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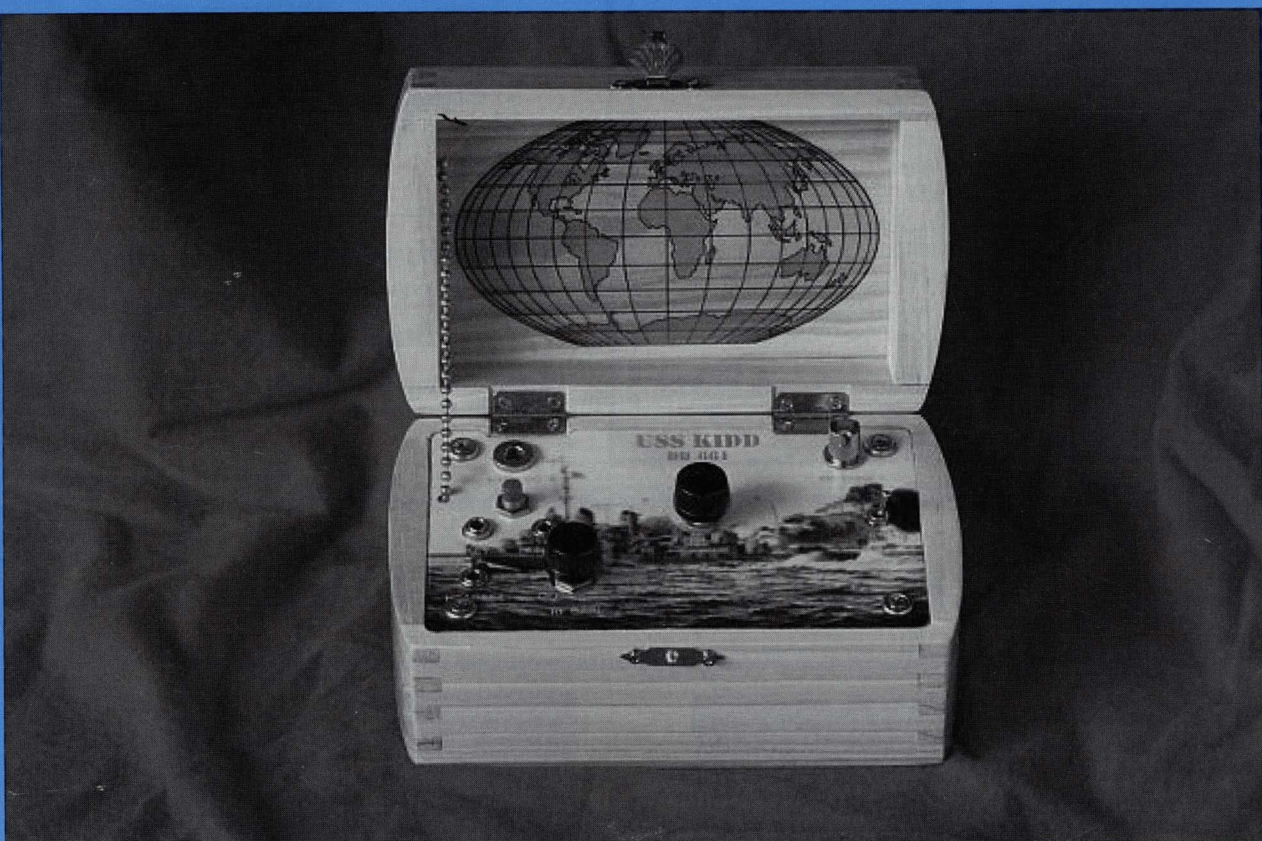
QRP Quarterly

Journal of the QRP Amateur Radio Club, International

January 2000 Volume XXXVIII Number 1



DSW20 Transceiver built by Jim Giammanco, N5IB

The winner of the cover picture contest this quarter is Jim Giammanco, N5IB. Inside this issue are details about the USS Kidd and an article by Jim detailing the building of these "elegant" boxes.

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

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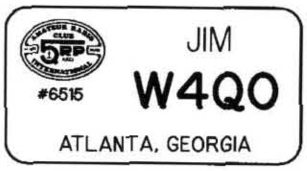

Designed especially for QRP members and offered with a Blue background, White letters and the oval QRP-ARCI logo in Gold.

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You too can win a one year membership or renewal to the QRP ARCI.Quarterly Just send your entry photo for the cover picture contest to the managing editor at the address on the back cover.

THE THRILL IS BACK!

Everyone is invited to check the QRP ARCI web pages at
http://www.qrparci.org/

Jim Stafford, W4QO, QRP ARCI Webmeister

QRP ARCI TOY STORE

The QRP-ARCI mouse pad has been tested under rigorous conditions. It excels at high speed clicking and browsing. It is a blue logo with a champagne background. Mouse and browsers not included

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ARCI
QRP QUARTERLY

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From the Editor's Desk

Mary Cherry, NA6E

8383 Sierra Sunset Drive, Sacramento, CA 95828-5304 email: mcherry@calweb.com

What better way to start the new century than with a suggestion from C. F. Rockey, W9SCH of Albany, WI. . (Rock is a long time QRPer and member of the QRP Hall of Fame.) *72 de NA6E*

C.F. 'Rock' Rockey, W9SCH *writes:* "Despite the technical tastes of our strictly state of the art people, there are still quite a few of us into QRP who build our gear in the good, old-fashioned style. Obtaining parts for building such gear is becoming very difficult, especially for newcomers or our younger QRP brethren. Among the parts always in demand, especially, are variable capacitors. My correspdence is filled with requests for these, it seems."

"As we all know, good old variables, suitable for ham use in antenna tuners and simple rigs, have already long left the general radio market. When such items do appear thereon, the price most often asked for them is prohibitive, particularly for the less financially flush among us. On the other hand, there are many old timers among us who have ham radio junk boxes that may be replete with such parts which might gladly be donated, or cheaply sold, to other worthy QRPers in need of such items."

"In order to facilitate such activity, I propose the setup of a voluntary "variable capacitor pool," containing donated, used capacitors, etc, which would be made available to QRP project builders in need of them. Indeed, if others would join me in such an undertaking, I would be glad to personally donate three such suitable, "used but usable" capacitors to a part pool from my own junk box. If a number of other "old timers", at no great hardship to themselves, would likewise donate to this proposed pool, it would greatly reduce the shortage of important homebrewing components, I believe."

"I feel that this activity might definitely encourage a needed restoration of homebrewing among us--especially those of us, such as myself, whose lack of facilities and skill make them unable to tackle state of the art, sophisticated, ultra compact projects but who still wish to build gear in "old fashioned style." Homebrewing of radio gear is deeply embedded in the tradition of amateur radio generally. Should we not wholeheartedly stimulate all such activity? Original, "scratch building", for instance, should not be confined to the geniuses, the well to do and the well equipped among us, as is now largely the case. But due to my age and decrepitude I am not in shape to administer and conduct, physically, such a "variable capacitor, etc" pool myself. But I would gladly do what I can to help in such activity, as needed."

"Is this just another wild dream, or does this "crazy" idea (possibly with some suitable modifications and corrections) have some possible merit? I am personally disturbed by many of the present trends in our hobby, of which the growing lack of hands-on gear building, etc, even among QRPers, is a paramount one! We have too many "yackers" and too few "doers" in our hobby today. How about it?"

C. F. Rockey, W9SCH, Box 171, Albany WI 53502

Editor's Note: Due to "real life" obligations, Rich Dailey, KA8OKH was unable to submit Part 3 of his RX Noise Bridge series. Look for

CORRECTIONS

Pictured on the cover of the October 1999 issue are L-R) Rod Stafford, W6ROD, Hank Kohl, K8DD and Leonard Young, KS4RN. Sitting in the back is Buck Switzer, N8CQA.

QRP-ARCI Notes

Mark Milburn, KQ0I Secretary/Tresurer

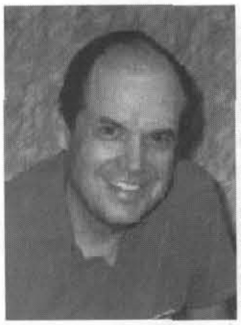
QRP ARCI has new President

President Mike Czuhajewski, WA8MCQ, citing increased responsibilities and workload, has announced that he will not be able to continue as President of QRP ARCI. Mike has been a member of QRP ARCI since 1967 and has served in many capacities including that of President since 1997. Some of his accomplishments with the Club have been the long running Idea Exchange in the club Quarterly. He has also served as Board member and Vice President. While president, Mike oversaw the growth of the Quarterly, a strong financial balance sheet, and a solid effort at the Dayton Hamvention by the club. He also brought back the Club's Hall of Fame program, adding 10+ members, and the Quality Recognition Program was implemented during his term.

Vice President Jim Stafford, W4QO, has been named President by the Board of Directors. Jim has been a member of QRP ARCI since 1990 and has served in many capacities within the club, the latest as Vice President for the past 2 1/2 years following a stint as Director. Among Jim's many innovations for the club are the QRP ARCI web site including the new QRP-F Forum that is being enjoyed by many. He has been active in promoting QRP ARCI at hamfests, especially Dayton/FDIM since its first year and has always been a positive force for moving QRP ARCI into the future. He is a charter member of the North Georgia QRP Club, as well as many other QRP organizations. Jim was also the 1992 Herb S. Brier Instructor of the Year for the ARRL, based on his work with school radio clubs in the North Georgia area. He is retired from BellSouth but owns a small but growing woodworking business.

QRP ARCI has been very fortunate over the years to attract high caliber hams to leadership positions. We are grateful for the contributions each of them has made, and we thank Mike for the years of leadership he has given the club. Although no longer President, we know that Mike will be an active supporter and advisor for the club in the future. At the same time, we are grateful to Jim for stepping up and assuming the Presidency at this time of growth and change in our hobby. It will be quite a challenge and we look forward to working with Jim as we move ahead.

QRP ARCI is now taking non-US membership applications/renewals via Credit Card! Amateurs outside the US may now pay for their membership using VISA or MasterCard. To apply or renew, you may send regular international surface or airmail and include your credit card type, number and expiration date. Include a reasonable copy of the form from inside the cover of your QRP Quarterly. This info should be sent to our agent: Bill Kelsey c/o Kanga US 3521 Spring Lake Dr. Findlay, OH 45840 Email with the same information may be sent to kanga@bright.net Or you may call him at US 419-423-4604 with the same information. Remember subscriptions may only be made for a maximum of two years. The rates are $18 US per year for Canada and $20 US per year outside US/Canada. Lastly, you may also enter data at the join/membership page on the club web site: http://www.qrparci.org Procedures are being studied to take credit card charges for all our US members as well.



Base Current—

Jim Stafford, W4QO
Club President
email: w4qo@arrl.net

Things have moved rather quickly this past quarter to say the least. Right after I returned from Pacificon (a truly magnificent QRP event - thanks go to Doug and his gang for this one), Mike C. told me he thought it would be better to relinquish the presidency at this time rather than wait until his term expires on April 1 . Mike and I discussed this on the phone and via email and several factors were involved on this. First, Mike by his own admission has been very busy at work for some time now and no matter how you cut it, this position can be a time eater. Just keeping up with email, challenges coming in from time to time, and keeping a solid crew of workers certainly takes time.

Also, there is a lot of activity leading up to Dayton that needs a great deal of attention during the first quarter. Trying to keep the quality of FDIM at a high level takes a lot of sweat on the part of many people. Although Ken, W4DU, is doing a great job again this year as overall chairman, there are always enough questions that need to be resolved that you can't take off for very long. My time flexibility is a lot greater than Mike's since I am technically "retired". When I assumed the VP position three years ago, I knew that at some time, I would likely be a candidate for the presidency if I could "keep my nose clean" and so this seemed like a reasonable time to make the move. The Board of Directors agreed and so here I am, your new president.

I am very excited about the position and the future of QRP and QRP ARCI. As much as has happened in QRP over the past 5 years, I believe that there is still much that can be accomplished to increase enjoyment of our community. Further, I believe that QRP has a bigger role in the amateur radio world and call me an optimistic; I believe that we can be a fundamental rung in the ladder of resurgence of ham radio.

With that said, let me offer nothing but positive comments about the progress of QRP ARCI during Mike's presidency. So many things have improved that they are hard to count. From the quality and size of QRP Quarterly to fiscal success to better services to the members in awards and contests, things are running very well in the past three years. Mike always points out that we have so many good, quality workers that have brought about this success, but Mike's leadership was a major factor along the way. Thanks, Mike. You may step aside but we trust you will continue as a big contributor to this organization. Send Mike a note of appreciation if you will. His tireless hours have in many ways made our enjoyment of the hobby reach some of those lofty levels!

