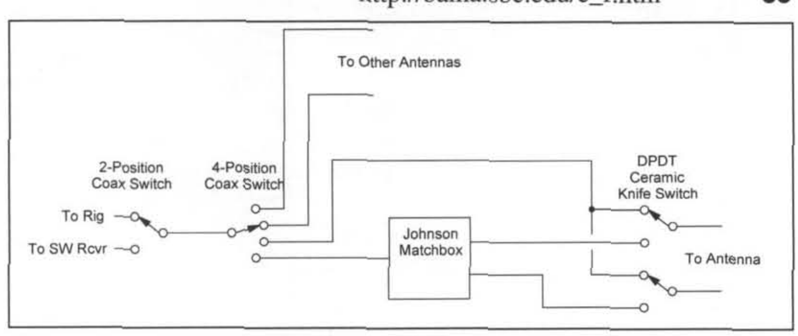

Figure 3—A simple circuit for bypassing the tuner.

A New Contester

Max Moon—KØMAX

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Guys:

I've read some of your postings about the 2002 QRP ARCI Fall QSO Party. It's always edifying to read reports from the expert's experiences. Well, what follows is a rank beginner's experience.

I wanted to try a contest someday. I'd never before entered any contest, party, sweepstakes. I got my license in February, and had my first QSO in April, so it's not like I've been ignoring Radio Sports forever. I even planned on helping out at Field Day with the Minnesota QRP Society and then got sick and couldn't make it. But for some reason, on Sunday, I decided to give it a try.

I figured I'd make it easy for myself: One band, (slightly less than) one watt. Logging with one pencil and one piece of paper. One straight key. No more than one cigar.

All right! Let's roll. But—what do you do? I listened a while to try and get an idea. I found my QRP-ARCI member number and wrote it at the top of that piece of paper so I wouldn't forget it. I listened some more. Finally I heard Brian, K7RE, and remembering the dinner at this year's Hamvention when he happened to be seated next to me—I gave him a call. Boy, was I nervous! But he answered; phew! One toe wet.

Okay! Let's get some points. I began to tune around 14.06 with an eye to playing search & pounce. I knew I needed to be right on frequency to get past everybody's narrow CW filter, but I just bought a new (20 yr. old) TenTec Corsair, and it has a "Spot" feature for zero-beating. I figured I was set.

Nope! Spot didn't like being in the contest. He likes to take his time, but here there're only six quick letters—CQ TEST —and a callsign. Or just a QRZ? Darn, not quite on frequency and somebody snuck in ahead of me. Okay, while I'm waiting I'll just check that zero-beat. Man, was that quick! Okay, wait till THIS one ends. There it is—but before I can move my right hand from the offset knob to the key, he's calling CQ again; elapsed time, 0.87 seconds. Breath deep, relax the shoulders, fingertips on the key, ready...GO! Darn. Maybe I'm not on freq after all? Eventually, I'd get an answer. It was slow. It was hard. The only good thing I can say about my technique is that I had his SPC and member number memorized before the QSO even began.

Then came the little matter of "SRI QSO B4." Darn! How do you keep track of that? I guess that before I called someone, I need to check my earlier QSOs. How else can I be sure it isn't a duplicate? Not that there's that many of them, but even so, it got slower. Let's see, KØFX, I don't think I worked him, let me check, let's see, Oh, I'm wrong, here he is, Oh, no, that's not him after all, that's K5FX, K-FIVE-FX. Not...hey, who AM I looking for?

This wasn't S&P contesting. No! It was something like S and (check the callsign) and (tune) and (miss an opening) and (send my call) and (retune) and (get my cigar off the floor before I burn down the house) and (miss another opening) and P.

And my QSOs themselves weren't all that quick, either. Mostly I blamed it on my QRP-ARCI member number. It kept getting longer and harder to send. I'd never given it a thought before Sunday, but suddenly I was confronted with the terrible truth. My member number stinks. Absolutely! Who picked out that number for me? It stinks! "11201." Think about it—5 characters, 20 dashes. By hand! With only 999 mW! ("SRI NR PSE" — 20 dashes!) With QSB! ("NR AGN" — 20 dashes!) And QRM. ("NR?" — 20 dashes!).

There's got to be an easier way. Hey! I'll just grab a spot & call CQ! This way, everybody else will come to me. Cool!

Cool? Yes. But easy? No. Fatigue sets in at some point. The mind begins to wander. Then everything comes to a halt. Is that my RST or his power level? Is that his state or his call? Is he calling me or the guy next to me with his alleged 250 mW at 30 over S9?

I lasted six hours. Or two cigars. I had 35 QSOs. Or 34,000 points. It's all a little fuzzy. One thing I'm sure of: afterwards, I slept 12 hours straight.

So when's this Bull & Matador thing?

—Max, KØMAX

The AF8X BBQRP

I love operating portable from distant locations, parks, etc., but sometimes operation from the back-deck has its advantages.

The compact MP-1 antenna and the K1 are ideal companions for a barbecue! The all-metal grill makes a good counterpoise for the antenna, so there is no need for additional wires.

Warning — This may seem extreme to XYLs and QSOs are some times interrupted by the need to check the burgers, but I believe the RF makes 'em taste even better.

—72 de AF8X

Funky—A Key Using Pressure Sensors

Ingo Meyer—DK3RED dk3red@qsl.net

Some surplus electronics companies are offering relatively inexpensive pressure sensors, and many times I wanted to see what I could do with one. Amazingly the sensors "played" well, so I started immediately to look for a project. I had long wanted a durable and light key, and decided to make a key using the sensors.

The pressure sensors need an interface for the connection to a keyer. First I had a solution with an operation amplifier (CA 3098) in my mind. I discarded this idea, however, as there was a simpler way. Sensors of this type have a resistance of over 1 Mohms in the non-actuated state according to the data sheet. With my sensors it measured even higher, as I could not measure anything within the highest range (10 Mohms) of my ohmmeter. If one presses carefully on it, the resistance changes rapidly down to a value of approximately 100 kohms, therefore the interface had to detect only this threshold. Thus I searched again in my junk box and found a CMOS trigger (CD 4093). This circuit family uses almost no current and can be used with a voltage range of 3-15 volts.

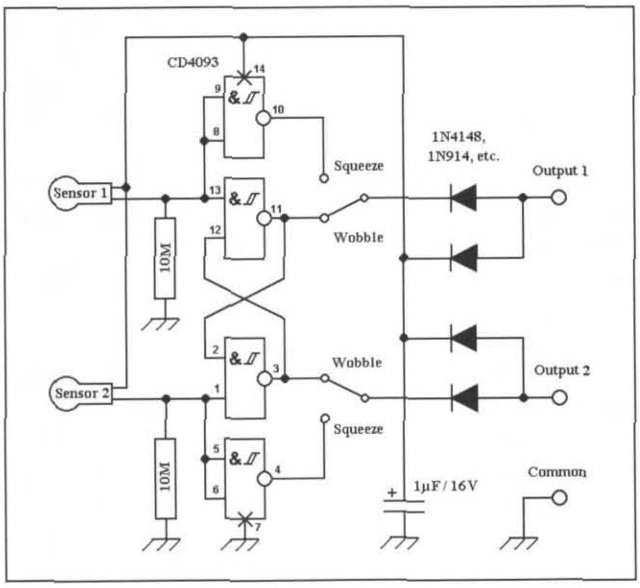

Figure 1— "Funky" key interface circuit; the outputs connect to the inputs of a keyer.

Interface Circuit

The interface circuit is shown in Figure 1. The sensing of the trigger level is done via two trigger inputs of the CD 4093. Two 10 Mohm resistors with hold the voltages at the inputs with non-actuated sensors to a fixed value below the trigger level. Thus the circuit is stable and it does not break into unwanted oscillations. If one operates a sensor, then its resistance is greatly reduced and the potential at the trigger input shifts over the trigger level toward the plus potential. The trigger output thereby switches abruptly.

According to the data sheet, the resistance of the sensor drops very rapidly with applied pressure. A force of 20 gm drops it to 2 Mohms (that is, for example, the weight of 2 normal writing pages). The more strongly one presses on the sensor, the further the resistance drops. If you want to make the key somewhat more insensitive, then you need only reduce the resistance at the input. If this is reduced to, say, a value of 100 kohms, then the sensor must be strongly pressed before the trigger is switched.

Additional transistors on the output to drive a keyer are not necessary, since the internal output transistors of the circuit can sink up to 20 mA.

"Wobble" or "Squeeze" Key

With a mechanical wobble key, you can produce either dots or dashes, but not both simultaneously. This key should function the same way, so I inserted a "barrier" which prevents the simultaneous output of both characters. That is the purpose of the RS flip flop at the input of the circuit. For fans of the squeeze (iambic) technique, the flip-flops can be disabled by a DPDT switch or jumpers as shown in Figure 1.

Power Supply

Oops, I almost forgot a very important point! Although the CMOS circuit needs very little current, it can't work without power. My first idea was to build the key into a transceiver so that its power supply could be used. However, then the key and transceiver are a unit, and I could not use the key with a different transceiver. The second idea was to use a small 9-volt battery to power the interface circuit. Even though the circuit uses very little current, one could forget to disconnect (or turn off) the battery. Murphy would undoubtedly show up and kill the battery at a most inopportune time!

I looked for, and found, another option. The key is powered (the current is in the microampere range) over the normal key cable, making use of the voltage normally present on the keyer input lines. Normally no keyer modifications are necessary. How does it work? Quite simply. It is possible to attach a resistance at the keyer input instead of the key without a keystroke being detected. With the K2 transceiver, for example, the "critical" resistance value is approximately 22 kohms. This results in a current up to 220 µA at the "open circuit" voltage of 5 volts on the key line. The current actually necessary is much smaller and is not measurable with my meter. A 1 µF capacitor stores sufficient energy during the output of a character to power the CD4093. The diodes prevent an inadvertent discharging of the capacitor due to the "short-circuit" on the appropriate line to the keyer. Since in most cases the key lines alternate, voltage is supplied even when one line is low. Thus the capacitor stays continuously charged. I have tested the "holding time" of the capacitor when both lines are held low and it is greater than two minutes—more than enough for even the slowest QRS station!

Construction

The sensors can be attached to any smooth and flat surface. However, no aggressive adhesive should be used since the plastic of the sensor could be destroyed. I used double-sided tape to attach the two sensors to an aluminum paddle (see Figure 2). If you don't like the flat surface of the sensors when operating with the key, you can apply a small self-adhesive device foot (idea of Dieter, DL2LE) as

Millwatting

Jim Hale—KJ5TF

sunwatt@starband.net

New antennas for my milliwatt station

I haven't added any new gear in the shack recently, so I've gotten pretty used to all the rigs, antennas, and bands that I normally use. And sure, the new modes (PSK-31, etc.) have been lots of fun.

At the moment I'm still suffering from the loss of my main ham antenna, my 3 band, 2 element quad beam! Boy I really miss it. It's now approaching winter, so no doubt I'll try to rebuild it again, and this next spring another ice storm will hit the Ozarks, and I'll try to survive it.

Every time, I rebuild stronger, and this time (like every time) I think I've got it right. So for right now I'm surviving on some new (for me) antennas. For some reason I never messed around with verticals much. Besides my 3-band quad, for 15, 12, and 10 meters, my only antennas on the low bands have always been dipoles.

This summer I built a 30 meter, vertical in the back yard. I've been off 30 meters for quite a while, so it's good to have a 100% resonant antenna for this band again.

On my Ozark mountaintop, the trees are stunted from the poor soil, so I don't have any nice tall ones to hang a tall stinger. No problem, easy enough to wind a coil and shorten the stinger, by 30%. Fits my scrub Oaks just fine. And as with my 40 meters, and 80 meters, the verticals I used have three elevated radials. Here I have to put the radials up high enough so that when the deer run by they don't snag them!

My 80 meter vertical amazed me this past winter when I worked HC8N with only 750mW in one of the DX contests.

As I write this, the CQ WW DX contest, (CW of course) is only a couple weeks away. The weather has changed, and the lower bands have gotten much quieter now. So, why not turn my lack of the quad beam into an opportunity for more fun?

This time I'll be working the high bands and low bands with verticals!

On 40 meters, this gives me a chance to do something new with my old NorCal Forty-Niner. Since in the past all I had was the dipole, I might find the vertical a lot better this time. Last spring when I worked HC8N on 80 meters it was with the vertical. So for this contest we will take a stab at DX on 40 meters, and 80 meters with these vertical antennas.

I can't remember working any DX with the Forty-Niner. I do remember trying real hard, but they always escaped me. It could be that with the 100% resonant vertical on 40 meters, DXing on the low bands will be an all-new experience! See you there!

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"Funky" continued...

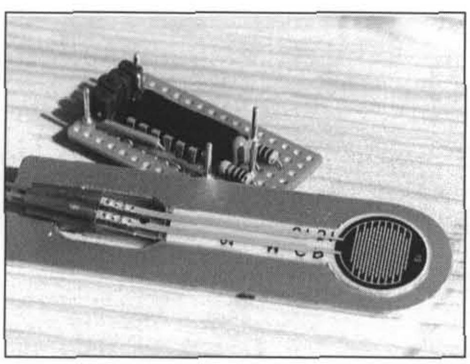

Figure 2. View of the sensor mount and circuit board.

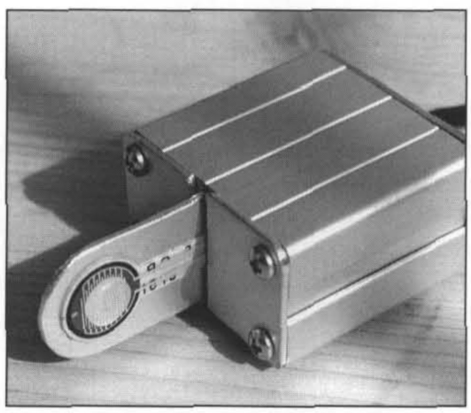

Figure 3. View of the completed key. Note the small plastic "feet" used as buttons on the sensors.

a button (see Figure 3). The button should not be larger than the active surface of the sensor (the pattern in the center), otherwise the key will not function correctly.

I built the circuit on a universal PCB without copper foil using bare wire. The building of housings is probably the most unpleasant part of homebrew construction, therefore I would like to make a suggestion for a simple housing for you. I made a mini-housing from the sawed-off part of an old housing with guide rails (Figure 3). I do not indicate the exact mass, since that is strongly dependent on the material used. Since the key is quite light, it should to be fastened to a heavy piece of sheet metal. Naturally you can also use the key on a leg strap or like the Palm Paddle with a magnet holding it to a desk or to the transceiver. You can also hold the key with one hand with one hand and operate it with the other.

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QRV? A Picture is Worth a Thousand Words

Mike Boatright—KO4WX ko4wx@mindspring.com

The great thing about QRP as a movement within amateur radio (I've heard it said that QRP is just a power level, but in my book, it is also a movement), is how it has stimulated interest in construction and equipment homebrewing. All things considered, I think that constructing my own radio equipment is by far my favorite thing to do as a ham. Maybe it is simply being able to create something with my own two hands (psychologists say that doing things with your hands is good for your soul), or maybe it is the yearning of a junior scientist (now in his mid-forties) who loves to figure things out and understand "how things work."

For the Mr. Wizard wannabe like me, there's nothing cooler than actually seeing some principle of radio theory come alive through test equipment. For the past year or so, my favorite construction projects have been test equipment. When *QRP Quarterly* arrives, one of the first columns I turn to is Joe Everhart, N2CXs, Test Topics and More. And if you don't have the new *Simple Test Equipment for the QRPer* by Graham Firth, G3MFJ, and Tony Fishpool, G4WIF, you're cheating yourself, because it is possibly the best $10 you'll ever spend.