Now Where? I mentioned in my column last quarter several things I see for the future for all of us. Let me say at the start that we need to find a way to "pull together" in QRP. I want to go on record as saying that my efforts will be toward finding a way to help people work more together and less against each other. Some of you may be asking what I could be talking about. However, others are nodding a solid YES. The title of my column may seem strange this quarter but just as in the transistor where the base "makes things happen', good and bad, our "base" is our tongue. If we use it wisely, good things happen; if we don't, bad things happen. Such a small part of our body with so much effect on ours and others lives. Let's try this - do more to build each other up than tear each other down. We need to stand on the shoulders of giants, but too often we are like a bunch of crabs in a bucket. Just when one of us tries to reach a higher level, the others pull it back in.

For many years, I have held as a personal tenet, a saying by Robert Woodruff, longtime CEO of CocaCola, "There is no limit to what man can accomplish, when he has no concern for who gets the credit." Look at the scientific community. So much time is lost trying to prove that my idea is better than yours. What we all need is a way to integrate our thoughts/ideas for the betterment of the hobby. So next time you write something, send a message to QRP-L, or a piece of email, try to ask yourself, "What will this add to the whole equation?" Frankly, "who shot John, who thought of it first, who originated the idea?" won't cut it around here. Ask yourself, "What can I do to help?" Nuff said.

How to HELP? OK, what can you do to help? We have a great team of workers in the QRP ARCI organization but there are always a number of "little jobs" that go begging. So I am proposing an ***Action Team***, a group of about 20 folks who would be willing to do some generally one shot jobs around here. It might be the design of a form, the selection of a vendor to handle a particular product, that sort of thing. Take for example, the new club badge. It took someone a few hours accumulated to get with Rick, the SignMan to get the logo imprint developed, work out the layout, pricing, etc. It was not a major job but someone on the ***Action Team*** could pick up one of these per year and feel like a contributor, because you would be. There are many ideas that come in from the membership. These need to be researched and a decision reached. With the heavy usage of email/web, there is not a lot of need to be geographically collocated to accomplish a project. So if you would like to be on this team, please drop me a line and in the title put "***Action Team***."

Speaking of the web - Much has happened in that arena in this past quarter. First, Chuck, K7QO proposed some administrative structure to QRP-L and well, things got, shall we say, interesting. I didn't see it as a real big deal but I guess that's from working in the software world for a few years. Other folks did. It has taken some time to settle down, but in the end, QRP-L did not die as some had predicted. In order to provide a larger package of tools for discussion, the club established a forum to permit a more casual format for QRPers. The thinking was that QRP-L had been set up as a place for technical information to be exchanged. Over time, many of the tech types had migrated off and volume of non-tech material had increased greatly. To provide this outlet for more communications, the forum, dubbed QRP-F, was set up. It can be found from a button on the club home page—http://www.qrparci.org. Come check it out. We try to keep a pretty current news set on what we call "Page2" One thing we had not anticipated was the shut down of Steve Hideg's QRP-L web site. Steve had done a great job over the years with the "reference" site for QRP-L. For various reasons, Steve turned it off in early November. Our club's web page with QRP-L info was beefed up quickly to try to help. We are always adding new features to the site and one I'd like to mention is the - Online Voting for Board Members site. Voting can be done either on this site or by mail. If using the site you will have to provide some vital stats like your membership number in order for us to verify that you are an active (paid up) member to vote, but it couldn't be simpler!

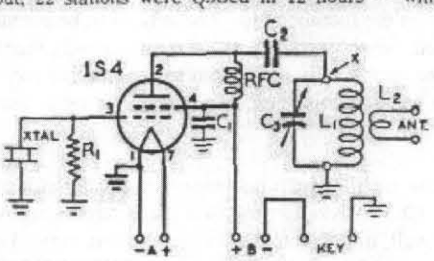
FDIM2000 - Well, there is so much going on for this year's Dayton extravaganza that I can mention only the highlights! Ken Evans, W4DU, (see flyer with details elsewhere) and his helpers are planning a "really good show" as it were. Starting again on Thursday, you won't want to miss the full day of seminars. The cost is $15 to cover some of the expenses but you will get a first class Proceedings and other items too secret to mention! The hospitality rooms will be abuzz Thursday, Friday, and Saturday nights. The banquet will be the big event on Friday night again. For Saturday - well, it's the Building Contests. Thanks to Doug and Norcal for starting this a few years back. This year, leading off is the challenge proposed by Wayne Burdick, N6KR, for the "1v rig". It generated so much activity its first week on QRP-L that the server over heated! The details are contained

elsewhere in this issue, but the idea is to design a transceiver that runs on 1.5 volts or less. Several folks had one working within a week of its posting on the Internet. Tying into that is what's called the "48 volt challenge", a contest encouraging the use of tube rigs. There has been a resurgence of interest in this area and we've decided to have a category for this at Dayton this year. Hall of Famer - C. F. Rockey, W9SCH, sent along a piece for this issue that extols the virtues of the tube rig and we thought it would be only fitting to have a contest based on tubes. We call it the 48 volt challenge, recommending that your design run on 48 volts or less.
My small contribution to this idea is in the form of a reprint of a note in Richard Fishers' Member News column of July 1993. It is a copy of W4BIW's Bantam 1 Watter.

Most of us know that QRP is not a new phenomenon. Long before QRP ARCI, people were designing and using QRP rigs, as confirmed by **"A Bantam 1-Watter"** featured in the **January 1948 edition of QST Magazine,** which is this quarter's Goodie Giveaway.

In an article by **Ernest B. Lindsey, W4BIW,** the "6 oz., 12-cu.-inch" CW rig utilizes a single 1S4 tube and a handful of other components.

"Performance?," the article asks. "From Atlanta, W4BIW has blanketed Georgia and worked into Alabama with the rig." From Connecticut, one correspondent said that "using 80 meters and 0.8-watt input, 22 stations were QSOed in 12 hours — without high-



powered preliminaries."

Curious about component values? C1 and C2 are .0047 ufd. mica; C3 is a 140 pfd. trimmer; R1 is 47K ohms, and for 80 meters, L1 is 42 turns and L2 is 4 turns of No. 30 wire on a 3/4-inch diameter plug in-form. The RF choke is 2.5 mh.

The 1S4 crystal oscillator is powered by a 1 1/2-volt "A" cell, and 30 to 90 volts of "B." The plate-and-screen current under load is between 8 and 15 milliamperes.

I was a friend of Byron who is now SK and I actually bought his SP400 from his estate a few years back. I know he would be proud to see a whole batch of these Bantams at FDIM2000! What a fitting tribute to a nice chap. I actually have his booklet of various tube rigs he put together somewhere in the 50s. This circuit appeared first in the Jan. 1948 QST. So, get out those irons and at a minimum build one of these things!

As a prelude to Dayton if you are designing a new rig for either challenge, would you please send at least a schematic and any related info to Ken by April 15? We plan to produce a monograph with a bunch of the entries for you take home with you from Dayton. The winners will be asked to submit an article for later issues of QQ, so keep good notes. In fact, we have a huge number of goodies we are producing for this year and one is the commemorative FDIM2000 long sleeve tee shirt. The actual design is a surprise but we think you will want one as a collector item. Why not get the size you want by ordering it with your FDIM and banquet tickets?

We also have an "open" class of contest for any rig you have built - homebrew or kit as well as the 1v and 48v challenge, so there is no reason to sit on the sidelines. Lastly, if you have anything of interest to display, bring it again this year to the Radio Show - an exhibit of your keys, rigs, antennas, bicycles, gadgets, etc. Started last year, we anticipate 100% participation in either the build it contests or the radio exhibits.

As in past years, there will be a forum at the Hamvention, and finally, Hank, K8DD, and Buck, N8CQA, are putting together another great booth for the club at the Hamvention. Be sure to drop by and see us there.

So much to cover and so little space - We want to thank so many people for making QRP so much fun and for helping with club activities. Richard Fisher, our Members News editor, has moved on and is now doing a column for QRPp. Best of luck Richard in all that you do. You are a true gentlemen. A good note to end on!

Jim, W4QO

QRP HALL OF FAME FOR 2000

As announced in the October issue, we are accepting nominations for possible induction into the QRP Hall of Fame in 2000. If you feel someone is worthy of the honor, please write up a nominating letter (or e-mail) and send it to WA8MCQ, whose street and e-mail addresses are found elsewhere in this issue. (If you do not receive confirmation of your nomination in a week or two, please follow up to be sure it was received.) Be sure to include plenty of justification and supporting information; remember, you think your favorite QRP hero is worthy, but you have to convince US! All nominations must be received by the end of January, and inductees (if any) will be announced at Dayton in May.

-- 73 and Queue Our Pea de WA8MCQ wa8mcq@erols.com

IDEA EXCHANGE

Technical tidbits for the QRPer

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

IN THIS EDITION OF THE IDEA EXCHANGE

40 METER NV ANTENNA

Joe Everhart, N2CX of Brooklawn, NJ is one of the guiding lights of the NJ QRP Club, and has been submitting his Technical Quickies to the Idea Exchange for quite a few years. Here's #32 in the unending series, which describes the NV (NVIS Vee) antenna, a minimalist portable 40 meter antenna. (Figures 1-3 were supplied by Joe.)

Background

One of the real joys of qrp operation is doing it in more-or-less impromptu style. Having small, lightweight equipment requiring at most a mini battery pack makes setting up and running a station almost anywhere very tempting. Probably the biggest challenge is erecting an antenna. But it needn't be a big chore.

Dave Gauding NF0R of the St Louis QRP club has popularized a series of "St. Louis" antennas beginning with the St Louis Vertical. While not necessarily high gain antennas, they are easy to quickly put up and can be quite effective. A common feature of them all is the use of telescoping 20 ft fiberglass fishing pole as the primary support. Dave and Doug Hendricks, KI6DS, initially popularized use of the South Bend SD-20 pole, though many have found the almost identical Black Widow sold by Cabelas to be more easily gotten via mail order.

One of the NJQRP members Ken, N2CQ has taken the Black Widow and used it in conjunction with one of my favorite simple antennas, the end-fed half-wave antenna. The combination is highly portable and can be put on the air in almost any surroundings in a matter of a couple of minutes. Ken likes to operate in QRP contests even when camping or visiting relatives. And he recently demonstrated his ingenuity by using just such a setup in the tailgate area of a local hamfest to demonstrate QRP operation.

Now using a 20 foot pole will not put the antenna very high in the air. And we all "know" that you want antennas up as high as possible - right? Well, no, not necessarily. There has been a lot of discussion lately on the QRP mail list about NVIS (Near Vertical Incidence Signaling) antennas. Basically they are horizontal antennas intentionally mounted a fraction of a wavelength above ground to emphasize close-in high angle performance. The "NV" antenna fits the bill.

Implementation

Figure 1 shows how simple it is. The 20 foot fishing pole supports the center of a half-wave (40 meter) end-fed wire. The far end of the wire is tied off using nylon line (in dry weather you don't even need an insulator) to a handy support 7 feet or so above ground to keep it above head level. The wire runs thru the "eye" atop the pole and the near end is tied off to another suitable support (like a car, fence or picnic table). Yes, the end of the pole bends downward but if you use light gauge wire (22 or smaller) and don't pull the wire too tight it's good for an afternoon's use. As in an article I wrote for QRPp, the NorCal journal, this forms an end-fed inverted vee. The whole thing is so low to the ground that its radiation is primarily almost straight up, as you want for NVIS.

A tuner is required to match the high impedance of the wire to 50 ohms. It can be quite elementary. A ordinary parallel resonant circuit tapped for 50 ohms suffices. For suitable designs check out the ARRL antenna book, my Rainbow Tuner on the NJQRP web site or G3YCC's web site. (See the end of the Quickie for references). A short counterpoise wire keeps stray RF from the high impedance

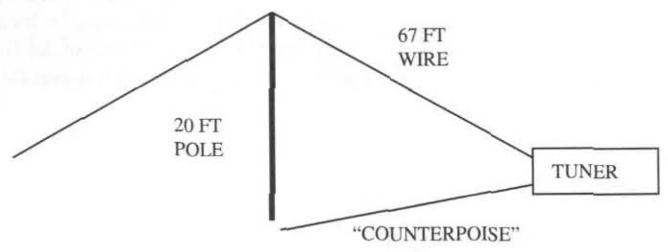


Figure 1 – NV Antenna is simple to erect

antenna from causing a hot chassis on your rig. A quarter wave wire (33 ft) is ideal, though when run on the ground it is no longer resonant - half that length has proved adequate.

Several means of standing up the fiberglass fishing poles have been used. NF0R's original means was to shove a dowel inside the base of a pole and use a sharp nail as a spike in the ground. This often works but can be mechanically unstable in very sandy or wet soil. Figures 2 and 3 show an idea I adapted (well, stole) from Tony, W2GUM. He noted that surf fishermen use PVC pipe cut at an angle as sand spikes for their fishing poles. As you can see in Figure 2, I used a 27 inch piece (because I had one that length!) of 3/4 inch PVC water pipe for my ground spike. Three quarter inch pipe makes a usable fit to the inner diameter of my Black Widow pole. The pipe's end is cut off at an angle to make it easier to drive into the ground.

I also added a three inch collar to keep the end of the pole from sinking into the ground. It is a length of 1 inch PVC pipe slit lengthwise and slipped over the ground spike.

The spike can be driven pretty easily into all but hard-baked clay soil - use the dowel and spike method for that! Sink it in about half way. You can do this by hand in sand or soft loam. If you need to drive it in with a hammer or mallet, use a piece of wood on top of the pipe so you don't mash over the end. Figure 3 demonstrates how the pole fits over the spike's end.

Results

I have not done any exhaustive analysis or antenna range measurements. I did use a similar setup with a more permanent PVC pipe mast as my home antenna with for several years. I did not work any 40 meter DX! However, I did use it on 40 meters in a number of QRP contests for contacts all over the east coast and as far as Europe, South America and the US west coast on 20.

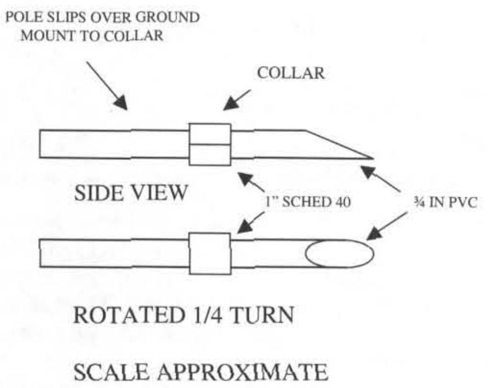


Figure 2 — Ground Stake for Fishing Pole

N2CQ, a much better contest operator than I, has used the fishing pole setup quite successfully a number of times when operating portable at relatives' houses and even in the flea market area of a local hamfest. In short - it works! So keep the NV in your bag-o-tricks for the next time you need a simple skywire to set up for casual portable QRP'ing.

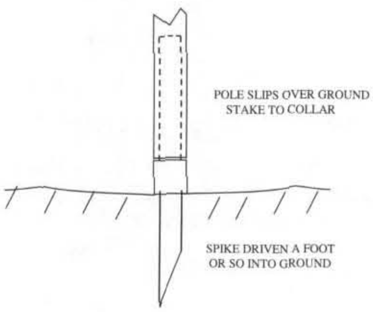


Figure 3 – Ground Spike Supports Pole

References:

NJQRP web site (Rainbow tuner) - www.njqrp.com
G3YCC site (end-fed wire tuner)- www.karoo.co.uk/g3ycc
Cabelas (fiberglass fishing pole) - www.cabelas.com
W7LS site - http://home.earthlink.net/~artskydnad/w7ls.htm
(surf this one for lots of NVIS info and links)

—DE N2CX

VOLTAGE PROBE ANTENNA

Todd Gale, VE7BPO *(jtf@direct.ca) operates the excellent "QRP Homebuilder Homepage" web site at*

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

His introduction on the site says, "These web pages were designed for hams who wish to build and operate low power radio equipment on the amateur radio bands. Although we are indebted to other authors, many of the stages have been designed or are based upon the design philosophy of Wes Hayward, W7ZOI. The website goal is to provide practical and low-cost "popcorn" circuit ideas for experimenting with and enjoying this great hobby."

Many of the items from his site have appeared in various QRP journals as well as the printed proceedings for some of the QRP symposiums around the country. If you have Internet access, you really owe it to yourself to check out his web page, which is loaded with a great deal of good technical info. In the meantime, here's something Todd sent to me a while back for the Idea Exchange--

I have an idea that needs developing and I wonder if you could experiment with it and make it into a project for your column. The project is a broadband voltage probe antenna.

I like to bring a receiver on holidays or have one in the bedroom without having it connected to coax and a large dipole. The answer would be a simple voltage probe antenna without any tuning. It could be used for MF/HF with reasonable results. I have built active antennas for one band operation that use tuning and they work quite well. But they are limited to just the one band and are a bit of a drag. I do not have time to develop this idea further, but am sending you what I have done so far. (See figure 4.)

There are many decisions and experiments to be done. How much maximum gain is needed, what type of transistors to use and how much current to stand in the RF amps are just some of them.

The Q1 circuit is just a source follower with less than unity gain. On 30 - 40 - 80 meters in my prototype, BC interference was noted and so I stuck in the BC highpass filter as shown. This filter should see approximately 50 ohms impedance at either end. I thought T1 would help with the input Z matching, however it may not really be needed and I am not sure.

The feedback amp Q2 draws a lot of current but this is probably not needed; in fact this active antenna is not used for top-notch, high dynamic range and low noise figure but quite the opposite, just to get you a reasonable signal into the front end of a receiver without too much noise. A minimum feedback amp standing current would probably be around 12 mA.

The Q1/Q2 amp would perhaps be great in a receiver that already had a built in preamp. I have tried a similar circuit in front of an ICOM 751a and I heard some DX on 20 meters. The switchable -6 B pad is just an idea I had and threw it in.

The alternate amp Q3 could be tried instead of Q2. I was thinking it would be neat to cascade two together to increase the maximum gain. There may be a need for 2 voltage probe ant amps, the Q1/Q2 version and the Q1/Q3 version.

It is also not necessary to just use feedback amps--other RF amps could be tried. I really favor feedback amps for RF and that is a personal bias that I got from W7ZOI

This might be some fun experimentation and I think it would perhaps be a useful project for your column. Any thoughts?

—DE VE7BPO

POWER ATTENUATORS

A power attenuator can be a handy thing for checking out a QRP rig, by keeping a good 50 ohm load on it and reducing the power to the point where it will not overload or damage sensitive test equipment. For instance, I've checked a number of QRP rigs on the spectrum analyzers at work. We're allowed to do personal projects like that, but with the understanding that if we break something, we pay for the repair. That gives some very good incentive to be very careful and keep the power input to the test equipment well below the limits.

One way to cut the power back is by running the output of the rig through a 20 dB coupler into a dummy load. The load terminates the transmitter and absorbs 99% of the power, and the coupler taps off a sample which is 20 dB lower in power, or 1%. I've described such a coupler a few times in the past, and it consists of nothing more than a ferrite toroid with ten turns of wire on it feeding the sample port, and a piece of wire through the center for power input

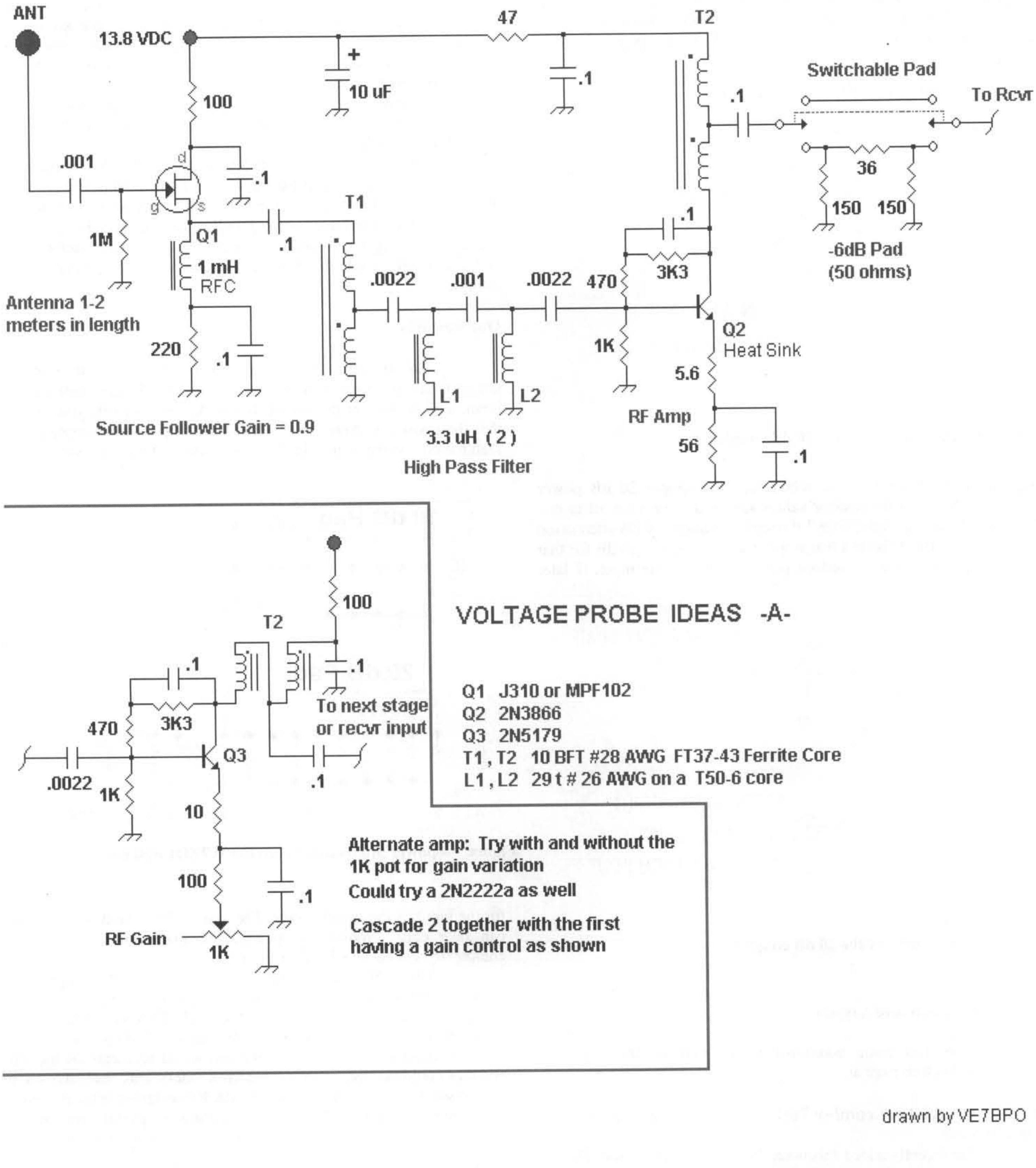


Figure 4—voltage probe antenna circuit suggested by VE7BPO

and the dummy load output. This is a handy device for a homebrewer to have around, and worth recycling the idea. Figures 5 and 6 show the details.

Another way is to use a resistive attenuator designed to handle relatively high power. We have some nice ones at work, for 10, 20, 30 and 40 dB, with power ratings of 50 watts, and rated to 8 GHz. Needless to say, that makes them a bit pricey for home use! (These were a few hundred dollars each.) But you can make one suitable for QRP for much less, using readily available metal oxide film power resistors. (Those are noninductive; using wirewound resistors is asking for trouble, since they do not present a purely resistive load.)

In the August and September 1998 issues of QST, **Wes**

Hayward (W7ZOI) and **Terry White (K7TAU)** described a 70 MHz spectrum analyzer that could be built at home. (Kits were made available by Bill Kelsey, N8ET of Kanga US.) On page 40 of the

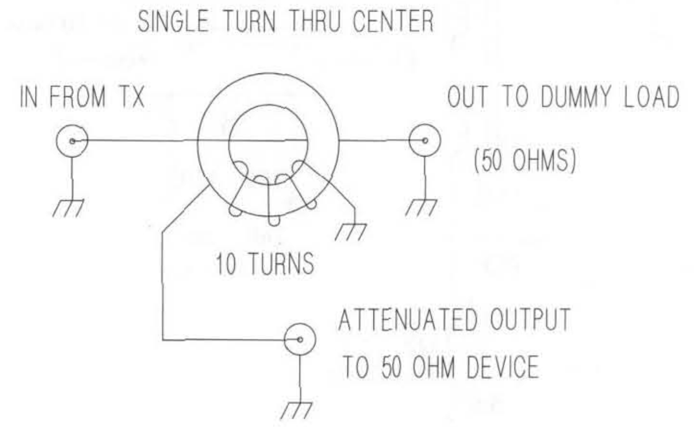


Figure 5—construction of the 20 dB coupler

September issue there was a schematic of a simple 20 dB power attenuator. Some of the resistor values appeared to be a bit off to me, and when I did the math I found it resulted in about 19 dB attenuation instead of 20. But I figured that it was close enough to 20 dB for that application, which was to reduce power to protect the input. (I later

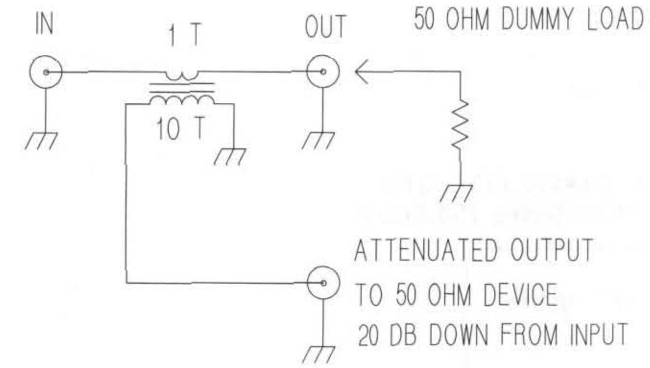


Figure 6—schematic of the 20 dB coupler

found that it was indeed a typo.)