All this might explain why I've spent the past few columns talking about the spectrum analyzer. What is so special about the spectrum analyzer? Well, basically, it allows you to actually see the radio signals (after a fashion) that you are trying to produce (or not produce, as the case may be). They say that a picture is worth a thousand words, and in the case of the spectrum analyzer, that really is true.

Time vs. Frequency Domains

In the last column ("QRV? The Ubiquitous Cathode Ray Tube," *QRP Quarterly*, October, 2002), we looked at what happens when you trace a beam of electrons in an cathode ray tube across an X-axis (by varying the voltage of the X-axis control in a ramp fashion, also known as using a sawtooth waveform input) while simultaneously changing the value of the Y-axis control voltage with a signal. What results is the graphical representation of the amplitude of a signal (that is, the signal applied to the Y-axis control) over time. An oscilloscope is a device containing a cathode ray tube with just such X and Y inputs—it is one of the most important pieces of test equipment that you can own if you intend to design and build your own radio equipment. The oscilloscope is used to visually observe signals in the time domain-that is, a view of the amplitude of a signal as a function of time.

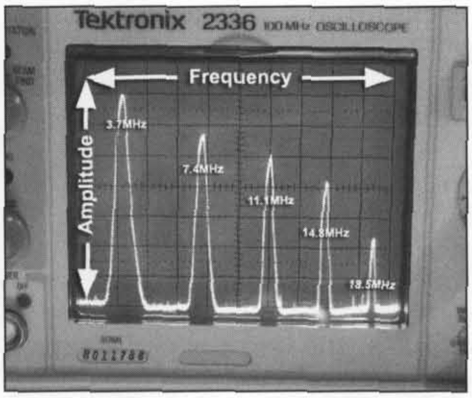

Figure 1—Spectrum analyzer plot of a simple transmitter's output.

Now imagine this—take a radio, quickly sweep its receive frequency over a particular span of radio spectrum, graph the S-meter reading (on the Y-axis of an oscilloscope) at particular times during the sweep across the span of radio spectrum (a process called sampling), and match the sweep time to be equal to the time it takes to make a single trace of the electron beam (last time, I equated all this to patting your head and rubbing your tummy at the same time). What results is a view of radio signals in the frequency domain—that is, the view of the amplitude of a signal as a function of frequency.

Take a look at Figure 1. This is a spectrum analyzer plot of a sample transmitter. This plot shows quite easily the first four harmonics of the fundamental 3.7 MHz signal. Each horizontal line or division (don't confuse this with the four ticks between each division) represents a change in amplitude of 20 dB. If you look closely, you can see that this transmitter does not quite meet the FCC requirements for suppression of spurious emissions (the second harmonic is about 26 dB down from the fundamental, not quite the required 30 dB)—a very useful thing to know about the signal if the transmitter is to be used on the air!

Putting It All Together—How A Spectrum Analyzer Works

To understand how a spectrum analyzer works, it is important to understand first how a radio works. There are many different spectrum analyzer designs, just like there are many different radio designs. Now I happen to really like the sound of a good direct conversion receiver, but to tell you the truth, if I really want precision in receiving a radio signal, I usually choose a superheterodyne (or superhet) receiver. Take a look at the superhet receiver block diagram in Figure 2.

In this superhet, a variable frequency local oscillator (LO) signal is mixed with the incoming signal to be received (a preselector filter helps limit the amount of spectrum and hence, number of signals to be mixed with the LO, helping to eliminate images and other unwanted mixing products). This results in a signal at an intermediate frequency (IF), which is filtered (again to eliminate images and other unwanted products), amplified, and then mixed with a signal from a fixed-frequency (crystal controlled) Beat Frequency Oscillator (BFO), a frequency very close to the IF frequency (usually the difference is between about 600 Hz and 2500 Hz). This results in an audio frequency signal, which is again filtered and amplified before being output by the radio.

In Figure 3, we've taken the basic superhet receiver and modified it using the ideas introduced in the past two columns: the voltage controlled oscillator, the ramp generator (or time base), the signal strength detector (more usually called the logarithmic amplifier in spectrum analyzer terms) and the cathode ray tube (CRT).

The time base creates a sawtooth wave that varies the reverse bias voltage on a varactor diode, sweeping the frequency of the signal mixed with the receiver input over a specific span of frequencies. The width of the band of frequencies spanned

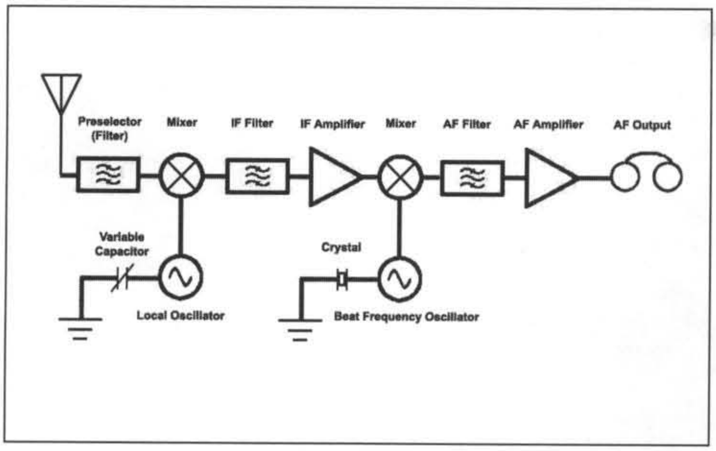

Figure 2—Superhet reciever block diagram.

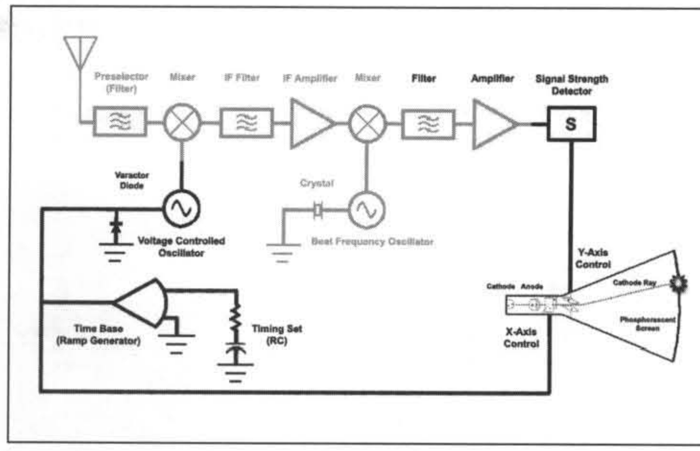

Figure 3—Spectrum analyzer block diagram.

is established by the amplitude of the sawtooth wave, by the way). The sawtooth wave generated by the time base also sets the X-axis trace or sweep in the cathode ray tube (note that the sawtooth wave frequency-that sets the refresh rate of the trace in the CRT-is set by an RC circuit).

The signal strength detector (or S-meter output) generates a voltage that varies (logarithmically) with the signal strength of the received signal. This is input to the Y-axis control and sets the Y-axis value (at a particular frequency) as the beam traces across the CRT phosphorescent screen.

Note that it is not really necessary that the frequency at which the strength of the signal is measured be at AF-that is, it could just as easily be measured at a second intermediate frequency. Using an IF higher than audio frequencies makes the filter much easier to build, and greatly simplifies the entire design.

Voila! Here's your spectrum analyzer. Simple but elegant!

Building a Practical Spectrum Analyzer

Earlier, I said that there are many different spectrum analyzer designs. Commercial precision spectrum analyzers can cost upwards of several tens of thousands of dollars! But there are several different designs that are within the construction abilities of many QRP construction enthusiasts. My favorite by far is the one described by Wes Hayward, W7ZOI, and Terry White, K7TAU in the August and September, 1998, *QST* magazine ("A Spectrum Analyzer for the Radio Amateur"). A kit of parts and boards (you have to supply shielding, interconnecting cables, feed-through capacitors, etc.) is available from Kanga US (http://www.bright.net/~kanga/kanga/w7zoi_sa.htm). I built this kit, and while it is a lot of work, it really does work, and is one of the most significant projects that I have ever built.

Previously, I mentioned the book by G3MFJ and G4WIF (*Simple Test Equipment for the QRPer*). In this project, Tony, G4WIF, uses a ramp generator to control the reverse bias on a varactor diode used to tune the classic absorption wavemeter. While this is not exactly a spectrum analyzer, it works very much like one and displays a representation of the amplitude of received signals in the frequency domain. I haven't actually built this project yet, but Ian Keyser, G3ROO (the GQRP "technical guru"), showed me his and I was dutifully impressed! What an incredibly elegant idea!

Well, we are now well into the winter 80-meter propagation season. I think I'll beef up the output filter of that transmitter we measured with the spectrum analyzer just a little bit and get it QRV for the weekly NOGA QRP net (9:30 pm Eastern Time every Tuesday, 3686.4 kHz)!

—72 de Mike, KO4WX

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RSGB NFD — June 1-2, 2002

Dave Sergeant—G3YMC dsergeant@iee.org

What is NFD? NFD, National Field Day, is an amateur radio contest organized by the Radio Society of Great Britain (RSGB), the national amateur radio society in the UK. The contest is arranged to coincide with a similar contest in other European countries, though the UK scoring system is slightly different. The objective is to contact as many other stations as possible, with extra points for working portable stations and stations outside the UK. In practice, most of the contacts are with UK and European contest stations.

NFD operation must be portable, with the station power derived from a generator or batteries, not from the mains. There are three sections: Open, with no restrictions on the number of aerials; Restricted where a single aerial at 11 meters is used; and Low Power where the power is also restricted to less than 10 Watts. This is a CW contest—there is a SSB event in September. Operation is on all the amateur HF bands between 160 meters and 10 meters, with the exception of the 30 meter, 17 meter and 12 meter bands where contest operation is not permitted.

NFD is a 24-hour contest, from 1500Z, June 1st, to 1500Z, June 2nd, 2002. For the Low Power section, which we entered, operation is limited to 12 hours, but can be in several sections over the period.

Initial Planning

Our club, the Bracknell Amateur Radio Club (G4RRA/P), has entered NFD many times in the past. We are always looking for something different, and as we are not a big club in terms of HF CW operators, we are not in a position to do well in the open section, where we would be competing against much better equipped stations. Two years ago, for instance, we operated a single band station on 160 meters, and were the band leaders (though way down in the overall entries).

Initial ideas started when I bought an Elecraft K2 transceiver. This is a very compact HF transceiver with, in its basic form, up to 12 watts output and running off a 12 V supply. With the options I have currently fitted, i.e. the 160 meter option and the KAT2 automatic ATU, it looked attractive to use in the low power section with its transceiver 10 watt limit. Normally we have powered all the station equipment from a 3 kVA petrol generator. What would be the possibility of instead powering the complete station with all its accessories, from batteries, saving the noise and running expense of the generator?

Photo 1—Setting up the station.

The K2 takes around 240 mA from 12 V in receive, and around 1.5 A key down in transmit. The receive current can be reduced to around 150 mA by turning off the LCD backlight and other measures. Rough calculations indicated that a 4 AH sealed lead acid battery, readily available for alarm backups, might last for 12 hours of operation, but a second one should be kept in reserve. I ran my K2 in the shack from such a battery one day as a check, and was impressed with how long it lasted. Just before Field Day, John, G3NCN, produced a couple of 7 AH units—we had enough power for several days! Oh, and the K2 has an internal keyer, which works very well. No problems with incompatible keyer interfaces and RF feedback into them. And excellent full QSK—no clattering relays.

But what about the rest of the station, in particular power for a logging computer (essential in today's contests), lighting and home comforts? The latter were solved when John offered us the use of his camping trailer as our operating position, towed behind his car onto site, then magically transformed by unclipping and reclipping a few bits into a spacious caravan, complete with all the lighting, cooking and heating mod cons you expect from a camping enthusiast. And it had a copious 12 V supply of its own—65 AH in fact—enough to power the rest of our gear. To maintain our aims, the K2 would still be powered separately from the gel cells.

Most modern laptops do not have enough battery capacity to run for 12 hours without charging, and also require unusual voltages such as 18 V, so they cannot be run from 12 V direct. By luck we still have a number of ancient Zenith laptops—no hard disks, 720k floppies, and incredibly slow—but they run off 12 V at around 0.5 A! We checked these out on bench supplies, and found they worked okay right down to about 10 V input. Software was EI5DI's Super Duper—the later versions will not run on 8086 processors, but the copy we purchased a few years ago did (take note, Paul!).

The Site

Field Day is a portable contest and a suitable site must be identified in advance, preferably one with plenty of open space for antennas and away from residential areas, permission obtained from the owners, and the site registered in advance with the contest organizers. There are several suitable sites available to the Bracknell Club, two of which are local.

Longhill Park, where we operated, is a former landfill waste disposal site that was converted into public parkland in the mid 1960s. We have operated NFD and other contests there over the years, and it is an excellent location for amateur radio—large, open, well away from housing developments, and with a low electrical noise level. It is open to the public, and a favorite place for "taking the dog for a walk," but in general is quite peaceful. Most significantly, it is conveniently located for all our members, and is only ten minutes walk from my QTH! Longhill is owned and maintained by the local council, and permission was obtained from them to use it for the weekend. Registration details were submitted to the contest committee in early May to allow their "inspector" to visit us if necessary to check we were operating within the spirit of the contest.

The Antenna

Stations in the Open section of NFD have no limit on the number of antennas they can use, apart from a 20 meter-height limit. In the Restricted and Low Power sections, however, only a single antenna is allowed, with a height of 11 meters maximum and no more than two elevated supports. If operation on all bands is required, the options for antennas are somewhat limited, and we decided to use what has become a standard for Field Day stations—an inverted Vee doublet with the center supported by a single mast and fed with open wire feeder. To give good performance on the 160 meter band, a total top length of 204 ft was decided on. There is nothing significant in this length; it is in fact a double size G5RV, so it can be expected to give a sensible impedance match on all bands. The feeder was 40 feet long, sufficient to reach the operating position with some spare.

The internal antenna tuner of the K2 can match most antennas but for feeding balanced line a balun is required. Using the designs in the ARRL *Antenna Book* I constructed a suitable balun and arranged it to be switchable between 1:1 and 4:1 impedance ratios via a toggle switch. In fact, it was used just in the 1:1 position and a match better than 1.6:1 was obtained on all bands. The K2 remembers the ATU settings for each band so instant band change was possible and it was not necessary to change the settings after the start of the contest.

In order to identify any problems with the impedance of the antenna, I downloaded a copy of the program dipole3.exe from G4FGQ's site (http://www.g4fgq.com). This program is specifically written to calculate the matching impedance of dipoles fed with balanced line. Although this was an interesting exercise, the results of the simulation bore no resemblance to the performance of the antenna when erected!

Any antenna requires a support mast or tower. Initially we had planned to use the same mast we had used two years ago: a lightweight aluminum mast designed by John, G3NCN. Just ten days prior to field day we heard that a former member of the club had kindly donated us an ex-army 30 foot sectional mast, brand new, for club use, and an initial check indicated this would be ideal. To check out however we needed to do a trial erection, which was done a few days before the contest. The whole antenna and mast was erected, checked with the K2, disassembled and repacked within an hour or two. With just two of us on site it was remarkably easy to erect the mast, though we were hoping more help would be available on Saturday! We had a quick QSO on 40 meters just to prove it worked. Of course, to keep within the Field Day rules, everything was then taken off site again.

Tactics

When operating all bands, it is important to choose what time to operate on each band in order to maximize the scoring rate. In NFD double points are given for all contacts on 160 meters and 10 meters. The operating time for 160 meters is from late evening until the middle of the night (by which time there will be few new stations to work). 10 meters is only open during daylight, and is unpredictable as it depends largely on sporadic E propagation, which may only occur for relatively short periods. It is important not to miss these openings on 10 meters!