Wes has some additional information on the spectrum analyzer on his web page at

http://www.teleport.com/~w7zoi/ (click on the spectrum analyzer icon)

He recently added this note: *"Attenuator Part Error. The six input resistors in the 20 watt attenuator of Fig. 16 (Sept. 98 QST, p 40) should be 620 ohms, 2 watt, rather than 820 ohms as shown. Many thanks to Jon, EA2SN."*

Further down on the web page, Wes added some info and schematics on making both 10 and 20 dB power attenuators. (The schematics from the page are shown in figure 7.) Wes says,

"Power attenuators are needed ahead of the analyzer when testing transmitters. We presented one in the [QST] article, but then discovered that the 2 watt AB resistors we used are no longer available, a familiar story these days. But Fred, W2EKB, came to the rescue. He purchased some Xicon resistors from the current Mouser catalog and built a couple of pads, shown below. He used some copper straps to improve the grounding. The circuits were built in the Hammond 1590B [die cast aluminum] boxes. Testing showed that they were clean through 150 MHz. Many thanks Fred !"

Many of you have probably never heard of Xicon resistors, but I've been using some of their 2 watt metal film units at work for a couple of years and had no problems with them. Another source of power metal film resistors is the DigiKey catalog, which carries 5% tolerance parts by Yageo and Panasonic. The former are available in 1 and 2 watt sizes, while the Panasonics are available in 1, 2 and 3 watts ratings.

One way only

An important thing to remember with an attenuator of this design is that it's a one way street; one side must be designated as the input, and another for the output. If you do a bit of math, you can see that the resistor sections on the left can dissipate much more power than the one on the right side. The power limit, if the right side is used

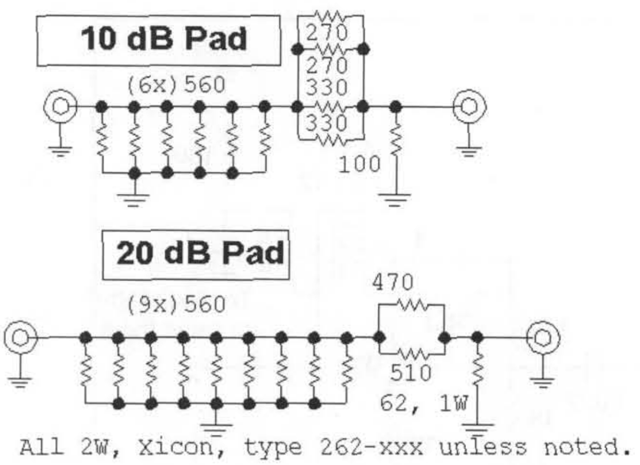


Figure 7—power attenuators from the W7ZOI web page

for the input, is thus much lower. The unit could be built so both sides can take equal amounts of power, but that would increase the complexity and cost, and isn't really necessary.

Those 50 watt attenuators at work have the output side limited to 20 watts when used as an input, and are very prominently marked with a large, red label on that end. They could have been produced a bit less expensively if they hadn't beefed up that side, but there are other considerations. In the real world accidents do happen, and they could be inadvertently connected "backwards" and have a few tens of watts applied to the "output" side. By designing it for relatively high power on that end, the chances of permanent damage are reduced and the manufacturer will have fewer upset customers to deal with.

Don't use wirewound resistors

Don't forget, "never" use wirewound resistors for dummy loads (although there is one possible exception). I had an item in the October 1997 Idea Exchange on some tests I did with wirewound resistors, and as expected, results were quite horrible.

In that column I reported on some tests of Radio Shack stock number 271-133, a ceramic wirewound resistor, 50 ohms, ten watts, 10% tolerance. Testing it with an HP 8753C network analyzer, I got these SWR values:

0.3 MHz	1.03:1
4	1.38
8	1.9
10.2	2.24
14.5	3.05
21.5	4.78
25	5.85
30	7.6

And it got even worse at higher frequencies. I also reported on some tests with a pair of RS 271-135 resistors in parallel, 100 ohms at 10 watts, the same physical size as the 50 ohm units. This put the two inductances in parallel, but each had a higher inductance than a single 50 ohm unit, so the net effect was about the same--the numbers were somewhat different, but the SWRs were equally horrible.

Although the resistance component remained relatively constant in both cases, as did the inductance, the inductive reactance increased with frequency, giving the increasing SWR. While this is quite unacceptable as a dummy load, it does perhaps suggest itself as an "SWR box" for exercising antenna tuners, especially automatic ones. (An old engineering adage is, "if you can't fix it, feature it!")

In that same column I also reported on a good dummy load made from Radio Shack metal oxide film resistors, and it's worth recycling here.

"I also made a load from a 4 hole, chassis mount BNC connector and a pair of those Radio Shack 100 ohm, 1 watt metal oxide resistors. Keeping the wires as short as possible, I soldered one end of both resistors to the center terminal and the other ends to diagonally opposite holes in the base. (See figure 8.) This one looked quite good on the network analyzer as well; at 30 MHz the SWR was under 1.02, barely over that at 50 MHz, 1.04 at 144 MHz, 1.12 at 450 MHz, and at 1 GHz it was 1.28.

"Two of these Radio Shack resistors make a load with a nominal rating of two watts. Make one with a BNC or UHF socket, which you probably have around the house already, and you have a nifty and small QRP dummy load for a half a buck plus tax. "

—DE WA8MCQ

Figure 8—QRP dummy load with a pair of Radio Shack 100 ohm, 1 watt metal oxide resistors (Oct 1997 issue)

IDENTIFY THAT HIGH VOLTAGE TRANSFORMER

Brad Mugleston, KI0OT, had some questions about how to find and/or identify a high voltage transformer to build a vacuum tube rig. He received this reply from ***Stuart Rohre K5KVH*** *(rohre@arlut.utexas.edu) and posted it on QRP-L--*

I can comment on a method of transformer selection. Actually, in the olden days the filament windings of the 1950's were pretty standardized as to current ratings, so you look for those that have four windings, with in some cases a few more, than the 8 wires four windings take.

If the unit had multi primary taps for AC, you would have at least two black primary wires, and maybe black-yellow and black-red. But, other than military and European or world brands, most US made brands did not have multi tap primaries, so see if you have a brand name logo stamp on a prospective transformer, such as Stancor, Triad, CTC, UTC, Hammond, or some others older such as Kenyon. The transformers of the types most popular for ham use either had the open core with two end bells design, or the potted square design, like the Heathkits used. European brands include Philips, and those often had many lugs for multi taps on primary, or a selector switch hard wired to the primary on pigtails marked for AC voltages between 90 and 300 VAC. Black to black is the standard connection for 115 VAC input, and remember that the standard for line voltage in the US went up over the years, so a 110 V transformer will put out a little more now, on modern lines.

The 5 volt tube rectifier filaments ran on yellow, yellow-blue for a center tap, and another yellow. So yellow and yellow is basic and should give 5 volts AC to a filament rectifier tube, like 5U4. The other filament winding for the oscillator and amplifier tubes was 6.3 VAC or 12.6 VAC, and of course you take an unmarked transformer and hook up primary black leads and a voltmeter to find out what other windings give out. Remember that the voltages will read high if there is no load.

You could find out the typical current drain for the filament of a 5U4 rectifier and hang a 10 watt power resistor of correct resistance to draw that on the filament winding of the five volt side, and then do same for the other filament winding, and see what the voltage does to decide if you have a six or twelve winding. The regular color code for those 6.3/12.6VAC filaments is green and green, with green-yellow center tap (if used). There could also be a multiple set of filaments, and the second set would be brown, brown-yellow center tap, and brown. A third set would be slate(grey), slate-yellow, and slate. The yellow was always a stripe of color in the tap winding wire, ie, slate wire with a yellow stripe.

The high voltage plate windings were red, red-yellow for tap, and red. This is very uniform, if the transformer has color coded wire leads, and most except military specials did have. But military ones, which could be square or rectangular steel cases with ceramic terminals on high voltage taps, usually had lugs or screws which were identified with a diagram of terminals on the side of the transformer. A problem these days is the scratched up paint on the sides, which can obliterate the information, but I find lots of NOS transformers alone. [NOS is "new old stock," parts that are very old but still unused, often in the original box. --WA8MCQ] Only in built up equipment do you see the rusted or scratched up transformers.

Now as to current ratings for a transmitter; you go by the transformer volume. It takes a certain amount of iron and copper wire to develop the current rating and so, with filaments always taking the same amount of wire and size, your main variant in making one transformer bigger is if it was for high current, high voltage vs. low current and lower high voltage. Best to find some tube gear of which you are able to see a label, or know the rating of the HV windings, and see what volume it has; say, 36 cubic inches for a transmitter transformer that is rated at 500-0-500 (500 volts either side of center tap), and with 100 ma windings, for 50 watt transmitter input to a tube plate. The secondary high voltage winding is probably really rated at 125 or 150 ma in those cases. This transformer, very close to what is in my Heath DX 20, also had 5 volt rectifier winding for filaments, and a 6.3 volt AC winding for oscillator tube and final tube filaments.

Any transformer that is bigger physically and with no more windings than this probably has higher voltage and current ratings. The only tricky ones might be the CRT, oscilloscope or radar tube transformers, and invariably they would have bigger ceramic stand off terminals for the several thousand volts, but low current CRT high voltage supply. Smaller 4 winding transformers, particularly those whose cores mounted vertical, with end bells coming down all the way to chassis, usually signified a receiver or lower power high voltage winding.

Kilowatt sized transformers are really heavy and big, and look heavy duty. For most circuits like the one you were interested in, your plate ran from 350 to 750 volts tops. Very old 1930's tubes of big glass globe round transmitting type triodes used very much higher voltages, but at often only 50 or 100 watts, even with 1000 volts on the plate. By 1955, you could do 50 watts with a TV sweep tube or 6146, or many others at only 500 volts and 100 ma on the plate of a pentode.

So, to sum up, you take a "suicide cord" to hamfests, an AC cord and plug with insulated alligator clips on the end that would normally go to the transformer primary. Identify the primary winding wires or lugs, and--with the cord unplugged!--clip onto those, and plug it into the wall, preferably with an in line circuit breaker of, say, 2 amps. On the output of each other winding, you carefully test one at a time, to see what open circuit voltages are present vs. color of wire leads. Unplug the cord from the outlet before changing the voltmeter leads, and have insulated alligator clips on the voltmeter leads, and make sure nothing crosses and shorts something, even another lug on a transformer or its case.

Don't hold voltmeter leads in your hands while the power is on! Tube work is shocking to the unwary! You can determine in short order if the transformer is functional on its windings, what they are, and if you include some power load resistors, for appropriate current drains, you can check the transformer for overheating, ie, whether it can take your loads. Once, I got a free surplus military transformer and built it into a power supply I needed, based on voltage hookup measurements alone. Once it was drawing a load, with both sides and center tap of high voltage hooked up, it got almost red hot on the steel case. I did not know why, until I looked at both high voltage sides on either side of the center tap wire, under the load of the supply.

I had unequal high voltage secondary voltages being developed, because of a partial short in one winding! So that one was a wash. But you can often find great transformers in original military packing for $5 at hamfests, so a little time invested can save you $50 or much more for modern tube type supply transformers

There are lots of collectors of old transformer catalogs on the "boatanchors" Internet discussion list or other such radio groups, and the old radio magazines can help on identifying model numbers and what a given hunk of iron might do. So just go out and look, and maybe from old tube type TV set, or junk ham radio you could find a suitable "glow bugs" power transformer. Of course, anything with a transformer case and only two leads is a power filter choke, and again, bigger means more current rating and more inductance in henrys. Figure on 10 henrys for a typical 50 watt transmitter supply filter, using the voltage and current example above. Anything less and you have to increase the size of high voltage filter capacity. For 10 Hy, I think I had only 20 mF or 40 mF at 450 volt caps, two in series at 40 mF gives 20 mF at a 900 volt rating, and thus it takes four to make a Pi filter power supply.

I used to find a transmitter in the handbooks that used something for power close to the parts on hand, and would copy the handbook circuits. Tubes were pretty flexible that way. If you had hum, add more capacity in the DC supply, shield leads, or bypass things better if it was RF induced hum. Twisting filament wires to each tube base and dressing them flat to the chassis helps the hum stay low. For higher power rigs, folks used shielded wiring to filaments to keep RF out, etc.

Again, the illustrations in old handbooks will teach you good layouts. The old handbooks are often $5 or $10 at hamfests, and maybe less at second hand book stores. Hope this encourages you to go scrounge!

--DE K5KVH

VARIATIONS ON G5RV TYPE ANTENNAS

*When he granted permission to use his QRP-L item above, **K5KVH** passed along this bonus item, which includes his variation on the popular G5RV antenna.*

The G5RV is often listed among antennas in use by hams and QRPers in particular. The true Louis Varney, G5RV antenna is simply a 102 foot dipole, center fed with a certain length matching ladder or open wire line. Variant flat top dimensions allow feeding with 300 ohm twin lead for the matching line. From the end of the matching line, coax can be directly connected and continued to the shack.