In the Low Power section we are also limited to a maximum of 12 hours operating time in total. We had another problem —both John and I have church commitments on Sunday. On that basis, an operating time of 5 PM to 5 AM local (1600Z-0400Z) seemed sensible. We would have a fair chance of catching any sporadic E opening on 10 meters on Saturday, and we would be able to use the whole of the night period for 160 meters, 80 meters and 40 meters. And by 5 AM it would be light, and the station could be dismantled easily allowing us to hopefully be rested in time for church (or that was the theory...).

Saturday Afternoon

Knowing now how long it would take to erect the antenna, we aimed to get on site around 3 PM, which would allow us plenty of time to achieve our starting time —in fact we were there a little earlier, as John's son-in-law was keen to witness the transformation of the camping trailer! Our third operator was Ian, G3TLH, a QRP die-hard, who cycled to the site. We were joined in due course by Steve, G4AUC (our "cameraman"). Photo 1 shows us setting up the site.

The first task was to convert the camper trailer into the operating tent, which was done by John with a little assistance. We were all amazed at how large and roomy it was after assembly. Having stored all unwanted items (and Ian's bike) underneath the trailer, we paused before unpacking and erecting the mast. With four on site this was erected fairly quickly, and the antenna with its open wire feeder uncoiled, pulled to the top of the mast with its halyard, and the remote ends secured in the correct places. The balun was attached, and the feeder fed through a convenient hole in the trailer to the operating position.

We then encountered our only hiccup during the weekend. When we came to check the trailer electrical system we found the voltage collapsed when we turned on any load such as the lighting. Dreading a flat battery which would have seriously limited our activities (but certainly not stopped us), we investigated. We found the master fuse was not making proper contact in its holder—a small piece of aluminum foil was placed in the holder to make it firmer (no, we didn't short the fuse out...). The other problem was we were unable to light the pilot light on our propane powered fridge—so the milk had to do without.

Setting up the station itself was done relatively quickly; it was just a matter of connecting up and go. Each band was then tuned with the K2's ATU, a simple case of pressing the tune button and letting it do its work (loads of clicking relays as it runs through all possibilities). On most bands the tuning had not changed since the trial run, quite surprising as the antenna had been in a completely different place in the field. The logging computer was then powered up and we waited while it booted and loaded the software. A quick check and break, and we were now all set for the fray!

The Station in Action

Photo 2 shows me operating the rig, with Ian, G3TLH, doing the logging on the Zenith laptop. Since neither of us had used the SD program for some time, we had a few problems during those first QSOs. In particular, we had forgotten that the "-" key is used to totally delete an unwanted entry. I took a "tea break" trip back home and returned with the SD instructions—we had no further problems with that one!

Photo 2 shows how compact our station was. Absolutely everything apart from the balun and antenna is in the picture. The gel-cell is behind the K2, partially hidden by the laptop. No, that is not a road you see out of the window—it was the newly mown grass the council had obligingly cut to allow us easier access.

As if by cue, we found the 10 meter band open right at the start of the contest, so we spent the first two hours down there taking advantage of the double points available. These sporadic E contacts were largely with European portables, though it was nice to work 5B4/GM3YTS/P in Cyprus who was doing very well indeed in the contest. We stayed on 10 meters until the band started to fade, followed by a short spell on 15 meters. Most of the time we kept the K2 output at 5 watts to maximize battery life, and we had no problem making contacts. After some successful sessions on 40 meters and 80 meters it was time to start on 160 meters at 2200Z. I had been skeptical as to how the 5 watts from the K2 would perform on that band, especially since I had only had two QSOs on the band from home. I needn't have worried, we could work virtually everything we heard. Time and time again John suggested we would be wasting our time calling a weak eastern European station and he was proved wrong every time when we made it on the first call! It seemed our antenna worked like a dream on that band.

It was a pleasant night. Fortunately there were no problems with thunder static, which can wreck havoc on the LF bands, and even worse, damage equipment if there is an actual storm. For a while we needed to use our propane gas heater, but it was by no means cold, and as always it is a thrill to see the sun slowly appearing out of the dark. All too soon it was 0400Z and time to pull the plug and take down the station.

The Results

As we drove off-site early Sunday morning, it was time to analyze the results and work out the strategy for next year. These days preparing the logs and sending them off is a very straightforward process—the logging software takes care of marking all duplicates, scoring etc., producing an electronic log file suitable for sending to the adjudicators. In fact the log was submitted by e-mail on the Monday morning. Gone are the days of laboriously copying all the contacts from paper onto the official log forms by hand, checking for duplicates with check log sheets, and adding up the scores

Photo 2—The author at the rig and G3TLH logging on an old laptop.

manually—in those days this took several days, and there were always problems reading individual operators' handwriting and sorting out conflicts and errors. Computer logging also makes the adjudicator's job much easier (but that doesn't mean they announce the results any earlier…). These are our results as submitted:

Band	Valid QSOs	QSO Points
160M	95	756
80M	90	331
40M	67	252
20M	4	14
15M	28	98
10M	51	364
Total	**335**	**1815**

These results should put us in a very good position in the Low Power section of the contest—the total score is in fact rather higher than the winners of that section in the 2000 NFD.

Analysis

Did our entry meet our expectations? Undoubtedly! Could we have done better? Probably!

I have no reservations in saying that the Elecraft K2 is an ideal rig for the Low Power section of NFD. Of course, now that they have introduced their 100 W version, it would also make an excellent rig for the Open and Restricted sections as well. But I shall not be buying that version myself! Although we could have run the full 10 watts allowed, we were very pleased with its performance at 5 watts—certainly we had no problem making QSOs, and whether we would have worked many more with 10 watts is questionable. Time and time again Ian, G3TLH, commented on how much he liked the feel and operation of the K2; it certainly is a nice rig to use and less daunting than many of the other rigs on the market today. The performance of its receiver is the real bonus, with excellent strong signal performance and very nice CW filters. I suspect we had an advantage in hearing stations, particularly on the lower bands, which others couldn't.

And what about the antenna? I think the length we chose, 204 feet, is a good compromise. It gave excellent performance on Top Band and still gave reasonable results on the higher bands. By using the K2 internal tuner we did not need to worry at all about matching during the contest—instant band change, and knowledge that it was always matched and working as it should be.

The advantage of powering the whole station from batteries was also well received. In the past the major expense in NFD has been the cost of petrol for the generator. There was also an absence of the generator humming away close to the tent, no worries about electrical noise from it, and no need to worry about keeping the fuel tank topped up (a potentially dangerous process at night). We now know that we have more than adequate capacity in our batteries, though this was something of an uncertainty this year. Yes, this is the way to do it.

Conditions on the bands were reasonable as far as NFD is concerned. Not much DX about, but good propagation into Europe, a nice sporadic E opening on 10 meters, and no QRN (static) on the lower bands. Our choice of operating times was optimum as it happened, though we would have lost out if the 10 meter opening occurred on Sunday. We missed out on working much on 20 meters. When we finally went on that band around 0130Z, we found propagation to Europe had faded and most of the activity was from the USA who were only interested in ragchewing. But the bonus points on the other bands made up for lack of QSOs on that band.

Will we do the same next year? Maybe, but that is a decision to be made nearer the time. But those taking part in this year's event agreed that it was a most enjoyable weekend and would recommend a setup similar to ours as an excellent way of putting on a station in the Low Power section of NFD with the minimum of effort - and achieve an excellent position in the results. ●●

Change Frequency with Crystal Penning

Hans Summers—GØUPL GØUPL@callsign.net

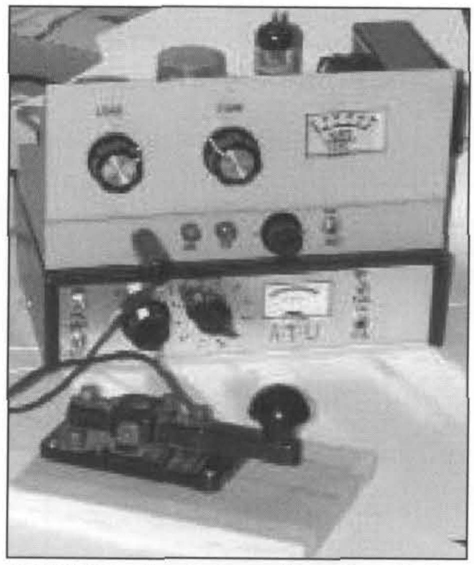
How to homebrew your own crystal frequency!

When operating a rockbound transmitter such as my 10 watt one-valve 80M CW transmitter (pictured right), you will often get frustrated by QRM on your frequency that drowns out any station further than the end of your street. Or you hear someone calling CQ nearby but you can't get the frequency close enough to work them. Pulling the crystal via a variable capacitor helps a little but doesn't entirely resolve the situation. What you really need is a VFO. But if you don't want that complication, then a few extra crystals will help.

I already had a crystal for 3.560 MHz, the international QRP calling frequency, and wanted one for 3.558 MHz, the FISTS club calling frequency. An advantage of having two nearby frequencies is that if you're listening on 3.560 MHz without the CW filter, you can hear CQs below you on 3.558. But, you can't buy a ready-made 3.558 MHz crystal anywhere, so you have to either have one made to order, or make one yourself as follows.

Before that though, what about ceramic resonators? They are stable (though not AS stable as a quartz crystal) and they can be pulled over a much greater range. A 3.79 MHz ceramic resonator certainly covers the band of interest. So I tried one in my one valve transmitter, but the results weren't good. Basically, the power dissipated in the crystal or ceramic resonator is quite high because it's a valve circuit, and the crystal gets quite hot. Unfortunately when using a resonator the heat results in a degree of frequency drift which is unacceptable, leading to severe "chirp." On key down, you can hear the transmitted note drop by many hundreds of hertz in the first second or so of keydown.

This idea for choosing your own crystal frequency comes from an article 'Penning Down' Crystals by Richard Wells GØRXH, published in *SPRAT* #99. In the article Richard recommends selecting a crystal frequency above the frequency of interest, and removing the case of the crystal and drawing on the surface with an



GØUPL's "rock-bound" valve (tubes for U.S. readers) transmitter.

indelible ink marker pen to lower the frequency.

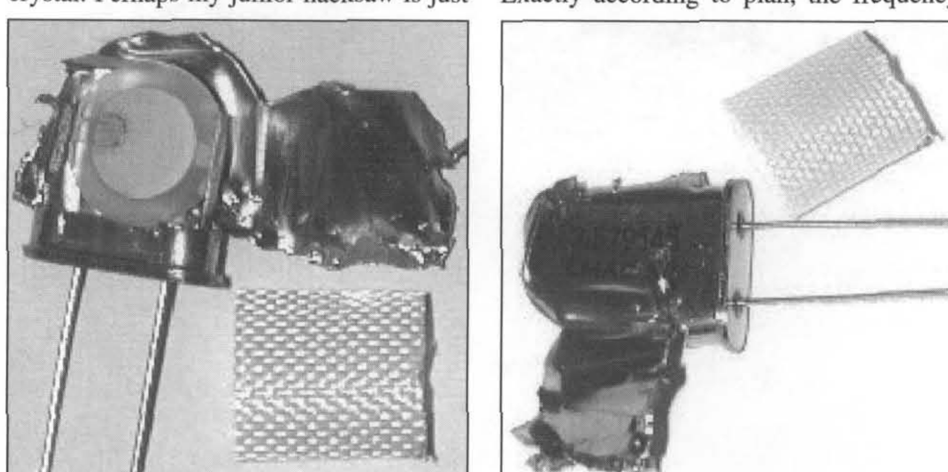
There are two types of crystal casing: resistance welded, and soldered. The soldered ones can simply be unsoldered, whereas the resistance welded ones must be sawn off. Unfortunately the only crystals I could get were resistance welded: it seems to be the current manufacturing method. I got two 3.579545 MHz crystals, which are very common as this is the television colour burst frequency.

I had no luck sawing off the case of my crystal. Perhaps my junior hacksaw is just blunt. All I managed to do was break one of the wires off the crystal. Then I realized that the crystal slab is circular, whereas the metal can is rectangular: there must be some space in the corners. So I cut off the corners opposite the leads using wire snippers. It is possible to VERY CAREFULLY remove the case by cutting it with wire snippers, but it is all too easy to accidentally break the crystal. Interestingly, inside the crystal case is a woven fabric sheath.

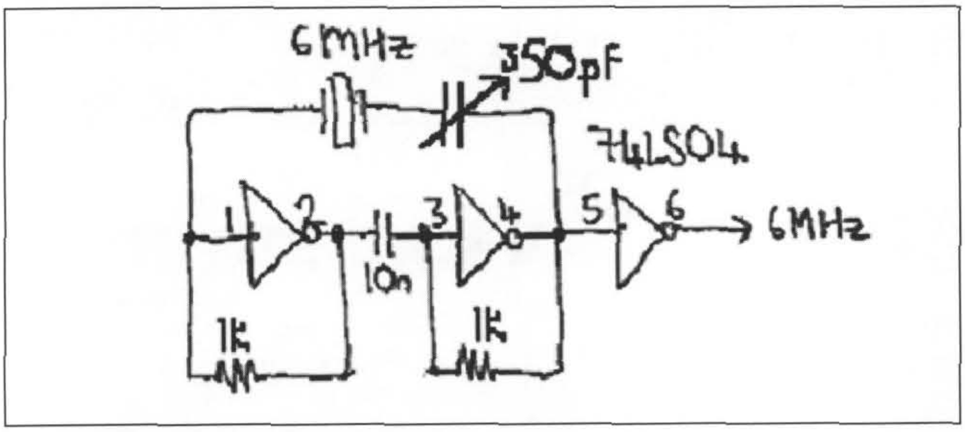
These pictures show the crystal I messed up. Lucky I had two of them (the other one had a missing wire due to the aborted hacksaw attempt, but at least the crystal was still connected). In this crystal, one side of the quartz slab became detached from its mast. The reason it looks a little melted on the left is because I wondered if you can solder to the silvered plate and thereby reconnect it. You can't.

The next thing to do is build a simple crystal oscillator circuit. I always use the same type of 74LS04 oscillator circuit, shown here from my Huff & Puff stabiliser page. In this case I did not use a variable capacitor to pull the frequency. The usual Frequency Counter is used for frequency measurements.

Then all that's needed it to start the art work. First I gingerly applied a small dot of ink to the crystal surface. The crystal stopped oscillating, but restarted a few moments later once the ink had dried. Exactly according to plan, the frequency



A close-up look at the crystal after disassembly with a small hacksaw (unsuccessful) and wire nippers (better, but be extremely careful not to break the wires).



A reliable crystal oscillator test circuit using a 74LS04 IC.

was lowered! ("I love it when a plan comes together"). But not by much. By the time I had completely painted the entire crystal surface black with the indelible marker felt tip pen, it still wasn't down to 3.558. So I repainted it again with a second coat, and got the frequency down to 3.553. Too low! (Well it did say in the article it's difficult to get an exact frequency).

Now for something not in the article, my own twist to the experiment—a little drop of the XYL's nail varnish remover on a cotton bud, with which a tiny bit of indelible ink can be gently removed. Taking the frequency back up to 3.565. Back and forth a few more times, a little more ink, then taking away with the nail varnish remover, and I got the frequency to 3.558 within 100 Hz. Nice. Nail varnish remover is mainly acetone and you can use it to remove all sorts of more useful stuff than nail varnish.

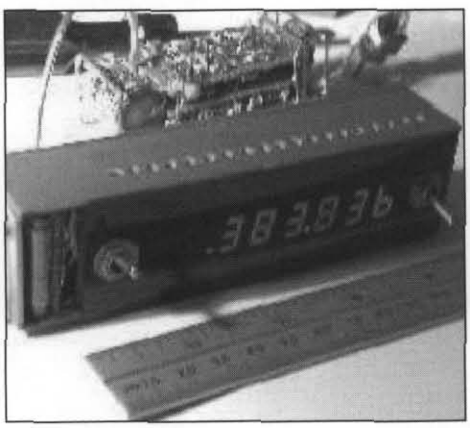
Finally, that delicate new crystal needs some protection. So I built a new case out of single-sided unetched copper PCB material soldered into the right shape. You can solder to the remainder of the crystal case, even if it's a resistance welded type. The picture to the right here shows the final result. It's about twice as big as the original crystal and isn't even air tight. Ugly, but it works great and you can even proudly write your new frequency on the case.