The lack of a balun does not impair the antenna's function, and may contribute useful low angle vertical radiation, if the G5RV is in the high and clear, which is usually 34 +/- feet up to allow the ladder line to hang at right angles to the dipole. Without a tuner, Louis's 102 foot dimension gives one and one half waves with low SWR on 20 meters, yielding gain over a conventional dipole. A bonus is a reasonable match on other bands, but with 15M usually being 3:1. Thus, a matching network is advised at the rig. If you are forced into using a network, you might as well use its built in balun, and ladder line all the way, eliminating the higher coax loss. The traditional G5RV did not, with low SWR, cover the non harmonic bands that WARC provided.

Enter the next family member, the ZS6BKW G5RV WARC capable antennas. With a reduction to a 92 foot flat top, and 40 feet of ladder line, plus 50 ohm coax to the shack, the WARC bands from 30M and up are also reasonable matches. The calculations also provided a differing flat top, and matching line length if 300 ohm twin lead is used.

Some years ago, Stuart, K5KVH, built the ZS6BKW flat top with dimensions for 450 ohm line, but did not have sufficient vertical hanging space for the ladder line over his single story house. Dismayed, he reread the W6SAI reviews of the G5RV family in "CQ" magazine, and had a revelation. The balanced feeder only needed to be at right angles to the dipole flat top, not necessarily vertical! A horizontal run of ladder line to the center insulator from a convenient tree, and a back stay nylon guy line on the other side of the insulator were added. This installation quickly confirmed that this variant worked better than any low dipole previously used at K5KVH! At only 15 to 20 ft. high for the dipole wires of no. 14 stranded copper, Stuart had a near omni directional DX cannon! This antenna could hold a fading band to other USA stations, while making ZL and VK armchair copy on SSB. DX was also good on 40M as well as 20M. The horizontal 450 ohm ladder line directly connects to RG8X coax which runs to the shack without use of a matching network, except for 15 M, where SWR was 3:1.

There you have the true G5RV family of antennas, including the ZS6BKW, and K5KVH. Some commercial applications have added a balun to the end of the parallel line matching stub, before the unbalanced coax connects. However, this version puts a heavy weight on the center insulator/balanced line junction, and wind will break such a feed, reports K5KVH. Additional strain relief of the balun weight is suggested for such a G5RV. This can be a line supporting the balun weight off your mast or tower, for center supported antennas.

—DE K5KVH

JOURNALS FOR THOSE IN THE TRADE

This isn't exactly QRP, but still of possible interest to many. There is something called a "trade journal," which is a controlled circulation magazine that is available free to qualified people working in a particular industry. These are written on a wide variety of topics of interest to people in various fields, with articles about new developments and products, new techniques, trends in the industry, just about anything you can think of. There are magazines written for people in RF, computers, general electronics, lasers, adhesives, plastics, machinists, office managers, medical, dental, safety--no matter what the industry, if people work in it, I can just about guarantee there's a trade journal for it, and probably several.

They are free to qualified subscribers who apply. While they get to define what "qualified" is, it basically means someone who is working in a particular discipline AND has some degree of influence in the process of buying and purchasing products for their company. That can range from final approval authority all the way down to merely suggesting or recommending things, which is where I come in, as a lowly engineering technician. They are limited in the number of free subscriptions they can give out, by regulation, and the more popular ones are more difficult to subscribe to. You may have to apply several times until someone has dropped off their rolls and made an opening for someone on the waiting list.

How can they provide free magazines? They get their income from advertising revenue. Companies advertise in trade journals because they have a closely targeted readership and get a lot of bang for their advertising dollar. For example, a company like MiniCircuits, which makes a wide variety of RF modules in addition to the double balanced mixers that hams use, would find ads in Microwaves & RF much more productive than putting them in, say, Field and Stream! They might be able to reach a lot more people at a much lower cost per reader in the latter, but an ad in a magazine read strictly by people who actually work in their industry will be much more effective. Thus, they are willing to buy ads which help pay for the free magazines and generate a lot more business for themselves.

At work I get a wide variety of trade journals, and not all of them directly related to electronics. But here are a few of the ones that might be of some interest to technically oriented QRPers. There are others, of course, and I may mention some of them in the future, but this is a good start. There's a good chance that those of you who would fit their definition of "qualified subscriber" and be eligible to subscribe already get many of these, but there might be some you haven't heard of.

More and more trade journals are operating web sites in addition to their paper products, and you can subscribe to all of these magazines from somewhere on their web pages without having to scrounge up a paper application card.

EE Product News happens to be edited by Dave Maliniak, N2SMH, of the New Jersey QRP Club. And well known QRPer Gary Breed, K9AY, is the publisher of Applied Microwaves & Wireless, and former publisher of RF Design.

A word of warning before you start subscribing right and left (if you rate as a "qualified subscriber" by their definitions), some are fairly easy reading while others are probably well over most of our heads! But you can still learn a lot from them.

Applied Microwaves & Wireless
http://www.amwireless.com/
Microwave Journal
http://www.mwjournal.com/
EE Product News
http://www.eepn.com
Microwaves & RF
http://sites.penton.com/mwrf/
RF Design
http://www.rfdesign.com/
Test & Measurement World
http://www.tmworld.com/
EDN
http://www.ednmag.com/
Electronic Design
http://subscribe.penton.com/ed/
Wireless Systems Design
http://subscribe.penton.com/subs_wsd/
Wireless Design & Development
http://www.wirelessdesignmag.com/

—DE WA8MCQ

QRP-L COMMENTS ON THE 1 VOLT CHALLENGE

There were quite a few comments on the QRP-L mail reflector when W4DU announced the 1 Volt Challenge from Wayne Burdick, and here are some of them for your enjoyment. I especially like the series of items from Steve Weber, KD1JV. (His e-mail address is kd1jv@moose.ncia.net.) He's become quite well known on QRP-L as a very highly competent designer and inveterate tinkerer, and I always enjoy his postings. His comments started out skeptical, then he started reporting on his progress, and before too long he was just about ready to move on to another challenge, having licked this one easily! We hope to have some schematics of his circuits in the April issue.

Here are some selected comments, in the order they appeared. (Remember, the challenge that N6KR presented was to build a transceiver capable of running off the voltage of a single D cell, and preferably as low as 1 volts, without using any ICs or DC/DC converters to step the voltage up.)

From **Steve Weber**--I don't know....building a transceiver that runs on one D cell is going to be a true challenge! 3V would have been a LOT easier. In fact, thanks to Walkmans and cell phones, there are a lot IC's available now that will run with as little as 2.5 volts, mostly digital parts, but also some op amps. 2.5 volts seems to the be limit for current technology. The only IC's I know of that will work down to 1V are those designed to boost that voltage up to a more workable one. Well, we'll at least do a few experiments before saying it's impossible

Later comment from Steve--Well, I'll be. Blow me down and dip me in flux ! Just dead bugged a crystal oscillator for 3.58795 MHz running at 1.5 volts and it works! And thanks to a clever way of driving an amplifier stage with a 4:1 transformer on the output, I'm getting 3 volts p-p into a 50 ohm output load. That's 20 mw! Now that's more than enough to drive a double balanced diode ring mixer and enough to be considered a transmitter. I'm thinking of a direct conversion receiver to K.I.S.S. {Keep It Simple, Stupid.]

I started with a transistor out of an old cordless phone. I figure these were designed to work at about 3.5 volts, so the transistors must have been selected to work at low voltages and may be better than the usual 2N2222's or 2N3904's.

So, this just might be possible after all. Hmmm, maybe when it's all done it will work on lemon power, or is that a new contest by itself? **—DE KD1JV**

From **Jim Hossack, W7LS**, w7ls@blarg.net--*A few years back*, a lady from the University of Washington department of forestry came to our ham club and described her work with bats in the area. They were tracking them to see where they went and what they did. In order to do that, they needed a really tiny transmitter. There are, or were, two companies that provided them commercially. They were built on the side of an HC-18 crystal can, with a single 1.5 volt hearing aid battery on the other. There was no case, but they were epoxy encapsulated. The power on/off switch was two wires that stuck out the side and when you wanted to turn it on, you tacked a little solder blob on them. Ran for a few days, as I recall. Weighed under a gram, if not mistaken. Anyway, a little bitty pregnant bat could haul them around. The antenna was a 2 or 3 inch wire. They were affixed with glue to the bat, and fell off after a while.

BTW, the transmitter was a pulsed oscillator, on roughly 2 meters.

—DE W7LS

More from **Steve Weber**--Instead of working, I spent all day playing with the 1.5V oscillator and amplifier. The best I've been able to do so far at 1.5 volts is about 40 mw out. If I go to 3 volts, it gets considerably better, 640 mw. This is using 2N7000 MOSFETs as a push pull amp. The 2N7000's in push pull don't work any better than one as a single end amp at 1.5V, but makes a big difference at 3.0 Volts. Might get even better if I select them for minimum turn-on voltage and match them.

HINT: To drive the 2N7000, put a tuned circuit across the gate (link couple the drive) and bias the other end of the coil at the supply voltage. So, even at 1.5V, a milliwatt transmitter is do-able. Now, I guess it's time to start thinking about a receiver...

—DE KD1JV

From **Wayne Burdick, N6KR** (n6kr@elecraft.com), originator of the challenge--Germanium and other low-drop transistors would be fun, but you can use even 2N2222's at one volt. It only takes 0.65 V or so to turn on a garden-variety NPN or PNP transistor, and you can definitely make one amplify or oscillate at this voltage. There are also other low-voltage transistor families, including some zippy new ones used in multi-GHz portable phones, etc.

One place where low voltage has an advantage is in low impedance circuits. You can drive an 8-ohm speaker directly from an emitter follower with no coupling caps; you can DC-couple some gain stages; etc.

As I mentioned in my original write-up, I was hoping builders could avoid ICs in this design contest because ICs hide the implementation details of low-voltage biasing. I think everyone learned a lot about discrete transistor circuit design from the 2N2222 rigs that were presented in a previous building challenge, and that was the point. Here, we'll find out just what you can do with 1 volt (or less!).

Just to lay down the gauntlet, what I'm hoping we see at Dayton is a fully-functional transceiver that works down to a bit LESS than one volt, has 1-uV receive sensitivity, and puts out a watt on 80 meters or higher. **—DE N6KR**

More from **Wayne** later--

Are special low-junction-voltage or high-gain transistors required to meet the 1-V challenge? No! To see what a 2N2222A could do with a 1-V supply, I just breadboarded a 28-MHz crystal oscillator, using a fundamental-mode crystal and a total of only five parts. It works beautifully, and actually continues to operate well BELOW 1 volt. Output, taken from the emitter, is about 1.5 V peak-to-peak into an open load, or 1 volt into a 1-K resistive load. Adding a second 2222 as an emitter follower yields about 1 V PP into 47 ohms, or 2.5 milliwatts.

One very important thing to keep in mind when working with low-voltage, high-current circuits is that supply decoupling caps and very low-impedance ground returns are NOT optional. When I first built the little oscillator/amplifier mentioned above, it was operating as a multivibrator--the signal on the 1-V power supply lead was almost as large as the signal into the 47-ohm resistor! Bypass caps near the collector of each transistor solved the problem. **—DE N6KR**

Later comments from **N6KR**--

Rather than use up alkaline batteries during 1-V circuit testing, you might want to make a simple 1-volt regulator that can itself be powered from a 12V bench supply. This is preferable to using two high-wattage resistors as a voltage divider (!), since it will provide a much more stable output as the load current varies.

All you need is a hefty NPN transistor to use as a "pass device" (emitter follower), plus one resistor and a standard LED. The resistor and LED are placed in series to ground to provide a base voltage reference of 1.7 V for the regulator transistor. Since this transistor's B-E junction drops another 0.7 V, bingo--you get a reasonably well-regulated 1.0 volt (approx.) at the emitter. The LED also doubles as a power-on indicator.

For low current use (say 20-30 mA output @ 1 V), you can use a 2N2222A or nearly any other NPN transistor as your pass device. For higher currents, use a 2N2219, 2N3053, 2N3055, or perhaps a TIP-series device, and a heat sink. **—DE N6KR**

From **Kent Torell, AB7OA**--

One of the projects that's been on my 'do' list for the last 25 years is to build a regenerative receiver described in Ham Radio, April 1973, pp. 42-45. Courtney Hall describes a WWV regenerative receiver he built that runs on a 1.5 volt battery and draws 1.5 mA! Looks a lot like Paul Harden's (NA5N) regen stuff, except it has three transistors direct coupled for the audio stage. He used a Fairchild transistor; the TIS97, which is still being made. It is a silicon part, high gain (min 250) and a 2 dB noise figure. Nice general purpose transistor, as it's breakdown is 40 volts. **—DE AB7OA**

[Note--Paul recently spurred tremendous interest in regens on QRP-L and in the pages of QRPp, the NorCal journal. In fact, KI6DS even devoted an entire issue of QRPp to a variety of regen receivers! --WA8MCQ]

From **Steve Weber** again--

I'm not sure Wayne fully considered what it would take to produce 1 watt of RF output power, with only a 1.5 or 1v supply. Lets take a quick look at some calculations and see why meeting this goal may be literally impossible to do. *[A statement that would come back to haunt him later! —WA8MCQ]*

For a start, lets make some assumptions.

VCC+1.5V. RMS power out 1 watt; efficiency 50%, Vce saturated, 0.5V

If we have an efficiency of 50%, we will need 2 watts of input power. Multiplying by 1.414 to get peak power, we need 2.83 watts.

A 1.5V supply minus the transistor Vce sat of 0.5V gives us 1 volt across the load. Peak collector current will therefore needs to be P/E or 2.83 amps!

In reality, getting a 50% efficiency is very optimistic. So is having a Vce sat of 0.5 volts with nearly 3 amps of collector current. Just supplying the required peak current is going to be a problem. One is bound to lose a few tenths of a volt due to I/R drops and internal resistance of the battery. All this drives the required peak current even higher.

Then there is the problem of getting sufficient base drive. The beta for high collector currents tends to be low. Base current may have to be as high as 100 ma. Vbe at this current will be high, about 0.8 volts, not leaving much head room to work with.

Now lets look at the equivalent collector impedance we need to match to. Using the formula VCC*VCC/2Po, we get 0.5 ohms. To match a 50 ohm load, we need a 100 :1 matching transformer!

The problem gets a little easier if a push pull amplifier is used, as each transistor only has to pull half that total current, but is still a difficult task.

The final problem is finding an RF power transistor which can handle 2-3 amps of peak collector current. Transistors with this kind of rating will be in the 20 to 40 watt power class.

I was able to get about 250 mw out using a push pull MOSFET (2N7000) output stage. Power out drops quickly below 1.5 volts. I doubt that much more power out is possible and was pretty amazed to get that much. If anyone can beat 250 mw, I want to hear from you.

It's interesting to note that the low voltage IC's that are coming out are mostly all built around MOSFETs.

On the other hand, building a receiver with good sensitivity was pretty easy. I whipped up a direct conversion receiver which drives a piezo speaker with a total of six transistors and 4 diodes and has 0.1v sensitivity. All this is on 80 M. It works at full sensitivity down to 1.1 volt. Oh, and it's a power hog, drawing almost 60 ma. Gonna have to work on that! **—DE KD1JV**

From **N2CX, Joe Everhart** of Quickie fame--

In what seems like another lifetime I was part of a team who designed a pocket pager that ran on a single AA NiCd. That's even a worse challenge than the more ordinary 1.5 volt (nominal) alkaline battery. NiCd's start out at only about 1.2V!

1. Use magnetics wherever possible. Chokes are great collector loads and don't waste voltage or power as resistors do. And transformers make life easy in giving DC isolation and impedance matching necessary to preserve gain. You can also "play games" using the voltage step-up properties of transformers and resonant circuits to get voltage swings well above the DC supply voltage.

2. As Wayne said, trade current for voltage. KD1JV worried about a 1.5 volt receiver that drew 60 ma. That's not all that bad. For the same power at 12 volts that would be only about 7.5 ma! And if you want more power in a transmitter, parallel a whole bunch of devices!

3. In the pagers we did use IC's. In them we used the inherent balance of devices made on the same chip to aid in biasing but you can hand select components to match them and provide good thermal bonding between them to minimize effects of differential thermal drift. And you can use forward biased diodes for base bias using inductors to provide AC isolation. Many of the IC tricks can be duplicated with discrete components if you use your head. Check out some of the low voltage IC manufacturers literature to learn their techniques. **—DE N2CX**

Steve Weber checks in later-- WOW, I'm up to 600 mw output on 80M using a single "D" cell ! A day or two ago, I would have never believed it possible to get this much power. Should have never questioned Wayne's off-the-cuff estimate at what could be done. Think MOSFETs, lots and lots of MOSFETs...

Only 400 mw to go, but at this point, every extra mw is going to be a struggle. As it is, the voltage from the battery drops from 1.52 to 1.40 volts under load, even using 1/4" wide braid soldered directly to the battery to make the power connections. Might have to go to several cells in parallel, with 1/2" wide copper buss bar welded to the terminals. At the currents need for high RF power out, small resistances produce noticeable voltage drops and a loss of a few tenths of a volt makes quite a difference in power out.

Last night when I was only getting 400 mw out, I tried 3 volts and got an amazing 2 watts! That was with just four 2N7000's. Now I have eight. Wonder what it would do at 3V now? I bet it would hit 1 watt out if the voltage at the FETs was about 1.7V.

—DE KD1JV

From **Stan Mcintosh, KD4BTH** (mcintos@basf-corp.com)

Last night, I threw together a regulator for the 1-V project. A string of 6 forward-biased 1N4002's worked very well at giving a stable voltage reference for a 2N3053 pass transistor. The nice thing about a string of diodes is that you can easily add or subtract 0.7V. Eventually, I want to replace that third or fourth diode to allow for hitting 1.0 VDC, instead of over or under-shooting by 0.3-0.4VDC.

For those of you that might consider using a 2N404, the single transistor audio amp that Paul Harden used in his regen article in 1996 (QRP Quarterly) requires very little modification to work surprisingly well, even at 0.7V on the emitter (this is a PNP). I had high-impedance phones connected between ground and the collector, a 500k pot between the collector and the base for playing with bias, and the emitter went to the regulated V+. Low impedance phones might be worth a try. With the bias pot resistor at 90-100k resistance, the amp took a barely-audible tone to a painfully loud tone at 1.4 supply volts, to simulate a worn-down "D" cell.

Over lunch, I moved the alligator clip up one diode in the string for 0.7V regulated output. It actually still amplifies, and very well. There's apparently enough headroom to make this work with an environmentally-friendly NiCd cell, and you'd only need three solar cells for charging. Now, what about a VFO? ***—DE KD4BTH***

Steve Weber again-- In order to get the 2N7000 MOSFET PA to work as well as it does, I had to find a way to develop a gate bias voltage of about 2.6 volts. Been keeping that a secret.

Although the PA produces some power out with a 1.5 v gate bias, it don't "kick butt" until the bias is up to the 2.6V level. I found a way to do this without resorting to a DC to DC converter, but it was a gray area in the rules, so I asked Wayne if what I was doing was legal. He said it was, but I should share the idea with the group to keep a level playing field. Since I've been sharing my work so far, I don't have a problem with that.

The PA was producing about 4 v p-p with the 1.5 volts nominally available. I simply tacked on a voltage doubling rectifier to the RF output and fed that voltage back to the gates, with a level control and a way to limit the voltage when full power output comes up. It works very well and reliably. In effect, this an RF to DC converter, so it's legal! Plus it gives a way to adjust the power output to some degree.

In the same vein, I asked if we could use some similar approach to develop the voltage need to use a varactor diode, so we could build a tunable VFO. This is also acceptable, provided the DC voltage is developed from an RF oscillator needed for the circuit to operate anyway. Therefore one could use the VFO itself to generate a varactor tuning voltage. Neat, eh? (If it's a superhet, the BFO would be a better source) **—DE KD1JV**

From **Glen Leinweber, VE3DNL** --

I put a couple of transistors on a curve tracer. I found an old 2N404 and compared it against a modern MPS2222A. I was interested in their saturation characteristic, since this will be a limiting factor in a low-voltage power amp stage.

With the 2N404 passing 200mA, the collector went down to within 300 millivolts of its emitter. The MPS2222A, at 200mA, had a similar Vce(sat) of 200 millivolts. So the advantage is silicon over germanium.

How 'bout them MOSFETs? The equivalent ON resistance of that MPS2222A is one ohm. You'd have to use a pretty big FET to beat it. A IRF510 has ON resistance of a little more than half an ohm. But you have to drive the gate to over +5v to get such low ON resistance. The advantage would seem to be with the big MOSFETs, as long as you can drive their monstrous gate capacitances with a decently high voltage. (See Steve Weber's method.) But don't count out those silicon bipolars - they're likely easier to drive.

—DE VE3DNL

A triumphal report from **Steve Weber**--

I did it, I did it! 1.05 watts out, 1.47V supply. Whew, glad that's done, now I can sleep tonight and get some real work done tomorrow.

Okay, if you've been following this saga, I made two major changes. One, used the RF Parts T-3/4 balun core, which was used in the 20 watt linear kits. This replaced the BN-43-202 core I had been using; 3 secondary turns instead of 2 and bigger wire.

Two, put two "D" cells in parallel. With just a single cell, power out was 900 mw. So close.... Added the second cell and "BINGO" 1.05 watts! Like I said earlier, 1/10 of a volt makes a big difference. Think of it terms of percent of the available voltage. A 0.1v change at 1.5 volts is like a 1v change at 15!

Oh, and maybe the two 50 uF tantalum VCC by-pass caps I put on either side of the balun helped. It has a nice, clean output signal too.

Do I dare add another set of MOSFETs? Can I get similar results on 40M? How long can this thing put out 1 watt? The FETs don't even get warm, so that's not a problem. **—DE KD1JV**

Next report from **Steve**-- I tried using IRF510's in the amp this morning and they also work. One set in push pull produces 500 mw, four produced just under 1W. However, due to their very high gate capacitance, it might be difficult to make them work on 40M or higher. Also, four IRF510's take up more room than eight 2N7000's. But then the IRF510's are available from Radio Shack, so somewhat easier to get for some people than the 2N7000's.

I tried using 2SC2078's, a common CB final amp transistor, also in push pull. Dismal results, only 50 mw at best; I might be able to do a little better, but am not going to try. Bumped the supply up to 3V and they put out 500 mw, a bit more reasonable. They get hot, unlike the MOSFETs, so efficiency must also be a lot less too.

All in all, myself and others have concluded that while it is possible to make a rig run on 1.5V, 3V is a lot more practical. Or 2.2 volts from a couple of NiCd's in series. **—DE KD1JV**

And in his final report, **Steve** said--Got a 40M superhet working last night. Not the best radio I've ever built, or the prettiest, but hears reasonably well. Works okay down to about 1.2 Volts and marginally at 1 V. Draws a real hefty 120 ma at 1.5V. Nine transistors and 6 diodes. Currently working with an external VFO, so next step is to build a 1.5V powered VFO to make it complete.

Observations.

Use diode mixers. Wasn't able to get a transistor mixer to work, but didn't try very hard.

Keeping the audio amps in a linear operating region with varying supply voltage was difficult, until I thought of connecting the base bias resistor back to the collector. A 600 ohm transformer makes a good collector load. Didn't think it needed a volume control, but a 1V p-p square wave (strong signal) into a set of headphones is really loud!

Intermod seems to be a problem, even with the diode mixers. I think the RF pre amp is having trouble handling the signals on 40. Might need to supply it even more collector current!

Use lots of RF chokes. One on the power to each stage. I've been pulling 100 uH out of junk VCR's. **—DE KD1JV**

SOME CHANGES TO QRP-L

For quite a few years, a lot of people had complained about the huge amount of traffic on QRP-L, the QRP mail reflector started by Chuck Adams, K7QO, in 1993. There was some discussion about splitting it into two different reflectors a couple years back, one for technical items and another for everything else. It never came to pass, and QRP-L continued to grow in size. Unfortunately, it also lost quite a few people over the years, who found the huge message load too much to handle, and were not interested in a lot of the topics.

Starting in late October, there is now an alternative to QRP-L. Created by K7QO and Jim Stafford, W4QO, it's called QRP-F, and is an Internet forum rather than a mail reflector. This one does require a browser and full Internet account, rather than just a simple e-mail account, and there are some other differences. But those who are familiar with using the QRP-L HTML archives, in the "sorted by thread" mode, will find this a very familiar format. It works just like that, for the most part.

The idea is to take some of the load off QRP-L and return that to what it was originally envisioned as, a technical discussion forum for QRPers, and have the other QRP related discussion topics on a separate media. This will allow people to more easily find the subject areas they're interested in.

There were some early growing pains as bugs were worked out and features added, but things are running more smoothly now. Whether this will catch on and become popular in the long run remains to be seen. The idea of splitting up QRP-L has always been a controversial one over the years, and some feel that the loss of a sense of community will detract somewhat. However, there is no question that many felt that something did need to be done, and the attempt has been made.

You can find QRP-F at:

www.e-discounter.net/qrparci/index.html

THE FINE PRINT: As always, if you have anything you'd like to share, pass it along by snail mail or e-mail, and don't worry if it's a bit rough or has hand drawn schematics. We take care of all that. The important thing is to get it to Severn for the rest of the QRP community to enjoy.