Note that this is the crystal with the broken off wire due to the unsuccessful hacksaw attempt. I placed a wire over the stub and managed to connect it to the crystal case. So the lower of the two connections in the picture is just to the case, which is one terminal of the crystal.

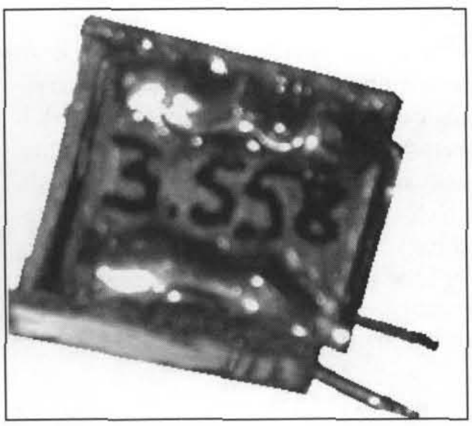
After building the new case around the crystal, the frequency changed by a few hundred hertz. It moved some more when I put it in the transmitter as opposed to the IC test oscillator (transmitter measurements made by zero beating the transmit frequency with the receiver VFO). For this reason it's advisable not to fix the lid of the new case on too securely until you have made any final adjustments (a bit more ink) with the crystal in place in its final circuit.

I have now had many QSOs on or near 3.558 MHz using my new crystal. It's great to have another frequency to escape to if there's too much TV timebase noise or something on 3.560. I have not noticed any adverse effects from the large amount of dried ink on the quartz surface. The output power of the transmitter is the same as with my 3.560 MHz crystal. Stability is the same, and the pulling range is if anything, greater. I get many good reports about the purity of my transmitted tone, and still get the same good comments when using this new crystal.

Many thanks to Richard Wells GØRXH for his SPRAT article, and also to Radovan Vlacilik OM2ZZ who alerted me to the existence of the article. ●●



Testing the crystal with a frequency counter.



The finished product—it may be ugly, but it works.

A Vertical Doublet for 30-10 Meters

L.B Cebik—W4RNL

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[Editor's Note: This article, written in December of 1999, and borrowed from his website, has been reproduced with the permission of its author, the noted antenna guru, L.B. Cebik, W4RNL. It addresses a need for a relatively inconspicuous antenna that can work remarkably well. Check it out—I think you just might be surprised how well it works.]

One common problem faced by many of today's hams is a total lack of space for an antenna system. Sometimes land restrictions prevent construction of the ideal antenna farm. Sometimes family objections get in the way. Multi-family dwellings also defeat antenna farm dreams.

Suppose that you can put up only one antenna and that it must be vertical in order to use the minimum space possible. One common solution to the problem is to buy a trapped multi-band vertical and place it on the roof, with the minimum number of radials tacked down to the roofing shingles or draped over the eaves. Most of the available trapped monopoles are good antennas of their type, but they are initially costly.

Is there a cheaper alternative? In fact, there is a much cheaper alternative that is also less visible. However, there will be several kinds of work involved, and you will need an antenna tuner.

Although an antenna tuner (ATU) is part of any antenna system where it is used, I tend to separate the cost of the ATU from the cost of the antenna. In a lifetime, one will wear out many antennas, but a good tuner should last forever. So I shall assume that you have-or will obtain-the best ATU for your operating needs.

A 20-Meter Vertical Dipole

Any dipole, when placed horizontally over the ground, shows the familiar figure-8 pattern broadside to the wire, even if we change its length from about 3/8 wl to about 1 wl long. (The lower the antenna height, the more "thick-waisted" the pattern gets.) As we lengthen the wire, the beamwidth gets narrower while the peak gain gets a bit stronger.

If we turn the dipole to a vertical position and elevate it off the ground by a few feet, we obtain an omnidirectional pattern quite similar to that of a standard ground-plane monopole. The same tendencies that kept our horizontal dipole showing its two lobes broadside to the wire now keep the elevation angle of radiation low as we change the length of the vertical dipole from 3/8 wl up to 1 wl long.

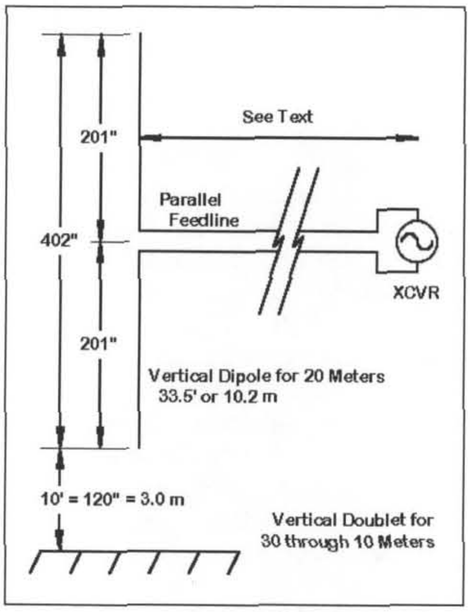

Figure 1—Diagram of the vertical doublet, showing the dimensions used for its evaluation.

Now let's fix the length, using a standard 20-meter dipole as our vertical antenna. As shown in Figure 1, we might place this antenna 10 ft. (3 m) off the ground and support its upper end, which is now about 43.5 ft. (13.25 m) off the ground.

At this point, the only change from standard ham practice that we shall make is to substitute parallel feedline for our usual coax. Although this move will require a bit of special attention—to be discussed further on—the basic run should be brought as straight away from the vertical as possible for as long as possible before routing it to the station. We shall use our ATU to provide a match between whatever impedance appears at the ATU and the station equipment.

Our 20-meter vertical dipole is nearly 3/8 wl long at 30 meters. It is 1 wl long on 10 meters. For the bands between 20 and 10, the antenna is somewhere between 1/2 and 1 wl long. It meets the conditions for having a decently low radiation angle on all of these bands.

Figure 2 shows the elevation patterns of our vertical dipole for all bands from 30 meters through 10 meters. As we expected, if we increase frequency, the main lobe gets a bit lower, ranging from 18 degrees on 30 to 10 degrees on 10. Of course, as we might also expect, the gain is much lower than that of a beam, but then, we are contemplating this antenna for locations where a beam is impossible anyway. Table 1 shows the modeled gain and elevation angle for a 1 in. diameter aluminum version of the antenna on each of the bands.

Even wire versions of the antenna (#12-#14 AWG) will show almost identical gain and elevation figures.

Construction

Since we are not seeking an exact match to a 50-ohm coaxial cable, the

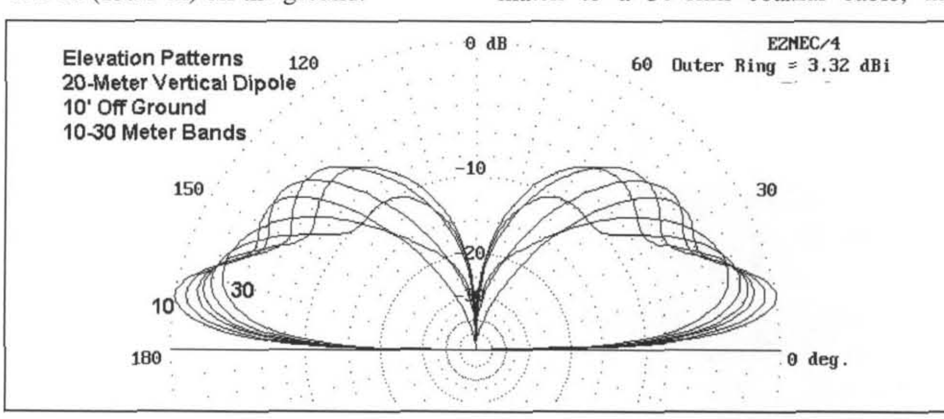

Figure 2—Elevation patterns of the vertical dipole on 30 through 10 meters.

Band (M)	Gain (dBi)	Elevation Angle (degrees)
30	0.9	18
20	1.4	15
17	1.8	13
15	2.1	12
12	2.7	11
10	3.3	10

Table 1—Modeled gain and elevation angle on each band.

dimensions of the 20-meter vertical dipole shown in Figure 1 are not critical within a few inches or centimeters. The antenna can be wire or tubing, depending on what the available support systems will allow.

Three of many possible support systems appear in Figure 3. On overhead limb of a tall tree can support the wire antenna, with a rope holding the bottom end in place. If the transmission line is very securely attached to the wire, a little tension will keep the vertical from flapping in the breeze. If you have 2 support structures separated by a space, you can support the top and bottom of the antenna with cross ropes. Of course, you can also mix and match the two top and bottom support means shown in the sketch.

Equally effective will be a self-supporting version of the antenna, although developing a 10 ft. support may be more difficult. As well, the antenna—if made from standard tubing—may wave mightily in stiff breezes unless guyed with light ropes about 2/3 the way up the tubing.

It is impossible to analyze in the abstract all the difficulties that may be faced by individuals trying to get an antenna in place in very restricted spaces. So the best advice is to give your situation careful study, looking for support possibilities in everything you see. For example, if a roof or chimney top is not quite high enough, but a tree in the area is more than tall enough, you can use a sloping rope between the two to support the wire antenna.

There is no magic about the 10 ft. minimum height selected for this antenna. Safety is the foremost concern. The end of the antenna on some bands will carry a very high voltage that can create RF burns if someone touches it while you are transmitting. Although the top height provides good performance, you can lower it if you bend the bottom wire to the side at a safe distance above everyone's head. The change in performance is small enough that it is unlikely to be noticed.

Matching the Antenna

The impedance that your ATU sees at its terminals depends on several factors—1) the band of operation; 2) the length and characteristic impedance of the parallel transmission line you use; and 3) the imbalance the occurs from routing the transmission line so that the antenna field couples to it.

Let's take up the first two considerations together. The impedance of the antenna at its center feedpoint will change from band to band. From any given impedance at the antenna terminals, the impedance will vary along the feedline depending on the characteristic impedance of the line, the line length, and the velocity factor of the line. 300-ohm twinlead has a velocity factor of about 0.8 due to the solid vinyl insulation between wires. Almost all other parallel lines have velocity factors above 0.95, and home-made line with periodic spacers has a velocity factor of just about 1.0.

Impedance, recorded as resistance and reactance in series, repeats itself every electrical half wavelength (taking into account the velocity factor) along a transmission line. As a test, I modeled the antenna with various physical feedline lengths, using a 3 in. spacing between #12 wires to simulate a home-made line. With lengths of 1/8, 1/4, 3/8, and 3/4 wl of transmission line at 20 meters, I obtained the impedances shown in Table 2.

The repetition points will vary from band to band, since they occur as a function of wavelength. Within in the limits of this small test, I have flagged very high impedance values that might exceed the range of the tuner controls to match easily. Notice that as the line length changes, the values appear on different bands. Hence, for any given line length, only 1 or 2 of the bands are likely to present a difficult matching situation.

The solution is sketched in Figure 4. Adding a 6-10 ft. (2-3 m) length of line will, under most circumstances, change the impedance values enough on a troublesome band to let you obtain a desired match. The extra line should form a wide loop and not be folded back on itself too tightly.

The third circumstance which can alter the impedance that appears at the tuner terminals is the degree to which the transmission line is coupled to the antenna field. This can occur whenever the line forms an angle other than 90 degrees with the vertical antenna wire. The closer to the antenna that the angled transmission line is, the stronger the coupling. Antenna field coupling to the transmission line appears as common mode currents—that is, currents that are the same in magnitude and phase on both wires. These currents add and subtract from the normally equal magnitude but opposite phase currents on a transmission line, upsetting the desired balance. The currents also show up in the shack as RF that can disrupt equipment operation or give minor RF shocks at any metal corner. They may also cause RF interference with household devices. Ordinarily, they are not strong enough to reradiate in ways that

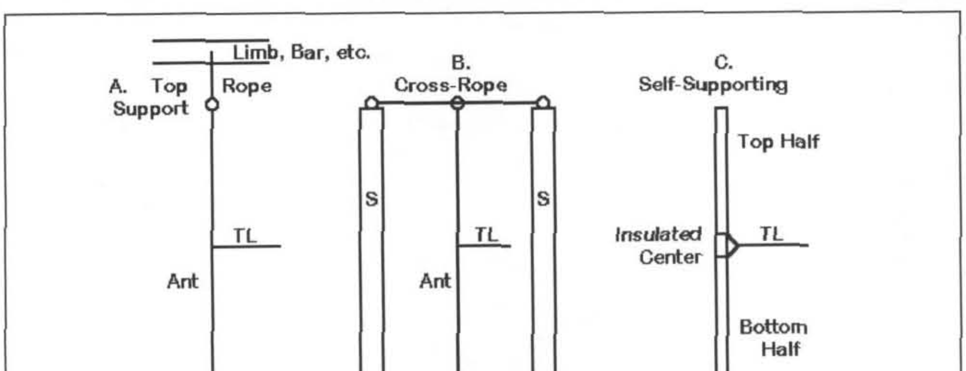

Figure 3—Possible methods for supporting the vertical doublet.

		Transmission Line Lengths (at 20M)			
Band	Antenna	1/8 wl	1/4 wl	3/8 wl	1/2 wl
30	35 – j465	20 – j95	25 + j225	60 + j175	4250 – j6720*
20	70 – j30	120 + j450	2880 + j1950*	170 – j625	74 – j50
17	165 + j420	1950 – j1310*	125 – j235	155 + j360	2740 – j465*
15	340 + j830	235 – j650	105 + j150	2215 + j135*	130 – j305
12	1310 + j1720*	90 – j200	300 + j870	135 – j440	135 + j440
10	4200 + j110*	65 + j5	4300 – j175*	70 + j10	4250 + j105*

Table 2—Impedance at the antenna, and with various lengths of transmission line, for the six bands of interest. (*These values may exceed the range of a typical tuner.)

seriously disrupt the antenna pattern itself.

The cures require a little work. First, re-examine the transmission line routing to see if the right angle to the antenna can be maintained farther away from the antenna wire. Second, you may install a 1:1 balun at the entry point to the house and use coax from that point to the ATU—if the ATU is a network-type tuner. (This treatment is not needed with a link tuner if the input and output sides do not have a common ground path.) If the coax run is short enough, losses due to high SWR will not be great. A ground wire—as short as possible—to a good earth ground should go from the balun end of the coax. Third, you may also install a balun at the input end of the ATU or use brute-force ferrite split blocks over the coax on the input side of the ATU (and on the output side, if using the second suggested system).

The suggested routes of cure are given in the recommended order of implementation. Only the most stubborn cases require all three techniques. The exercise will teach you much about how RF gets from an antenna into the shack—and how to block it most effectively. The presence of common mode currents does not mean that the antenna is not performing correctly or that the pattern shape and strength are ruined. It only takes a little RF in the shack to disrupt matters.

One question that often crops up with multiband antennas is whether one might use coax instead of parallel line all the way from the antenna to the ATU. If the coax run is very short, one might use this technique of feeding the vertical doublet, but some of the impedances at the antenna terminals will present a very high SWR to a 50-ohm coaxial line. As frequency increases, so to do coax losses, and performance on the highest bands may suffer from appreciable power being turned into heat in the line. For this type of application, parallel feeders are far more efficient.

How "Good" is the Multiband Vertical Doublet

When a dipole is pressed into service on bands other than the one for which it is near resonance, it often becomes other than a dipole. The old name "doublet" is more properly used with such antennas. In assessing how good such an antenna is, of course, we must compare it to the right group of antennas. Comparing it to a beam is unreasonable, since we already agreed that the antenna is for use where no beam is feasible.