—qrp—

Building and Using the Elecraft K2 Transceiver

John King, KB3WK 9936 Whitworth Way, Ellicott City, MD 21042 email: kb3wk@arrl.net

Back in the days of my amateur radio youth (yeah, I know – logbooks were made out of stone tablets in those days.), it was quite common to see a ham make his entire suite of equipment from kits. Heathkit alone had a major fraction of the ham market. But, for many years now, things have been different. The vast majority of hams have a commercial transceiver as their main rig. With all due respect for some fine equipment, the kits on the market have mostly been aimed toward specialty market niches, allowing simplifications in design and implementation. The Elecraft K2 is, I believe, a different story. With all of the options available or planned for the K2, the enterprising amateur will be able to once again say that he has had a hand in producing his main set of equipment.

As is the usual case, we QRP'ers are way out in front of our ham brethren, and have already recognized the fun and value in this great little rig. The basic kit, priced at approximately $550, produces a state-of-the-art, QRP CW transceiver. With all of the planned options, including the QRO final amplifier, it should be possible to develop a good, all-purpose HF station for less than about $1,200. Without the amplifier, the cost is limited to about $900. The extra added plus with the K2 is the fun of actually building your own stuff. With the superb construction manual and excellent technical support available, it really should be quite within the skill level of the average ham to successfully complete the K2 and put it on the air—and have some fun doing it.

What's Inside

Two features make the K2 exceptional, in my opinion. First, it has a very competent receiver, with good strong signal handling capabilities that are so important for today's crowded bands. Second, it uses a microprocessor-based controller to make possible a number of operating functions and options. This latter feature puts the K2 a step ahead of the pack.

As interesting as the microprocessor control idea might be, the first consideration must be receiver performance. The heart and soul of a good QRP CW rig is sensitivity (in order to hear our QRP friends) and strong signal handling performance (in order to escape from the QRO giants). The K2 works well on both counts. Sensitivity is specified as 0.15 microvolts and, at least in my suburban location, that is sufficient for the receiver to be external noise limited (at 1.5 kHz bandwidth) on all bands. Most birdies are below the noise, once an external antenna is connected. One or two birdies do seem to exist above the noise near the low end of 15 meters, but they are not particularly bothersome. This excellent performance is no doubt due to the use of a synthesized VFO, and a very capable, double-balanced diode mixer. The VFO output is directly mixed with the input signal to produce a 4.915 MHz IF. Selectivity is provided by two adjustable bandwidth crystal filters at that frequency. The main filter is a five-pole device, and is followed by a separate, two-pole filter. Both filters' bandwidths are controlled with varactors on each crystal. The varactors are, in turn, controlled by the K2 microprocessor. The result is an ability to pre-set (and change) up to four bandwidths, which can be selected by a front panel pushbutton. The filter shape factor is specified at about 2:1, and my own operating experience confirms that the filter is quite sharp, and sufficient in most instances. Filter ringing is not especially noticeable. Performance is not quite comparable to the filters on my venerable Ten-Tec Corsair II, but then those filters are fixed and separately optimized. The most noticeable comparison occurred during the 1999 Sweepstakes contest. S9+40 to 60dB signals abounded, and it was quite possible to estimate the filter shape on the K2 by just watching the S-meter. The K2 filters worked as specified, but there was still appreciable energy over about 2.5 to three times the filter bandwidth for these very strong signals. This is quite commensurate with a 2:1 shape factor, and indicates that the contest operator may want to use an additional filter for exceptionally crowded conditions. In fact, the K2 provides space for additional filter boards.

The K2 web site contains an interesting table on receiver performance, comparing it to several commercial rigs. *[See also the K2 technical review elsewhere in this issue. –W1HUE]* In general, the table shows that the K2 is a better performer against strong signals than the Ten-Tec Scout, Kenwood TS-50, and SGC-2020. It is favorably comparable to the Ten-Tec Omni VI, and only the Yaesu FT1000MP shows significantly better performance, but at a price that calls for selling off at least one of the kids as a bonded servant. Considering that it would keep the family intact, that makes the K2 an excellent choice for the price. Another ham friend of mine, who also builds low-noise receivers for a living, says that synthesizer phase noise is the limiting factor and that the K2's performance might even be improved, with some effort. This sounds like a project for dyed-in-the-wool tinkerers to me, and it could easily consume several months. I would need to be convinced it was necessary to the type of hamming I do, before embarking on such a venture.

The microprocessor controlled and synthesized VFO is the second important feature of the K2. While I believe that many of the microprocessor-based features in commercial rigs fall under the heading of "gimcracks and doodads", this microprocessor has been put to good use. With the synthesizer, it allows for RIT/XIT and split VFO operation. This latter feature allowed me to bag S79BL (Seychelles Islands) last week, making it a clearly necessary addition to this transceiver. Scanning is also possible, and there are provisions for setting up ten preset scanning patterns. Scanning rate is fixed, but appears to be quite useful at this single setting. I have already found more than one DX station on a "dead" band. The microprocessor performs some other tricks, as well. For instance, it remembers the settings for each band, so that the frequency, filter bandwidth, and mode are returned to the position they last held on that band. This is particularly handy when switching back and forth between two or more bands, watching for an opening or the appearance of a DX station. In addition, there is a memory keyer, with the ability to provide nine stored messages that can be repeated at a regular interval chosen by the operator. The repeating message is especially useful when trying for a contact on a quiet band. It is quite easy to repeat a CQ at 15-30 second intervals, with the audio output on the internal speaker, and go about your other business within the ham shack. When the band opens up, you will be the first to know. This can be a particularly good way to catch DX before all the big guns catch on that the DX station is available. Other features of the microprocessor are that it can (1) reduce receiver current drain (at the cost of strong signal performance), (2) put coprocessors to sleep to reduce interference, (3) monitor and control transmitter output power to within a tenth of a Watt, and (4) allow expansion in modes and capabilities (e. g., SSB) as they occur. All in all, the microprocessor makes the K2 a versatile rig, which can certainly be considered for the position of "*main station*".

In addition to the features mentioned above, the K2 contains a very competent CW transmitter. As would be expected because of the synthesizer, the output frequency is very stable on all bands. Full, solid state implemented, break-in is the rule at all times. Keying results in a good waveform, judging from on-the-air reports. And, when I have heard a K2 on the other end of a QSO, the signal has been quite clean—without clicks, chirps, or other artifacts of any kind. The output power control is a particularly nice feature. Power can be set for any level between 0.5-10 Watts. Changing bands has no effect on power output. By contrast, I have several times changed bands on my trusty old Corsair, only to find that I am inadvertently transmitting a non-QRP signal, because the same drive level results in a different power output.

The K2 contains several other distinctions. Latching relays are used for changing bands. While this function could be achieved via solid-state devices, the designers contend that the latching relays use less current (important in battery powered operation) and provide superior strong signal response. A second feature is the use of a separate IF (150 kHz) for the AGC. The designers state that this approach reduces the need for shielding between the signal and AGC amplifiers, an important point in a receiver that may be backpacked. The lack of shielding also simplifies the construction process. Other features include voltage and current monitoring, and a frequency counter, all contained within the transceiver. These monitoring devices provide built-in test equipment, useful in building and tuning the K2 and significantly curtailing the need for external measurement equipment. Voltage and current monitoring are also useful during battery operation. To my knowledge, these features are unique to the K2, and are a very good idea.
Several options are offered with the K2, either currently or in the near future. When I purchased my K2, all options with the exception of the internal battery were not yet available. However, many of the options are currently being shipped, and I should have the ones I ordered installed by the time this article appears in print. The list of options include:

- an internal 2.9 Amp-hour battery;
- a 160M option, with provisions for a second receive antenna;
- a noise blanker, with adjustable blanking level;
- an SSB module, with separate IF filter;
- an automatic antenna tuner;
- a 50 Watt final RF amplifier (later next year);
- an audio filter (later next year);
- a transverter for additional bands (no availability time given).

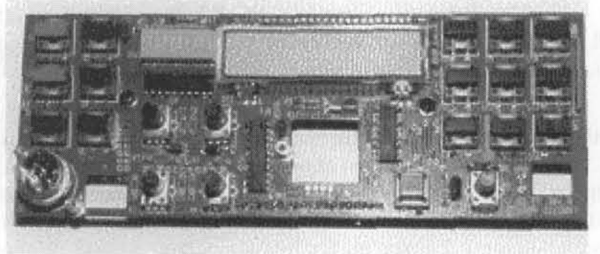
How Hard is it to Build?

The K2 designers, Wayne Burdick (N6KR) and Eric Swartz (WA6HHQ), have developed and implemented a very well designed kit, augmented by an exceptional construction manual. In my opinion, they have surpassed Heathkit, although to be fair, Heathkit did not have the publication capabilities afforded by the ubiquitous personal computer. Nevertheless, it is the mechanical packaging and documentation that set this rig apart from its competition. Construction proceeds in an orderly process, with tests occurring at regular intervals. If you follow the directions with care, it is hard to go wrong.

The designers do state that some experience is recommended before tackling the K2. They are likely correct. However, that experience need not be extensive. If the prospective builder has no experience whatsoever, it would be a good idea to try one of the single board, single band transceivers on the market before proceeding to the K2. The experience in following construction directions, handling and soldering small parts, and tuning a simple rig would indeed be useful. After one such experience, it should be easy to progress to the K2. This is particularly true because of the excellent technical support offered by Elecraft. This support consists primarily of e-mail, and a reflector hosted on the Elecraft web site. Both of these support facilities constitute a dimension that was not available to Heathkit in its heyday, and greatly assist in the building process.

Various hams have reported that the K2 can be completed in about 40-45 hours. However, in my own case, building time encompassed about 60 hours, including the time required to check against the parts list and do the final testing. No doubt my local ham friends will attribute this extra time to my penchant for orderliness ("fussbudget") and detail ("nitpicker"). In spite of that penchant, I did suffer one attack by the notorious Murphy, involving a missed capacitor. This "vacuum between the headphones" incident was the only problem suffered during construction.

There are about 625 parts in the kit, more or less, including major chassis parts but omitting hardware. There are no surface-mounted parts. But even so, the size of these parts dictate the regular use of a magnifying glass, for those of us who have attained a certain age ("old fossil") and visual acuity ("blind as a bat"). There are three PC boards—Control, Front Panel, and RF (main) board. The Control and Front Panel boards are completed first, being necessary to a series of partial tests, and plug into the main board. The Front Panel board, shown in the photo below, is itself an interesting feature. Almost all controls are mounted on this PC board, which is attached to the front cabinet panel. This results in a very uniform appearance for the transceiver controls, and the existence of very few wires in the transceiver. Controls typically interface to a system bus, resulting in a cleaner PC board design and simpler construction



K2 Front Panel PC Board

Once the Control and Front Panel boards are finished, a minimal amount of construction is completed on the RF Board, to supply power and some essential connections to the microprocessor. The first test is then accomplished, concentrating on some controls and other features designed to show that the microprocessor is functioning properly. Parts placement proceeds in order, and is well thought out with respect to accessibility of the parts. However, one should definitely be sure that all parts are in their right place and correctly installed. Removal of a part at some later time could be rather exacting, and might easily result in the destruction of the part, or worse the board. The second phase of the construction concentrates on the receiver. Once completed, it should be possible to receive a reasonable number of signals on 40 meters. The third phase, which concentrates on the transmitter and most of the band-peculiar components is the most tedious. The time consuming portion of the construction occurs because of the twenty or so toroids required. Winding the toroids is not hard, and the associated drawings are excellent. But some time is required for winding, and for stripping the wire ends. Taking it slow and easy will result in a well-constructed transceiver.

Overall, construction was quite straightforward and without major incident. However, some minor improvements could be made to the instruction manual. First, since the instructions recommend checking the parts list before construction, that parts list should be correlated against the instructions inside the manual anytime a parts change is made. There were two instances where this was not done, leading to some confusion. Second, the instructions concerning BFO/filter tuning could use some improvement. This is already occurring on the web-archived reflector. Several improved methods have surfaced on the reflector, again demonstrating the usefulness of this new construction aid. The manual should also emphasize the need for this tuning, in order to achieve maximum receiver sensitivity, but it is barely mentioned in the final test section. One must instead refer to portions of the manual's operations section in order to learn the tuning methods and their purpose. There are several hints and kinks in the manual that will make the construction process quicker and more pleasant. First and foremost, the designers recommend a temperature controlled soldering iron, with a fine tip. They ain't kidding! You can easily ruin the PC boards if you ignore this point. The second point concerns the internal test equiment, the voltage/current meter and frequency counter. The builders contend that this internal test equipment is essentially all that is needed to construct the K2. They are probably correct, but in my opinion, it is helpful to have some minimal amount of external test equipment. An analog display voltmeter is useful when tuning. The continuous swing of the meter makes it easier to find the peak of a monitored voltage. Similarly, I found that an analog SWR meter, capable of appreciable deflection at one-Watt output, was useful in tuning the transmitter. However, I imagine that tuning is still possible with the internal meters, if necessary. I also found that a resistance/capacitance meter was useful. For the small resistors and capacitors, with their equally tiny markings, the quickest method to insure that you have the right part in hand is simply to do a quick measurement of its value.