A fairer comparison is with a 20-meter ground plane monopole elevated to about the same top height as the vertical doublet. This antenna represents a roof top mounting, such as one might use with a trap monopole. For this test, the ground radials of the monopole were sloped, as they might be on a rooftop, and the antenna was resonated to give a 50-ohm resistive impedance on 20 meters.

Figure 5 compares the 20-meter elevation patterns of both the vertical doublet and the monoband monopole with a sloping ground plane. Although there are slight differences in the two patterns, performance of the two antennas is close enough that the user would detect no operational differences.

If you have the space and resources for a better antenna, by all means use it. However, for the ham with limited space and resources, a vertical doublet for 30 through 10 meters-based on the 20-meter dipole-makes an effective antenna for general communications.

[Editors note: I used a very similar antenna multi-band for a number of years and can attest to how well it can work. Mine was 22 feet of aluminum in a roof mounted small tripod with wire making up the downside It was my only antenna, worked well, and it was quite unobtrusive. I used it with an LDG tuner and obtained a good match on 10-30 meters While 30 meters and 40 meters were touchy, it did load and many contacts were made on these bands too.]

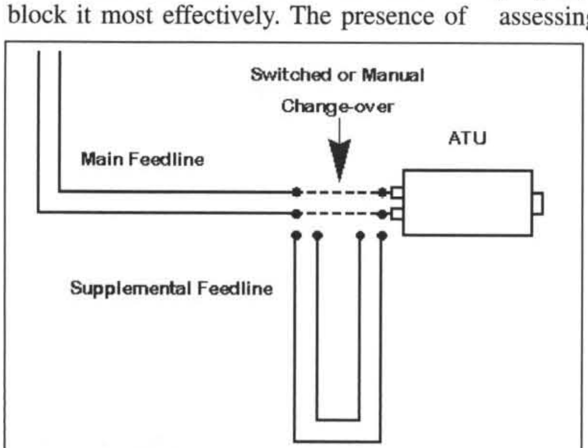

Figure 4—Adding an extra length of line can help with "untunable" bands.

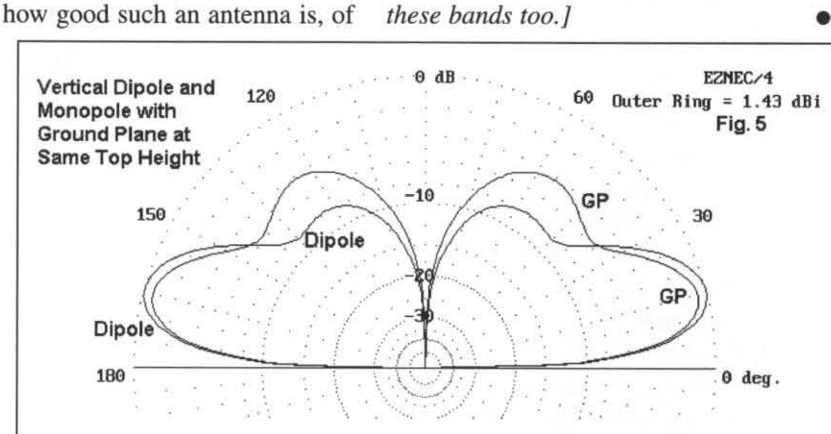

Figure 5—Comparison of radiation patterns between the vertical dipole and a conventional ground plane.

A Better TTC Filter for 40 Meters

Mike Boatright—KO4WX

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In the October, 2002, *QRP Quarterly*, I showed the circuit for the "G Filter" that Roy Lewellan, W7EL, introduced in *SPRAT* magazine (and reproduced on Page 125 of the RSGB *Low Power Scrapbook*). This nifty little filter is a triple-tuned (three resonator) filter designed to deal with the nasty conditions on 40M in Europe. After building a version of the filter (in an Altoids tin, of course!), and seeing how well it killed the QRM (I live three miles from a 50,000 Watt AM radio transmitter), it occurred to me that this filter was very similar to the 110 MHz IF filter (scaled appropriately to 40M) used in the W7ZOI/K7TAU Spectrum Analyzer (*QST*, August-September, 1998).

Roy, W7EL, had said that if you found his G-Filter to be useful, send him an e-mail and let him know about it. So, I did, and I also mentioned the similarity to triple-tuned circuit filter in the spectrum analyzer project. He wrote back saying that I was the first person to ever write him about the filter, and yes, indeed, it was based on Wes Hayward, W7ZOI's work on triple-tuned filters (check out, "Extending the Double-Tuned Circuit to Three Resonators," by Wes Hayward, W7ZOI, *QEX*, March-April, 1998), and he copied Wes on the e-mail.

Wes then wrote me and told me more about the triple-tuned circuit filter, and gave me some insight into a new book he was working (that's all I'll say about that). What resulted is the design for a filter, centered on 7.050 MHz, with a 100 kHz (yes, 100 kHz!) 3dB bandwidth, shown in Figure 1.

The component values are reasonably close to standard values, certainly within component tolerances. Note that the filter terminates in a 50-ohm load at either end (that is, it is reversible). You don't want to transmit through this filter, because the trade off you get for such a narrow bandwidth is a fair bit of insertion loss, 6 dB or so. But, the point of this filter is killing QRM, not transmitter spectral impurities.

But this is a slight improvement over the G-Filter presented in my *QRP Quarterly* article, which had over 9 dB of insertion loss. It is also somewhat easier to build, using a pair of capacitors to form an impedance match instead of tapped inductors (either way works, but the capacitors are much easier to work with!).

The schematic shown in Figure 2 is a practical circuit for this filter, using standard values. Note that capacitors C10, C11 and C12 are optional, but can be used to make the tuning of the filter a bit easier (the design values are on the high end of the suggested trimmer capacitors' range). All capacitors should be high quality, NPO

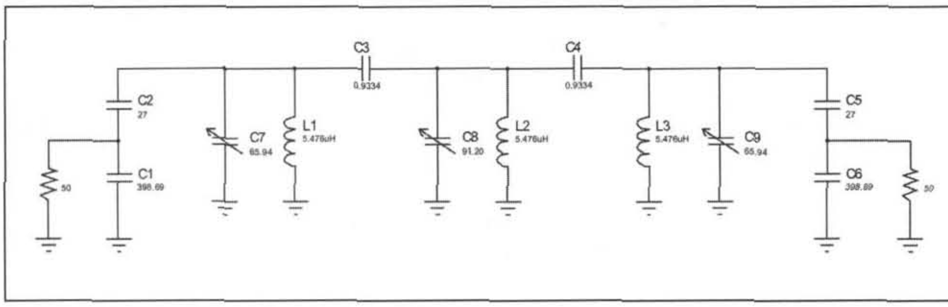
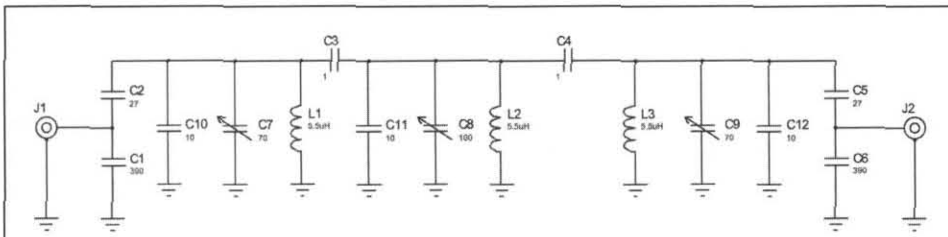


Figure 1—40M triple-tuned circuit filter design parameters.



Parts List

C1, C6 390 pF C0G/NPO (Mouser 80-C315C391J1G)
C2, C5 27 pF C0G/NPO (Mouser 140-50N5-270J)
C3, C4 1 pF C0G/NPO (Mouser 140-50N5-1R0D)
C7, C9 6.0-70 pF trimmer (Mouser 242-3810-70)
C8 12.0-100 pF trimmer (Mouser 242-3810-70) or 70 pF trimmer + 30 pF NPO
C10, C11, C12 optional 10 pF or 15 pF NPO capacitor
L1, L2, L3 5.5 µH, 37 turns, T-37-2, #30 wire

Figure 2—Practical 40M triple-tuned circuit filter and parts list.

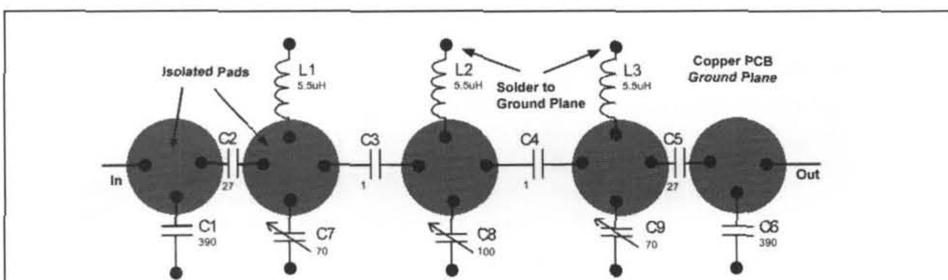


Figure 3—Suggested PCB layout for building the filter.

capacitors, since the filter has such a sharp passband.

This circuit is not nearly as complicated to build as it looks. It can easily be built in just a few minutes (depending on how you wind toroids) using the Manhattan-style construction technique. Figure 3 shows one possible layout for construction of the PC-board. Alternatively, you could glue PCB pads on the floor of an Altoids tin and construct the circuit without additional PC board.

An Altoids tin makes the perfect enclosure for this filter. For filters like this, I like to put a male RCA connector on one side and a female RCA connector on the other. This makes it really simple to plug right into the rig experiencing QRM problems (in most of my smaller, home brew radios, I use RCA connectors because they are cheap and quick to install). Figure 4 shows a completed version of this filter.

—72 de Mike, KO4WX

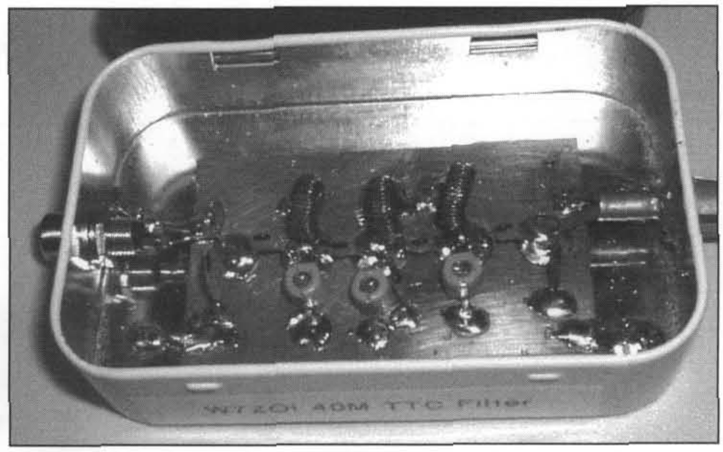
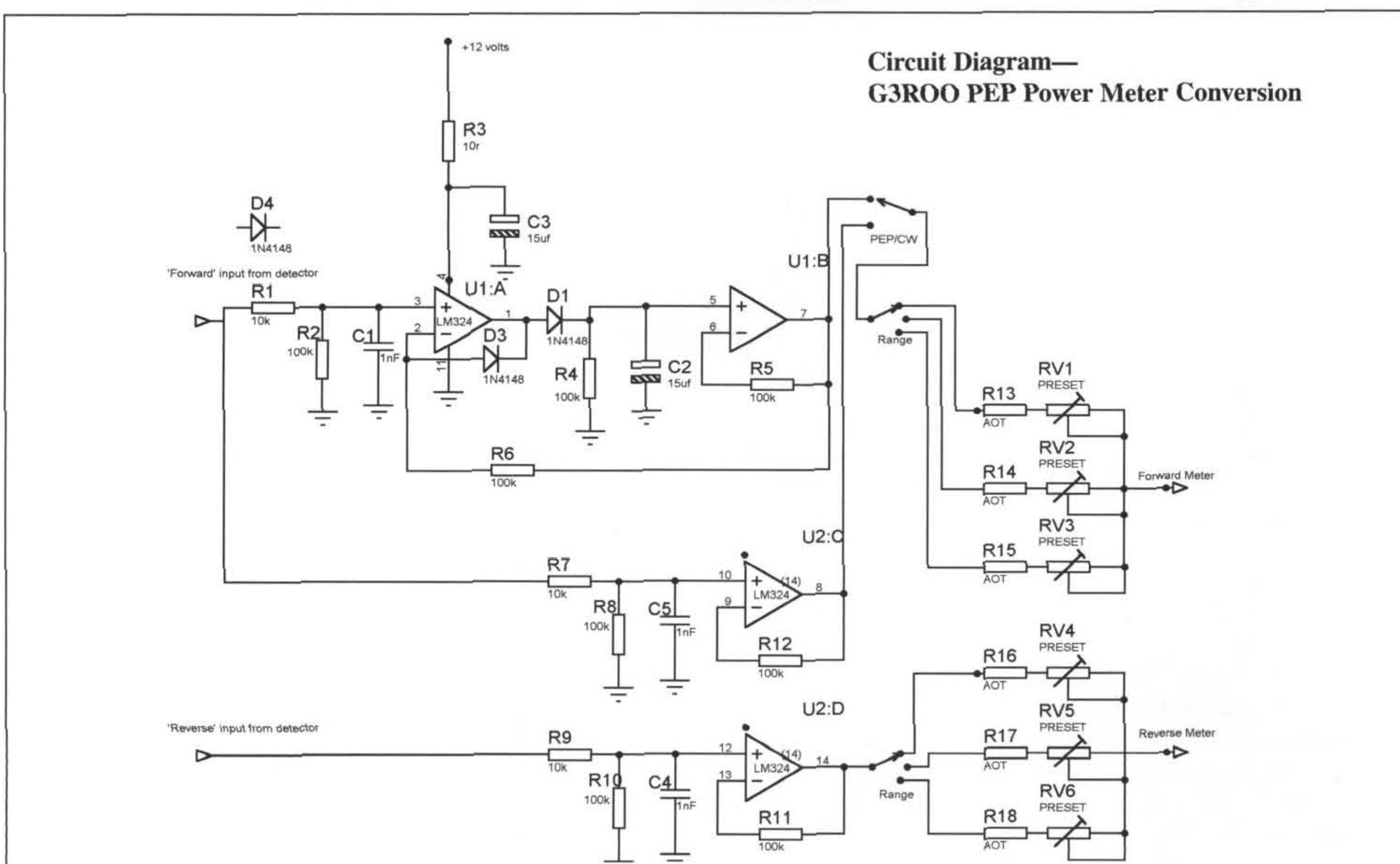


Figure 4—Completed TTC filter.

An Addition to G3ROO's PEP Power Meter Article

The circuit diagram below is the PEP adapter for power meters described in the article "Convert Your Power Meter to Read CW and PEP," July 2002 *QRP Quarterly*, pg. 37. Somehow, it was not received with the article, but we are pleased to print it now.

As a bonus, we also have a picture of the author, Ian Keyser, G3ROO in his well-equipped electronics workshop. With him in the photo is G4WIF (seated).



**Circuit Diagram—
G3ROO PEP Power Meter Conversion**

Smoother Tuning for the HW-8 Transceiver

Bill Coleman—N4ES

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Editorial comments: I found this article by Bill Coleman, N4ES, while browsing the web page of Expanded Spectrum Systems. I was there to check out the miniature ham band crystals they offer, which I mentioned in the Idea Exchange recently. The article was a bit long, so I trimmed it down some. You can find the full text at www.expandedspectrumsystems.com. Click on Feature Articles, then scroll down to the bottom of that page. (The text here does not include the discussion of calculating how much capacitance to use.) I also redrew the schematic of the HW-8 VFO from a fuzzy copy of the full HW-8 schematic found on another web site; I accept full responsibility for any errors in it. One site where a portion of the HW-8 manual can be found is http://bama.sbc.edu/heath.htm

—WA8MCQ

I picked up a Heathkit HW-8 QRP CW transceiver at a recent hamfest. Although it uses a direct conversion receiver, the sensitivity is excellent and adequate selectivity is provided by the built-in audio filter. The heterodyne VFO provides excellent frequency stability, but the tuning is a bit touchy, and there is just a hint of backlash. Although I had told myself that this was one rig I was not going to modify, I could not help myself. How about one simple, easily reversible modification that slows down the tuning rate by decreasing the tuning range from 250 kHz to 125 kHz, which is where I always operate anyway?

The frequency of the VFO is determined by inductor L9; numerous fixed capacitors; the main tuning variable capacitor (C302); and stray inductance and capacitance of the circuit. C302 is divided into two sections: C302A is the main tuning section, and C302B is the trimmer which is adjusted during alignment of the VFO.

The tuning range of C302 can be reduced appropriately by connecting a 28 pF capacitor in series and a 1.6 pF capacitor in parallel. In the HW-8, the "hot" side of C302 is connected to the main circuit board by a single wire, which is an ideal place to insert the series capacitor. The trimmer portion of C302 has more than enough range to add the required 1.6 pF parallel capacitance. Inductor L9 may need a slight tweak as well.

The only remaining requirement is a new scale for the tuning dial. You will notice that in the mixing scheme employed in the HW-8, the VFO tunes backwards. Measurement of the original dial reveals that the scale starts 15.5 degrees from the mechanical stop (minimum capacitance), and rotates approximately 31 degrees per 50 kHz. The overall dial is 3.13 inches in diameter, and has a scale arc that is 2.13 inches in diameter. The new dial scale starts at the same point, and rotates approximately 31 degrees per 25 kHz.

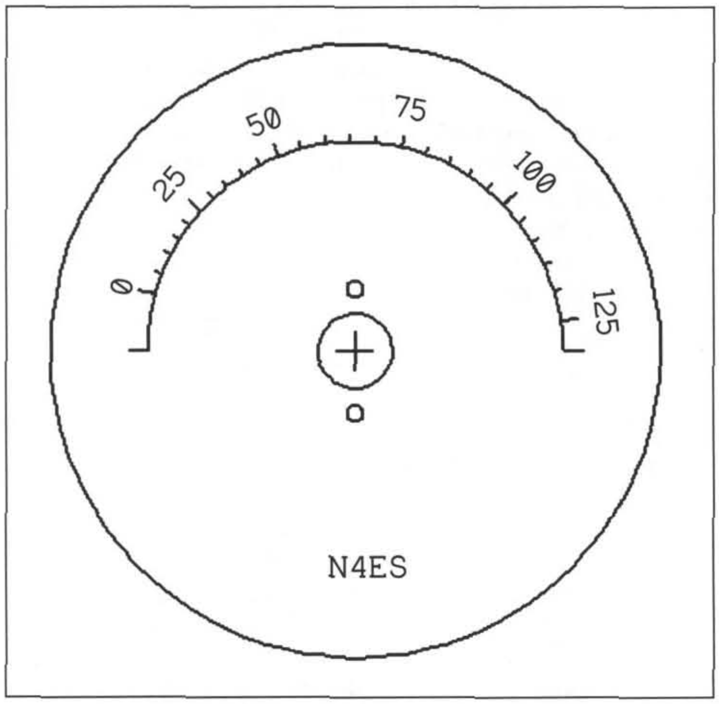


Figure 1—New dial for the modified HW-8. Copy, cut out and attach to existing dial (full size).

The calibration tick marks, originally spaced at approximately 3.1 degrees per 5 kHz, are now spaced at approximately 6.2 degrees per 5 kHz. The new dial is shown in Figure 1. Make a photocopy and cut it out. [I'm hoping the drawing came out close to actual size on the printed page, but it may be necessary to resize the copy slightly so that the outer diameter is 3 1/8 in. Many copiers can change the size of the finished product. —WA8MCQ]

A dial based upon purely linear tuning was tried, but the calibration error was unacceptable. The deviation from linear tuning was measured, and a corrected dial was designed. Looking back, the most direct way to design an accurate dial scale would have been to fabricate a wheel calibrated from 0 to 180 degrees, and note the reading for each desired frequency mark in a table. The rotate function of a CAD program could then be used to place the calibration marks at the appropriate locations on the dial. Instead, I started with a linear dial, determined the error of each mark in degrees, and rotated each mark by the amount of the error. The new dial was designed using the Generic CAD program for the IBM PC, "printed" to a disk file and later printed out.

Modification

The modification of the HW-8 is simple and easily reversible. Just rotate the original dial scale so that the blank half is showing, lay the new paper dial scale over it, and reinstall the two screws. Insert a 28 pF capacitor between C302 and the circuit board, and realign the VFO. The entire process takes about an hour, using the following step-by-step procedure.

Ceramic disc capacitors are available from Radio Shack or from various mail order outlets. Most low capacitance ceramic capacitors use thermally stable materials, and no frequency drift has been noticed with the modified VFO. I bought the "Picofarad 50-pack" assortment from Radio Shack (272-806) for $2.99, and used a 22 pF and a 6 pF capacitor in parallel. Just twist the leads together to make your own 28 pF value.

You can use any two or more capacitor values which add up to 28 pF, such as 10 pF and 18 pF. Unfortunately, 28 pF is not a standard value in most capacitor series. The 28 pF capacitor is the optimum value for 125 kHz total coverage. A larger value would increase the frequency coverage, while a smaller value would decrease it.

Start preparing the new paper dial scale by cutting it out with scissors. Next, carefully cut out the large center shaft hole and the two smaller screw holes using a sharp hobby knife. Once you are satisfied with the dial scale, set it aside and begin working on the HW-8.

Remove the top cover by removing the two rear screws and the two side screws. Set the main tuning dial to the 250 kHz end of its travel to fully mesh the plates of C302. This gets the plates out the way and protects them from damage. It also keeps you from installing your new dial backwards.

Set the LOADING and RECEIVER PRESELECTOR controls for full engagement of the capacitor plates. Note the positions of the control knobs. Remove the front panel by first removing all of the knobs, and then removing the bushing nuts from the SELECTIVITY switch and the AF GAIN control. Set the front panel aside. Remove the two screws securing the original dial scale. The original dial scale is used to provide support for the new paper dial scale. Leave the original dial scale on the shaft, but rotate it 180 degrees so that the plain white half is showing.

(Note: DO NOT flip the original dial face inward, toward C302. I tried it, and damaged the original dial by scratching the numbers where the dial rubs against the heads of the screws which secure the mounting bracket for C302.)

Set the new paper dial scale over the original dial scale with the 125 kHz end pointing upward, and reinstall the two screws, being careful not to overtighten them and tear the paper. A few tiny dots of "glue-stick" applied with a toothpick may be required to get the paper dial scale to lie flat against the original dial scale.

Reinstall the front panel, being careful to properly align the RELATIVE POWER meter with the opening in the panel. Reinstall the bushing nuts to secure the panel, and reinstall the knobs. Do not reinstall the top cover until completing the VFO alignment procedure.

Cut the wire from C302 to circuit board point "F" near the center of the wire, as shown in Figure 2. Using long-nosed pliers or sturdy tweezers, form hooks in the two remaining wire ends for attachment of the capacitor. Form similar hooks in the leads of the 28 pF capacitor, and attach the capacitor leads to the hooked ends of the two wires. Crimp the hooks to secure the capacitor in place, and solder the connections, being careful not to overheat any adjacent components. Allow the capacitor to cool completely before beginning the alignment procedure. Figure 3 shows the schematic of the VFO and the added capacitance.

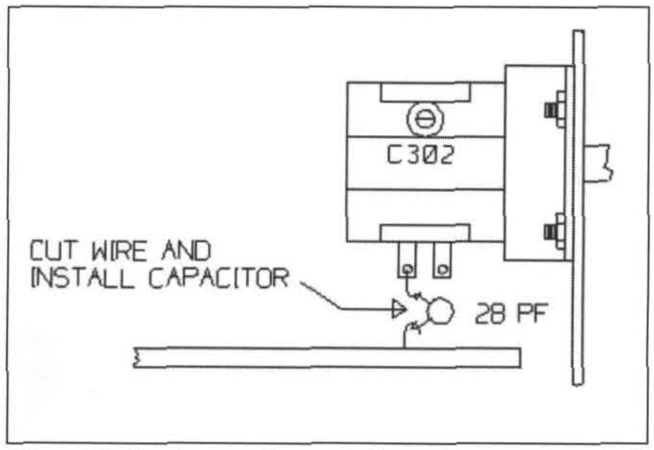


Figure 2--Cut the wire between the tuning capacitor and PCB, and insert 28 pF. (This is not a standard capacitor value and will require two smaller caps in parallel.)

Alignment

The alignment can be performed using a frequency counter, as described below, or it can be performed in accordance with the VFO ALIGNMENT steps from the HW-8 manual, substituting 7.125 MHz for 7.250 MHz as appropriate.

To perform the VFO alignment using a frequency counter, connect the HW-8 to a dummy load prepared as shown in PICTORIAL 5-2 of the HW-8 manual. If you do not have access to the manual, fabricate a 50-ohm dummy load by connecting two 100-ohm 2-watt resistors in parallel to an RCA phono connector, using short leads. Connect a manual key to the key jack.

Turn on the HW-8 and the frequency counter, and allow them both to warm up for at least 30 minutes. Connect a shielded lead to the frequency counter, with a two-inch insulated but unshielded section at the end. Select the 7 MHz band on the HW-8, and set the dial to 7.000 MHz. Press the key, and hold the unshielded end of the frequency counter's pick-up cable near the dummy load until a stable frequency is displayed. If necessary, tape the pick-up

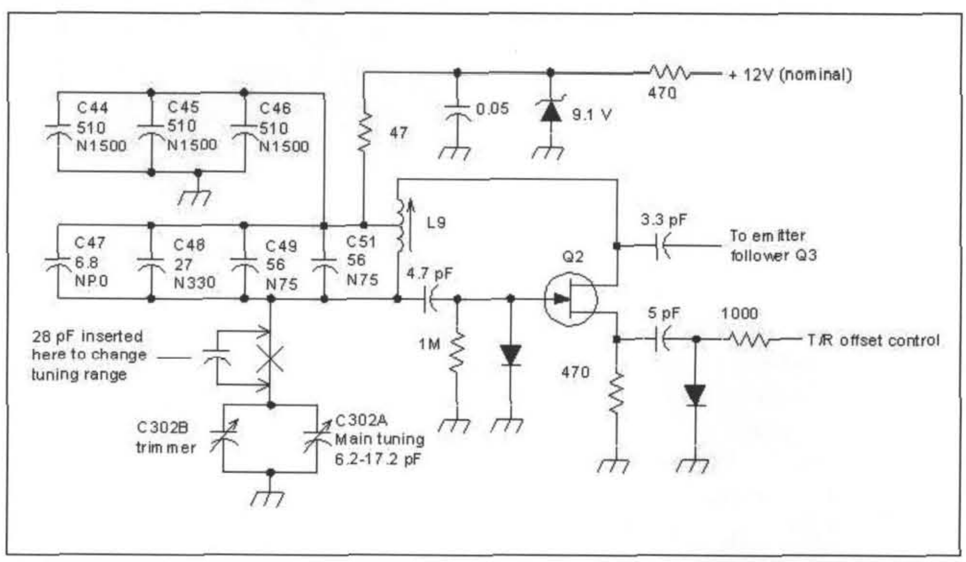


Figure 3--Schematic of the HW-8 VFO. (Note the use of several different types of temperature compensating capacitors used to stabilize the freqency--NP0, N75, N330 and N1500.) A 5 pF capacitor is switched onto the drain of Q2 during transmit to provide a small frequency offset.

HW-8 Tuning, continued from previous page

lead in place near the dummy load.

Adjust the trimmer portion of C302 (C302b) until a frequency of 7.000 MHz is displayed on the frequency counter. Release the key. Set the dial to 7.125 MHz. Press the key, and adjust the slug in L9 until a frequency of 7.125 MHz is displayed. Repeat the 7.000 MHz and 7.125 MHz steps until correct tracking is achieved. The process can be shortened by slightly "over correcting" during the first few steps. Remember to adjust only C302b at 7.000 MHz and only L9 at 7.125 MHz.

Now it is time to reinstall the top cover and enjoy operating the modified HW-8. The frequency accuracy with the new dial installed should be better than 1 kHz across the 125 kHz tuning range.

Conclusion

Operating the modified HW-8 is a pleasure. Digging other QRP signals out of the QRM with the narrow audio filter is easier now, because the dial backlash is no longer noticeable. The tuning now has more of a big-rig feel, yet it is not so slow as to be annoying. Perhaps the best feature of this modification is that it can be undone by simply reversing the two dial scales, connecting a jumper wire across the 28 pF capacitor, and realigning the VFO.

—de N4ES

A Short Vertical Dipole

Brice Anderson—W9PNE

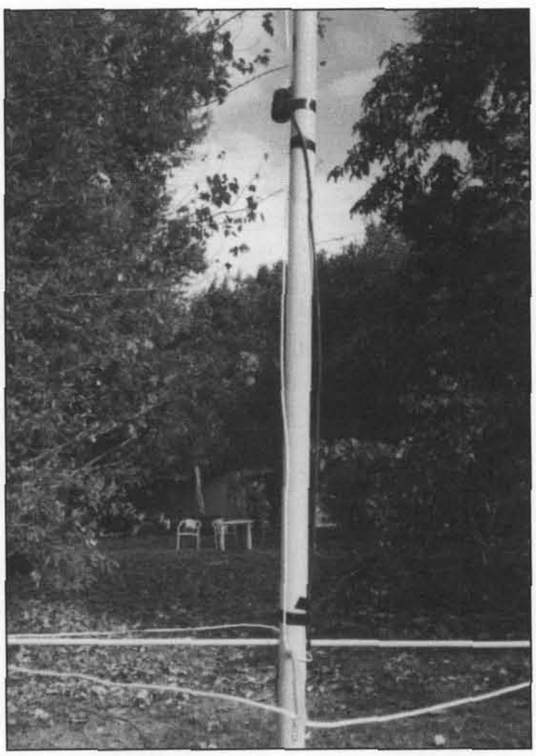
Small antennas have always been of interest to amateurs, especially if the amateur has limited property space or faces antenna restrictions. These small antennas will work, although they cannot equal the performance of a high full-size antenna.

I have tried 3-foot brass welding rod verticals on the operating desk and have even worked European DX with them. But I have had much better results with a 3-foot diameter loop of heavy copper tubing (magnetic loop).

I wanted a small vertical, but didn't want to use a ground radial system. An antenna catalog from Force 12 showed their center-fed 5-foot vertical with loaded ends, which looked good. I though I could make something similar.

To support the antenna, I used a 10-foot pole of 1-1/4 inch schedule 40 PVC. At the top, and 6 feet down, I drilled holes to support 4-foot lengths of 3/8-inch wooden dowel rods.

The antenna itself was made of #14 AWG insulated stranded wire. In the center of the top 6 feet, I mounted a two-terminal strip to anchor the ends of the center of the antenna and mount the matching hairpin coil, needed because a short dipole has a low impedance. Using the formulas for inductance and impedance, I found that a 7-turn coil wound on a 35 mm film canister (about 13/16 in. diameter by 1-3/4 in. long) of #16 AWG wire gives a calculated feedpoint impedance of approximately 50 ohms at 14 MHz.



A close-up look at the construction of W9PNE's short vertical dipole. Note the spreader arms to hold the end-loading wires and the shunt (beta) matching coil across the feedpoint, wound on a 35 mm film cannister.

The dipole formula of L = 492/f (MHz) gives a total length of 35 feet. I found this to be too short. I ended up with a wire length of 39 feet. The top half must be shortened by the length of the wire in the beta coil, for balance.

I made my initial resonance and SWR checks with he entire antenna laid out horizontally on a plastic picnic table. After adjusting the length to resonance, the SWR was near 1:1. Then I dropped the pole over two rod-type electric fence posts to support it vertically. The SWR was about 1.3:1 over the lower 100 kHz of the band. My IC-751A put out full power over the band. I first measured SWR at the end of the half-wavelength of RG-58C/U and then at the rig, which is at the end of 150 ft. of RG8M feedline. In the shack, the SWR at the middle of the band (at resonance) was 1.1:1, and 1.4:1 at the band edges.

I was anxious to try the vertical on the air. Running 40 watts, I called an Oregon station. He gave me 549 and he was 549. Then a Florida station gave me a 599, which was very encouraging. Then the band died. The next day, running mostly 50 watts, I worked about every DX station I heard: HP1, 6J1, 4Z5, ZY7, two R1s in Antarctica, UA4, 5B4, EA7, ZA1, VE3, UA1, R9 and RV9. The RV9 gave me 579. Later, in schedule with my son K9DCF in Albuquerque, NM, I was S9+10 with my TH5DX tribander and S8 with the vertical. In comparisons by other hams, the vertical was sometimes louder than the beam, but usually was down by 1 or 3 S-units. With 500 watts into the vertical, I got many 599 reports from DX stations, and a large group of "tail-end" calls from DX stations. I also tried the vertical with 5

W9PNE adjusts the end-loading wires to tune his 20M short vertical dipole.

The finished antenna is held upright by slipping it over a rod-type electric fence post.

watts and got good reports.

I found the antenna heavy to move and mount, so I constructed a much lighter one using 1/2-inch PVC pipe as a support, 1/4-inch dowel rods and #18 AWG wire. This was easy to handle and one electric fence post would easily support it. The antenna was strong enough to withstand some severe storms with winds up to 50 mph. All wire dimensions were the same as the first antenna. The SWR in the shack was 1.2 at band center and 1.4 at the edges.

I made extensive tests of the lighter weight antenna against my station vertical, A Hustler 4BTV, which is mounted on top of a 20-foot mast. Incredibly, I got the same reports with either antenna. An experienced W1 said the short vertical was perhaps down 2 dB, a scarcely noticeable drop in signal strength from the Hustler. DX was easy to work with 50 to 100 watts.

I could easily move the antenna around with just one hand, and I am just a 5 ft. 3 in. 84 year old. The antenna withstands storms without damage, proving that the 1-1/4 in. PVC is overkill. If one wants more strength, one-inch PVC would be great and still be light weight. I painted the wooden dowel rods with a clear weather proof enamel, but a green enamel would add invisibility to the antenna.

I believe this antenna could be built to cover the bands from 14 to 30 MHz, but I that will be a future experiment.

—de W9PNE

State QSO Parties and QRP

Bob Reisenwever—W3BBO RobW3BBO@aolcom
Jim Gooch—NA3V Jgooch@Penn.com

Bob, W3BBO, and Jim, NA3V, work contests QRP from time to time from western Pennsylvania. We have spliced together some thoughts about working state QSO parties for QRPers who are contest newbies, and have added a little info about four of our favorite state contests.

W3BBO says:

Arrgh! The weekend is here and all I hear on the bands are contest stations! What's with it with these guys? Fortunately, there's no contesting on the WARC bands, so the contest-hater has a refuge. However, contesting can offer so many interesting opportunities for the QRPer. Finished that new rig? Just put up a new antenna? Like to improve code speed or other operating skills? Contact those rare states you need for WAS? Jumping into a contest will quickly shake down that new rig or antenna. Keep at it and your code speed will improve, along with learning how to time your calls to get through pileups.

My first exposure to contesting was the ARRL Field Day. While not truly a contest, it is an exercise in making lots of contacts using a snappy exchange. Since then I've operated in many contests over the years, including big DX affairs where my mediocre antennas are pitted against the big guns and massive aluminum arrays. It's always interesting to see the printed results, but for me the question is how did I do compared to my last entry in the event. My favorite contests are the CW Sweepstakes and the NAQP CW contest. As I get older, though, I'm beginning to enjoy the shorter events. They're a lot easier on this old guy than the major 48-hour marathons.

Contesting in state QPs is fun with any QRP rig, but I am fortunate to have an Elecraft K2 transceiver. Running five watts, is actually five watts of output. However, a decent receiver with selectivity and not subject to overload makes crowded contest conditions much easier. My antenna farm includes a horizontal loop approximately 250 feet long and 20 to 30 feet high. It is fed with 450 ohm line using a 4:1 balun and the K2's ATU on all bands from 80 to 10 meters. With the feedline tied together and fed against ground with a tuner, it does an excellent job on 160 meters. The other antennas are verticals, an old Cushcraft R5 for 10-20 meters and a Butternut HF2V for 40 and 80 meters.

State QSO parties are a lot of fun. Some of them fill up the bands, while others require some searching. New participants are always welcomed by other contestants and by the sponsoring organization. The score multipliers in state QPs are counties, so if you're interested in county hunting, this is the place to pick up new ones. A fascinating feature of state QPs are the mobile stations. They hop from county to county, giving out contacts. It's always fun trying to figure out where they will pop up next. After the contest, awards are sent to the top-scoring operators from each state/province. QRP stations get an additional multiplier in some state QPs to level the playing field. In other contests QRP is a special category and has separate awards.

OK, so what contest is going on this weekend? There are several sources of information. The contest page of *QST* lists contests of the month and gives an overview of the rules, procedures, and where to submit your log. The Contest Calendar compiled by the Eastern PA QRP Club lists all the contests with a QRP category for the entire year. A great source for QRP ops is the monthly notice on the QRP-L reflector by Ken, N2CQ. Ken lists the major contests, state QPs, and other contests that welcome QRPers, and provides links to the sponsor's sites to obtain the official rules.

Two contests I enjoy are the Michigan and the Georgia QPs. The Michigan QP, sponsored by the MRRC (Mad River Radio Club) is held in April. It is a twelve hour contest with plenty of activity. There are 83 counties which can be counted once per mode as score multipliers. As a CW op, I sometimes lose out in this contest. While CW contacts count 2 points and Phone only one, a much higher score is gained by operating both modes. To win big in this QP, guess I'll have to find a mike.

The Georgia QP is sponsored by the Southeast Contest Club and is held in July [*It has been reported that the GaQP will move to an April weekend in 2003, out of the hot and radio-noisy mid-summer*]. Operating time is split into a Saturday time period 1800Z to 0359Z, and a Sunday slot 1400Z to 2359Z. The time split works for me, as I get time to sleep, go to church, and have breakfast with the family. As in the Michigan QP, each county can be counted as a multiplier on both modes and CW contacts are worth 2 points compared to 1 point for phone contacts. Activity is high, and the mobiles zoom quickly over Georgia's 159 peanut-sized counties, keeping you on your toes to make contacts.

NA3V speaks:

Amen to everything W3BBO says above. Those frantic, 48-hour major contests are wearing me down, too. To get through one you need a chair in the shack that brews coffee, massages your back, and has a built-in porta-potty. State QPs, with a couple of exceptions, are not that busy. You can wander out of the shack and pull weeds, rake leaves, shovel snow, or whatever, and return to the contest and still make a respectable score. Another thing is that the organizers of state QPs want to increase out-of-state participation. In fact, some of the smaller state contests are struggling, and they would love to have more entries, QRP included, to juice things up. Code speeds in state QPs are lower than the blur of dits you hear in the big contests, and that the general attitude is relaxed. You will definitely put a big smile on the contest sponsor's faces if you submit your log, no matter how many or how few contacts are in it.

When contesting I operate an ICOM 756 and 40 meters and 80 meter QRP monobanders in my basement shack. The neighbors are not too antenna-friendly, so I keep it simple—for 80-10 meters there's a ladder-line fed 130 ft. doublet that hangs like a catenary from several high trees in the backyard connected at the shack to a

1:1 balun and tuner. For 160 meters, I rigged an inverted-L up a tree and then out over the doublet. I've built dipoles, windoms, G5RVs, verticals, half-squares, and extended double zepps, but the doublet, overall, does the best job.

A couple of my favorite contests with awards for QRPers are the Virginia QSO Party and the New England QSO Party. The VA QSO Party, sponsored by the Sterling Park ARC, is a weekend-long contest in March. There are a slew of multipliers—counties and independent towns and cities. With county names like Prince Edward, Prince George, King William, and King and Queen, it's easy to think you have been transported back to old England. Activity is pretty brisk from northern VA and the Richmond and Norfolk areas. The far western counties and some of the eastern shore counties are quieter, though you can pick up many of them by following the track of mobile stations. Don't forget the phone bands, if you have the capability. Some VA stations operate primarily SSB, and they are always happy to hear from QRPers. Often they will ask details about your setup. The bands with the most activity are 20 meters and 40 meters, where the mobiles generally hang out.

The New England QSO Party was launched in the first weekend in May, 2002. Formerly there were separate QPs in each of the six New England states, but activity was sparse. The new monster contest, co-sponsored by a coalition of six of New England ARCs, covers sixty-seven New England counties. In its inaugural run, the contest buzz was good, with lots of fixed stations transmitting from the metropolitan regions, while a bunch of mobiles were criss-crossing the thinly-settled counties of northern VT, NH, and ME. Working the islands of Marthas Vineyard and Nantucket was a special treat. Operating QRP from PA, I noted plenty of fixed and mobile stations on 40 meters, both CW and SSB, and some fixed stations on 80 meter CW but few on SSB. I was too close in to evaluate activity on the higher bands. Posted scores on the Web, however, indicate that 20 meters and 15 meters were hot, so these would be the bands of choice for the QRPer whose QTH is a skip or two away.

W3BBO, his final:

As we mentioned, unlike the worldwide mega-contests, state QPs are laid back and lots of fun. If you give them a try, you will improve your operating skills, better understand how the new rig and antenna are working, and meet a lot of new friends. Like our close-knit QRP group, contesters also embrace each other. It's neat during a contest to have other stations come back to you by name and ask how you're doing! Please join in- the welcome mat is out. ●●

NoGaQRP NoGa Compendium does it again..!

With the help of the *NoGa Compendium Vol. 1* and a number of NoGaNaughts, I recently put together a resonant feedline antenna to go with a QRP station that I was putting together for a blind ham friend of mine in Florida.

Steve, AD4LY, is a really good CW op, and when I moved to Lawrenceville, in 1992, he had just gotten back into amateur radio after quite an absence. He was also in the process of upgrading. Unless you met him face to face you would never know that he was blind. He even uses wood working tools and made a number of items that were sold in local stores.

When Steve upgraded to Extra and took the 20 wpm code test he refused any special treatment. He actually wrote down what he copied with a pencil — and it was quite readable to the VEs.

Now he is really wanting to get back on the air, and I'm helping him do that. I wanted to give him an antenna that was easy to put up, and the story that follows is about that antenna:

AD4LY's QRP rig and antenna

Steve Burel, AD4LY, lived most of his life in Lawrenceville, GA. He lost his sight at an early age, but is pretty much an independent soul. Steve is one of the best CW operators that I have had the pleasure of working. About 6 years ago, Steve moved to Florida where he teaches computing at the Lighthouse for the Blind in Ft. Lauderdale. It was in that move, that he sold his TS-450 with the VS-2 speech option.

Steve was in town recently for Thanksgiving, and I enjoyed visiting with him and demonstrating my K2 with K2 voice, which I thought would be perfect for him. He was not quite ready to make that sort of investment, but he did really want to get back on the air. With a little looking around, I was able to get him an MFJ-9020 transceiver in good shape for less than half the original price.

I built a resonant feedline antenna out of the *NoGa Compendium, Vol. 1*, and it really works great. There is a 1:1 SWR between 14000 and 14040, and reflected power only rises to 200 mW between 14040 and 14060. I wound the choke on a piece of three inch PVC pipe and capped the ends, since Steve wanted this part of the antenna outside. I put a steel eye in the top cap, glued that cap down, and put a coax connector on the bottom with a single sheet metal screw in the side to hold the bottom on. I wrapped the choke with electrical tape just to hold it solid, and put hot glue in all the holes except for a drain hole in the bottom.

My NoGaWaTT meter shows 3.5 watts out at 14050 with a 1:1.1 SWR. I tested the whole thing in my upstairs bedroom (since I could run the 33 feet of antenna down the hall), and I got a 459 report from Columbia, Maryland. The op there said it would have been better, but I was off the end of his antenna.

Check out this simple antenna and don't miss a chance to bring someone into (or back into) amateur radio. There are a lot of folks out there that need just a little help, and there can never be too many QRPers!

—Pickett, AD4S

QRP Contests

Randy Foltz—K7TQ rfoltz@turbonet.com

Greetings fellow QRP contest fanatics! This month's version of QRP Contests will be a short one. You'll find only the results from the End of Summer PSK-31 Sprint. There wasn't sufficient time for the Fall QSO Party results to arrive and for me to digest them before this issue's deadline. In the next issue of the Quarterly, I'll have full coverage of the Fall QSO Party, the Running of the Bulls, the Top Band Sprint, and the Holiday Spirits Sprint. That will be a good one.

There are announcements for the Winter Fire Side SSB Sprint, the Spring QSO Party, and one of my favorites, the Hoot Owl Sprint. As I did in the previous issue, I've included side bars about each one intended as a guide for new contest operators. After each contest you can use the High Claimed Scores form at http://personal.palouse.net/rfoltz/arci/form.htm to send me your contest summary. Your log can be sent separately by either e-mail or regular mail. Watch the claimed scores change each evening at 9 PM Pacific Time for 10 days after the contest by looking at http://personal.palouse.net/rfoltz/arci/highclm.htm This web page contains only those results submitted by those who use the web form above.

The QRP ARCI contests for 2003 are at http://personal.palouse.net/rfoltz/arci/arcitst.htm along with results from past ones.

See you on the air!

Mark Your Calendars:

Winter Fireside SSB Sprint
February 9, 2003

Spring QSO Party
April 12 and 13, 2003

Hoot Owl Sprint
May 25, 2003

End of Summer PSK-31 Sprint

The 2002 version of the End of Summer PSK-31 Sprint was held on September 8. There seemed to me to be sufficient activity to keep this one around for at least another year. Between the end of the contest and compiling the result, a bad thing happened. All of the electronic reports that did not come via the High Claimed Form were deleted by me. Whoops! I did it intentionally, but it wasn't what I had in mind to do. They were not retrievable either. What this means is that if you sent me a regular mail entry or an e-mail entry using the High Claimed Form, you're okay. If you did all your reporting by e-mail, then I deleted your entry. I apologize to everyone who got caught by my error. I've changed the way I keep e-mail submissions, so it won't happen again. Next year's event is scheduled for September 14, 2003 and I'm sure I won't delete any scores you send to me.

End of Summer PSK-31 Sprint Top Three

NS5A	20,496
K7RE	14,973
KF4FH	12,502

Soapbox

WB6BWZ—PSK31 newbie. Participated at the last minute. Looking forward to the next QRP ARCI PSK31 contest. **WB4JFS**—Surprised at how few stations I heard/printed. Kept running across the same ones over and over. I do enjoy the PSK mode, especially for contesting. **W3HF/3**—Operated from a parking lot, just inside the Delaware border. Antenna problems kept me off the air until 2135Z, so I had less time to operate than hoped. Wish I could have worked everyone I heard. **W2TAG**—I called a lot of CQs but didn't see much activity on the 20 meter band or make many contacts. I thought there would be a lot more activity than there was or maybe I just couldn't hear it. **W2AGN**—Just can't seem to get the hang of contesting on PSK. Kept hitting the

PSK-31 Sprint for 2002

QTH	Call	Score	QSO Pts	SPC	Power
BC	VE7ASK	4277	47	13	LT5
CO	NØIBT	4158	54	11	LT5
	KØSU	3864	46	12	LT5
DE	W3HF/3	2772	36	11	LT5
GA	WB4JFS	6860	70	14	LT5
	WB6BWZ	140	10	2	LT5
HI	KH6GMP	32	8	4	GT5
HP	HP1AC	6090	58	15	LT5
ID	K7TQ	6370	70	13	LT5
	N6YIH/7	2352	42	8	LT5
KY	KG4LDL	2632	47	8	LT5
MA	K1HJ	735	21	5	LT5
MN	NØUR	11543	97	17	LT5
	NØMY	4234	146	29	GT5
NC	AE4EC	378	18	3	LT5
NJ	W2AGN	2072	37	8	LT5
	W2TAG	210	5	6	LT5
SD	K7RE	14973	93	23	LT5
TX	NS5A	20496	122	24	LT5
WA	KF4FHS	12502	94	19	LT5
	W7QQ	7168	64	16	LT5

wrong "macro" buttons. Never replace CW... **VE7ASK**—This was a fun event; one I looked forward to for a long time. Wish there was more PSK contesting activity as it is a great motivator for improving gear and operating skills on this mode. **NS5A**—This is the second time I participated in this contest. Missed last year's though. Like them short ones. Hope to see more. **N6YIH/7**—Got a late start so not as much fun as last year so next time I will do better. Had lots of fun looking forward to the next one. THANKS. **NØUR**—I almost forgot about this one, was able to get in a 1.5 hours. Finally realized I could take my headphones off, much better that way! **NØMY**—Was fun! Condx were good I thought, but was my very first PSK contest! **KH6GMP**—Called CQ for the whole 4 hours and only 8 QSOs...sorry. **KG4LDL**—Band not too good. **K7TQ**—Lots of activity. Waterfall sure got sparse after 2400z. **K7RE**—Many non-contest stations replied to my "CQ TEST," so they were added to the log. I would never guessed that this many stations and SPCs could have been worked in so short of a time. **K1HJ**—Propagation seemed difficult, especially to the west. First hour I was running just 1 watt but only made one contact. Got tired of that so I went up to 5 watts but that didn't seem to help that much. **KØSU**—A fun contest! Interesting to be able to watch others as you are making contest QSOs! **AE4EC**—Where was everybody? I could only print very few stations.

Contest Announcements

2003 Winter Fireside SSB Sprint

Date/Time:
February 9, 2003, 2000Z to 2400Z
SSB HF only

Exchange:
Members—RS, State/Province/Country, ARCI member number
Non-member—RS, 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 one band for QSO points and SPC credit.

Power Multiplier (PEP):
Note the higher SSB power limits compared to CW!
0 - 500 mW = x15
500 mW - 2 W = x10
2 W - 10 W = x7
Over 10 W = x1

Suggested Frequencies:

80M	3865 kHz
40M	7285 kHz
20M	14285 kHz
15M	21385 kHz
10M	28385 kHz

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

Categories:
Entry may be All-band, Single-, High-, or Low-band.

Entry includes a copy of logs and summary sheet. Include legible name, call, address, and ARCI number, if any. Entry must be received within 30 days of contest date. Highest power used will determine the power multiplier.

The final decision on all matters concerning the contest rest with the contest manager.

Entries are welcome via e-mail to rfoltz@turbonet.com or by mail to

Randy Foltz
809 Leith St.
Moscow, ID 83843

After the contest send your Claimed Score by visiting http://personal.palouse.net/rfoltz/arci/form.htm. You must still submit your logs by either e-mail or regular mail if you use the High Claimed Score form. Check the web page for 10 days after the contest to see what others have said and claimed as their scores.

2003 Hoot Owl Sprint

Date/Time:
May 25, 2003, 8:00 PM to midnight Local Time. CW HF only.

Exchange:
Members—RST, State/Province/Country, ARCI member number
Non-member—RST, State/Province/Country, Power Out

...continued on next page

***How to Operate the Contest:* Winter Fireside SSB Sprint**

Date: February 9, 2003 from 2000Z to 2400Z

How to participate: Get on any of the HF bands except the WARC bands and hang out near the QRP SSB frequencies of 3865, 7285, 14285, 21385, and 28385 kHz. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself. You can work a station again on a different band.

What to send: Give a signal report and your state (for Americans), province (for Canadians), or country (for everyone else), and QRP ARCI member number if you have one, or your power if you don't have one.

Best reason to participate: You can pickup needed states for 2xQRP WAS in one evening.

Relative challenge: Easy for all. (Short duration, good number of participants, QRP only contest.)

Scoring: Standard QRP ARCI method for SSB contests

Web link: http://personal.palouse.net/rfoltz/firesid.htm

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 one band for QSO points and SPC credit.

Power Multiplier:

0 - 250 mW = x15
250 mW - 1 W = x10
1 W - 5 W = x7
Over 5 W = x1

Suggested Frequencies:

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

Score:

Points (total for all bands) x SPCs (total for all bands) x Power Multiplier.

Categories:

Entry may be All-band, Single-, High-, or Low-band.

Entry includes a copy of logs and summary sheet. Include legible name, call, address, and ARCI number, if any. Entry must be received within 30 days of contest date. *Highest power used will determine* the power multiplier.

The final decision on all matters concerning the contest rest with the contest manager.

Entries are welcome via e-mail to rfoltz@turbonet.com or by mail to

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2003 Spring QSO Party

Date/Time:

April 12, 2003, 1200Z through April 13, 2400Z. You may work a maximum of 24 hours of the 36 hour period.
CW HF only.

Exchange:

Members—RST, State/Province/Country, ARCI member 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 one band for QSO points and SPC credit.

Power Multiplier:

0 - 250 mW = x15
250 mW - 1 W = x10
1 W - 5 W = x7
Over 5 W = x1

Suggested Frequencies:

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

Score:

Points (total for all bands) x SPCs (total for all bands) x Power Multiplier.

Teams:

You may enter as a team of either 2 to 5 members per team or unlimited number of operators as long as a maximum of 5 transmitters on the air at a time. You compete individually as well as on

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***How to Operate the Contest:* Hoot Owl Sprint**

Date: May 25, 2003 from 8:00 PM to midnight in what ever time zone you live in.

How to participate: Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies of 3560, 7040, 14060, 21060, and 28060 kHz. Work as many stations calling CQ QRP or CQ TST as possible, or call CQ QRP or CQ TST yourself. You can work a station again on a different band.

What to send: Give a signal report and your state (for Americans), province (for Canadians), or country (for everyone else), and QRP ARCI member number if you have one, or your power if you don't have one.

Best reason to participate: Gives you a good reason to stay up late on Memorial Day weekend.

Relative challenge: Easy. (Slow CW speeds, short duration, QRP only contest).

Scoring: Standard QRP ARCI method for CW contests

Web link: http://personal.palouse.net/rfoltz/hoot.htm

***How to Operate the Contest:* Spring QSO Party**

Date: April 12, 2003, 1200 Z through April 13, 2400 Z

How to participate: Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies of 3560, 7040, 14060, 21060, and 28060 kHz. Work as many stations calling CQ QRP or CQ TST as possible, or call CQ QRP or CQ TST yourself. You can work a station again on a different band.

What to send: Give a signal report and your state (for Americans), province (for Canadians), or country (for everyone else), and QRP ARCI member number if you have one, or your power if you don't have one.

Best reason to participate: This one and the Fall QSO Party have the greatest QRP participation of any QRP contest!

Relative challenge: Easy to Moderate. (Slow CW speeds, long duration, large number of participants, QRP only contest).

Scoring: Standard QRP ARCI method for CW contests

Web link: http://personal.palouse.net/rfoltz/spring.htm the team. Teams need not be in the same location. Team captain must send list of members to Contest Manager before the contest.

Categories:

Entry may be All-band, Single-, High-, or Low-band.

Entry includes a copy of logs and summary sheet. Include legible name, call, address, and ARCI number, if any. Entry must be received within 30 days of contest date. Highest power used will determine the power multiplier.

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

Randy Foltz
809 Leith St.
Moscow, ID 83843

After the contest send your Claimed Score by visiting http://personal.palouse.net/rfoltz/arci/form.htm. You must still submit your logs by either e-mail or regular mail if you use the High Claimed Score form. Check the web page for 10 days after the contest to see what others have said and claimed as their scores.

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Contest Results in the Next Issue:

- **Fall QSO Party**
- **Running of the Bulls**
- **Top Band Sprint**
- **Holiday Spirits Sprint**

QRP ARCI Financial Statement

QRP AMATEUR RADIO CLUB INTERNATIONAL CASH RECEIPTS AND DISBURSEMENTS FOR YEARS ENDED JUNE 30,	2000	2001	2002
Beginning Cash:	$14,793.72	$19,042.24	$23,229.70
Cash Receipts:			
Memberships	25,082.00	27,661.74	28,947.29
Toy Store, net	861.29	(224.03)	(185.98)
Dayton banquet, net	(616.74)	(319.36)	(218.27)
FDIM seminar, net	1,628.41	47.62	(2.93)
Sale of Quarterly magazines, net	496.75	651.13	(156.95)
Advertising revenue		945.50	2,370.42
Sale Projects	(100.15)	1,537.19	
Gifts and bequests	139.73	10.00	5.00
Interest income	304.22	1,183.03	435.44
Total	27,795.51	31,492.82	31,194.02
Cash Disbursements:			
Quarterly magazine costs	20,479.73	23,203.11	24,740.14
Prizes and awards given	1,215.00	1,094.72	834.60
Contest expenses	191.54	141.16	60.00
Dayton booth and hospitality	500.00	1,000.00	650.00
Treasurer and legal expenses	279.25	234.61	211.53
Membership expenses	352.98	865.13	471.23
General administration costs	528.49	766.63	766.56
Total	23,546.99	27,305.36	27,734.06
Net Receipts over Disbursements	4,248.52	4,187.46	3,459.96
Ending Cash:			
Working funds	4,042.24	8,229.70	8,689.66
Reserve funds for unearned subscriptions	15,000.00	15,000.00	18,000.00
Total	$19,042.24	$23,229.70	$26,689.66

Technical Tidbits—Coaxial Cable Data

Cable Type	RG-type	Impedance	Outside Diameter	Velocity Factor	Loss at: 1 MHz	10 MHz	100 MHz
Belden 9913	RG-8	50 ohms	0.405 in.	84 %	0.1 dB	0.4 dB	1.3 dB
Belden 9914	RG-8	50	0.405	82	0.1	0.5	1.6
Times LMR400	RG-8	50	0.405	85	0.1	0.4	1.4
Belden 9258	RG-8X	50	0.242	80	0.3	1.0	3.3
Times LMR240	RG-8X	50	0.242	84	0.2	0.8	2.5
Belden 8259	RG-58A	50	0.193	66	0.4	1.5	5.4
Belden 8262	RG-58C	50	0.195	66	0.4	1.4	4.9
Times LMR200	RG-58C	50	0.195	83	0.3	1.0	3.2
Belden 8267	RG-213	50	0.450	66	0.2	0.6	2.1
Belden 8268	RG-214	50	0.425	66	0.2	0.6	1.9
Belden 8216	RG-174	50	0.101	66	1.9	3.3	8.4
LMR500	LMR	50	0.500	85	0.1	0.3	0.9
LMR600	LMR	50	0.590	86	0.1	0.2	0.8
LDF4-50A	1/2" Heliax	50	0.630	88	0.05	0.2	0.8
LDF5-50A	7/8" Heliax	50	1.090	88	0.03	0.1	0.6
Belden 8263	RG-59B	75	0.242	66	0.6	1.1	3.4
Belden 8215	RG-6	75	0.275	66	0.4	0.8	2.7
Belden 8213	RG-11	75	0.405	78	0.2	0.4	1.5
1/2" Hardline	CATV	75	0.500	81	0.05	0.2	0.8
7/8" Hardline	CATV	75	0.875	81	0.03	0.1	0.6

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

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

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

QRP ARCI
117 E. Philip St.
Des Moines, IA 50315-4114

Need an Information Pack? Send e-mail to k3tks@abs.net, or send an SASE to:

Danny Gingell, K3TKS
3052 Fairland Rd.
Silver Spring, MD 20904-7117

TIPS:

1. Use the Online Member Lookup feature to keep track of your membership status—check: **http://www.qrparci.org/lookup.html**
2. Is your data on file now correct? Use the online form to send info to our database manager: **http://www.qrparci.org/**

US–$15 • Canada–$18 • Non-US/VE–US$20 per year

New Member or Renewal Form

CALL __________ QRP ARCI# (OR "NEW" IF NEW MEMBER) __________

FULL NAME __________

MAILING ADDRESS __________

CITY __________ STATE/COUNTRY __________

POSTAL CODE (ZIP+4 FOR USA) __________

PREVIOUS CALLSIGN(S) (IF ANY SINCE JOINING) __________

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

E-MAIL ADDRESS __________

COMMENTS __________

Become a Famous Author! Write a Review for QRP Quarterly

Have you just purchased a new gadget, rig or kit that you would like to tell the QRP world about? Then write a review and send it to the *QRP Quarterly*! Reviews are handled by our Special Features Editor, Larry East—W1HUE (see page 3 for address). We have no strict guidelines for reviews, but we do ask that you include the manufacturer's basic technical specs and any results of technical tests that you have performed. If you are not sure about some aspects of the device that you are reviewing, don't guess; ask the manufacturer for clarification. (We reserve the right to also contact the manufacturer for additional details or clarification.) Please try to be as objective as possible; tell about the good as well the bad features. Larry prefers to receive articles in machine-readable form, as ASCII text files on PC format floppy disks or as e-mail attachments.

If you want to send word processor files, Larry can handle MS Word 6/95/97/2000, Word Perfect 5/6 and Rich Text Format (RTF) formats. Please don't do any fancy formatting or embed graphics within WP files! Figures (drawings and photographs) can be supplied as "hard copy" (good quality B&W or color prints for photographs) or as digitized images (check with the Editor for acceptable formats). If you want your disks, drawings, etc. returned, please enclose an SASE with sufficient postage. ●●

The QRP-ARCI Toy Store

The **official** QRP-ARCI Coffee Mug. Used by the top QRP Fox hunters, contesters and casual operators found near the normal QRP Frequencies. Kelly Green on White and the Logo is on both sides. *Coffee, tea or milk* not included.

The QRP-ARCI patches are fully stitched, black on white. 3-9/16" wide x 2-1/2" high oval. And they can either be *ironed on, or sewn on the* finest evening wear!

Trouble reading those resistors? Plastic magnifiers for kit builders in a carrying case. Magnifiers are $1.00 each.

The blue and brass metal pins *have a tie-tac pin and clasp on* the back.

The White '72' pins say "WISHING YOU 72 GOOD QRP"

Midnight Blue mugs are still available.

All Prices PostPaid!

Patches $5 Coffee Mugs $8 Blue Pins $7

2002 Dayton FDIM Proceedings...	$17
2001 Dayton FDIM Proceedings...	$17
2000 Dayton FDIM Proceedings...	$16
1999 Dayton FDIM Proceedings...	$16
1998 Dayton FDIM Proceedings...	$16
1997 Dayton FDIM Proceedings...	$16
1996 Dayton FDIM Proceedings...	$16
Any 4 or more FDIM Proceedings...	$13 each

Antennas & Feedlines for QRP by L.B. Cebik... $16
The North Georgia QRP Club Compendium, Vol. 1... $16

No shipping & handling on pins & patches when ordered with a coffee mug!

QRP-ARCI Hats

Denim Blue Tan Charcoal Tan/Blue
Tan/Green Green
Hats are $15 each postpaid

Orders to:
QRP-ARCI Toy Store
2130 Harrington Road
Attica, MI 48412-9312
Checks made out to: QRP-ARCI
or PayPal to k8dd@arrl.net