There are also some items to watch during construction. The T2 toroid in the transmitter must be wound in a particular way. Both windings must be spread over more than 180 degrees of the toroid. If not, power on the higher bands may be reduced. This winding method requires careful placement of the secondary wires to avoid connection with other parts and somewhat awkward connections to the board. It's not as hard as it sounds; you just need to pay attention and proceed with a normal amount of care. Similarly, the transmitter heat sink, which is a part of the cabinet, can also be a problem. Several hams have noted that, if the heat sink is installed and then removed, tiny metal shavings can accumulate on the heat sink pad attached to the final transistors. The shavings can then cause a short to ground, and perhaps some permanent damage to the final transistors. A magnifying glass and some masking tape can pick up the shavings fairly easily. The shavings seem to be the result of star washers used to bind the transistors to the cabinet/heat sink. Split ring lock washers have been used as a substitute in some rigs, but one must be careful of the amount of force used to tighten the associated nuts. Too much force can cause a short; too little can cause the nuts to fall off later and the heat sink to be ineffective. Again, the remedy is careful attention.

In all, these are not hard problems, and the experience of building the K2 is worthwhile. It's a real thrill to see the finished K2 all ready to go! (See below – photo courtesy Elecraft.)

How does it operate?

In a word, operating the K2 is a first class joy! It is quite possible, depending upon how the options work out, that the K2 might become my main station.

One thing becomes obvious, within the first few minutes of operation. The designer of this transceiver has logged lots of hours operating CW. Controls are intuitive, quite, and smooth. Operation is generally "one handed", with the right controls placed close together. Buttons on the transceiver typically do double duty, using a "tap and hold" rule. That is, a tap on a button initiates the main function; holding the button initiates a secondary function. The result provides enough buttons to handle all frequently used functions, without the need for an "F" button that would necessitate an additional motion to activate a secondary function. Less frequently used functions are contained in menus that are again easily accessed via a button on the front panel. Once the menus appear on the main display, the tuning knob can be used to find a particular menu. Holding the menu button allows you to navigate any one of the menus, and the tuning knob can then be used to change a particular parameter. The intuitive operation of the K2 can be something of a problem, in that I have several times wished that some feature was available, then later, upon reading the manual, I found that a combination of buttons would activate the feature I desired. (What a novel idea: "Read the instructions!")

The main deficiency I have noted is the lack of a notch filter and some form of passband tuning. An acceptable alternative to the passband tuning would be independently adjustable filter skirts. Adjustable skirts, and the notch, could be achieved with an external audio filter. Or, an option may be offered one day. In any event, these shortcomings are somewhat secondary, especially on CW. The narrow IF filters are sufficient for the most part. SSB operation may cause me to change my mind about the adjustable filter skirts.

Another operating feature is a bit of a problem. The K2 uses a "Spot" function to zero beat an incoming signal. This function causes activation of the sidetone, and the operator is then required to adjust the main tuning until the incoming signal has the same audio frequency as the sidetone. Those of us who are tonally challenged (c.f., "old fossil") may find that matching the audio tone takes some practice, given a weak signal in a crowded band. To my mind, a better approach would be to use the spot function to adjust the VFO to the transmit frequency, and zero beat the desired signal. Perhaps this might be an option in some future version of the firmware guiding the microprocessor.

All in all, any shortcomings are decidedly minor. The general impression is that Wayne and Eric have designed, and implemented, a truly first class transceiver. While they may have used the QRP segment as the introductory market, I believe that the K2 will ultimately be received by a much larger audience.

John King, KB3WK

About The Cover

Pictured is a Small Wonder Labs DSW-20 transceiver, specially packaged by Jim Giammanco, N5IB, to commemorate operation aboard the USS Kidd during the recent *Museum Ships on the Air* special event weekend July 17 and 18. The USS Salem Amateur Radio Club sponsored the event. The artwork on the panel of the DSW-20 is a reproduction of a painting by Tom Freeman depicting the Kidd in action on April 11, 1945, under kamikaze attack in the Pacific off Okinawa. During that engagement the Kidd suffered a hit in her forward boiler room which killed thirty-eight of her crew and wounded fifty-five more. After repairs and a refit in San Francisco she was en-route back to Pearl Harbor when World War II ended.

The USS Kidd (DD-661) is a WW II Fletcher Class destroyer, a "Tin Can" which earned the nickname *Pirate of the Pacific* for her crew's habit of "ransoming" rescued aviators for ice cream and other amenities. Restored to her August, 1945 configuration, she is now permanently moored on the Mississippi River at Baton Rouge, Louisiana, as part of the Louisiana Naval War Memorial. She rests in a unique docking system designed for the near forty foot rise and fall of the river each season. Half of the year, she rides the currents of the Mississippi; the other half, she sits dry-docked in a cradle where visitors can see her full dimensions. Members of the Baton Rouge Amateur Radio Club (W5GIX) formed an adjunct unit - The USS Kidd Amateur Radio Club, with club call sign W5KID, and have been authorized by the Kidd museum staff to place a permanent amateur radio station aboard ship, presently located in the aft radar jamming compartment. A regular schedule of operation should have commenced by the publication date of this issue of QRP Quarterly. N5IB hopes to conduct regular QRP operations aboard. For more information about the BRARC and the USS Kidd ARC, visit <http://www.brarc.org>

Construction of the DSW-20 was completed by N5IB only the night before the *Ships on the Air* event commenced. The signal flags flanking the BRARC club and ARRL logos on the under-the-cover artwork signify W5KID. Though tempted to conduct on-the-air tests before taking the transceiver aboard, he demurred, preferring that the first QSO take place from the deck of the Kidd. That patience was rewarded, as the first QSO's, using a non-resonant, end-fed wire, were with F6EHE, and OM2ZZ, both qualifying as *Thousand Miles per Watt* contacts. Elsewhere in this issue is a description by N5IB of the techniques used to mount the DSW-20 in the wood enclosure and to produce the panel artwork.

The Kidd routinely flies signal flags representing her WW II call sign, NYKF. Along with her signal flags, the Jolly Roger flies high from her mast and the image of the pirate looks out from her forward stack, greeting sight-seers strolling along the levee and aboard nearby riverboats. One of the few restored ships whose guns still speak, her 5-inch turret can be heard booming a salute on Independence Day and other special patriotic events. Whispered tales of courage, heroism, and sacrifice seem to follow the many visitors who tread her decks. For more information about the USS Kidd and the Louisiana Naval War Memorial, visit <http://www.premier.net/~uss_kidd/home.html> Special thanks to George Rush, K5GWR, for the digital photo, taken aboard ship on July 18.

FDIM2000

Four Days In May

May 18 -19 - 20 - 21 at the Dayton Hamvention

QRP Amateur Radio Club, International (QRP-ARCI) proudly announces the fifth annual "Four Days In May " QRP Conference commencing Thursday, May 18, 2000 - the first of four festive days of 2000 Dayton Hamvention activities. Mark your calendar for these four days and register early for this not-to-be-missed QRP event of the new millennium. Amateur Radio QRP presentations, workshops and demonstrations will be the focus of the full day Thursday QRP Symposium to be held at QRP ARCI headquarters - the **Days Inn Dayton South.**

Here is a brief overview of the four days:

Thursday: QRP Symposium: 8:00 AM til 4:30 PM Contribution: $15.00
Topics include:
"The 2N22/6" – Jim Kortge K8IQY - Last year's first place award winner!
"The Super Gainer Regen Receiver"- George Dobbs G3RJV
"Do the VOMBA: The Dance of Vertically Oriented Multi-Band Arrays." – L. B. Cebik W4RNL
Many more speakers and great surprises to be announced!

Thursday Evening: Author Social 7:00 PM til 11:00 PM. No Charge
A chance to meet and talk with the QRP Symposium Speakers

Friday Evening: QRP ARCI Awards Banquet - $25.00 per ticket
Friday evening starts with the annual QRP ARCI Hall of Fame Awards Banquet honoring QRPers who have made major contribution to QRP & Amateur Radio. Fantastic "door prizes", great speaker, tons of fun - be there.

Friday Evening: Vendor Social - No Charge
Following the banquet, the rest of the evening has been set aside for QRP Vendors. Here is a chance to eyeball the latest equipment and talk with the vendors.

Saturday Evening: Building and Design Contests PLUS Radio Show—FREE!
Saturday evening provides time for QRPers to socialize with the QRPers from around the world. Show off your projects/collections at the Radio Show! The evening culminates with a Building Contest. This year there are three contests:

1. Wide open category – bring your latest homebrew or kit project.
2. The 1 Volt challenge - Build a rig that operates on 1.5 volts!
3. The 48 volt challenge - Build a tube transceiver, tx, rx!

Judges will select winners from all categories. Prizes will be awarded along with a feature article in a future edition of the QRP Quarterly for winners.

Need Hotel Reservations?
Hank Kohl, K8DD has arranged for a Dayton QRP rate at the renewed Days Inn Dayton South. Rooms are $72.00/night plus tax (pending confirmation from Days Inn) with as many occupants as will fit in a room! For reservations, contact Hank at 1640 Henry, Port Huron, MI 48060-2523 USA. Hank can be reached at k8dd@arrl.net

Please include this form or a copy *along with an SASE* with your reservation

Indicate those items you wish to reserve and include total amount.

- ☐ FDIM seminar—$15
- ☐ Banquet—$25
- ☐ FDIM2000 commemorative Long Sleeve Tee shirt - $15
  Add $1 XXL & larger
  Size ________

Total enclosed ______

Make checks payable to: QRP ARCI

Name ____________________

Address ____________________

____

Callsign ____________________

Email: ____________________

Mail to: Ken Evans
848 Valbrook Ct.
Lilburn, GA 30047

QRP ARCI ANNOUNCES

FDIM 2000

BUILDING CHALLENGES

1-VOLT CHALLENGE & 48-VOLT CHALLENGE

THE OPEN

QRP-ARCI has laid down a design and building challenge for FDIM 2000 in addition to their traditional categories.

1 VOLT CHALLENGE

The idea comes from Wayne Burdick, N6KR, the innovator (perpetrator?) of the famous 2N2222 challenge.

Design a transceiver of any kind that will function satisfactorily over a range of about 1.0 to 1.6 volts. (This is about the working range of a single alkaline cell, i.e. AAA, AA, C, D.) We're specifically suggesting transceivers, not just receivers or transmitters, because it will get us thinking about both low-voltage radio *and* control circuits.

There are only two rules:

1. No ICs. Since the emphasis is on exploring low-voltage design techniques, you can use any transistor types you'd like but NO ICs. Ics hide the design details, making it hard to see what you did to get your design working on low voltage. Also, we hope that the designs will work with a variety of available transistors. Low-voltage ICs may be harder for the average builder to obtain.
2. No DC-to-DC converters. You can't simply step up the single cell's output to a higher voltage. That's not in the spirit of the contest!

Hints:

#1: Use inductors and transformers.

#2: For higher dynamic range, increase the *current*, not the voltage.

#3: Use low-threshold devices (like bipolar transistors). There are some JFETs with very low pinch-off that might be useful, such as the J210. The average 2N7000 is pretty useless since it can take up to 3V at the gate to turn it on.

Extra Credit: Design a keyer that runs from as low as 1V, too. (Big hint: you don't need a microprocessor!) ICs are allowed for the keyer, but no DC-to-DC converters.

In addition to what Wayne has said, we ask that you submit your design (schematic/notes) to Ken Evans, W4DU, by April 15, 2000. You should of course bring (or send) a working prototype with you to Dayton. QRP ARCI will award prizes for the Best Design and Best Construction and will ask the contestants that their designs be published in a future edition of the QRP Quarterly. Decision of the FDIM judges will be final.

So turn on the brains and heat up the irons. Additional information on the one volt challenge and other QRP activities at Dayton can be found at the QRP ARCI home page: http://www.qrparci.org/

48-VOLT CHALLENGE

Based on several questions/suggestions on the QRP-L list and input from our members, the QRP ARCI club is happy to announce the 48V Challenge. C.F. Rockey, W9SCH, recently pointed out that there are many "old timers" and newcomers alike that would enjoy building a tube rig. He wrote: "Despite the technical tastes of our strictly state of the art people, there are still quite a few of us into QRP who build our gear in the good, old fashioned style."

Accordingly, this Build-It contest for FDIM2000, entails building a tube receiver, transmitter, or transceiver that will operate on 48v or less. It's really that simple.

You may enter tube rigs you built over the past years as well as new rigs. The judges will consider the following factors (plus many of their own) in the contest:

1. The complexity of the unit - a transceiver would get higher points than a simple receiver.
2. The voltage at which this rig operates - the lower the voltage the higher the points.
3. When the unit was built - generally the newer the construction, the higher the points. It may however be a recently build old time rig.
4. The quality of the construction - neatness counts!
5. Multimode vs. single mode and mult band vs. single band. Obvious!

Entries may be original design or taken from articles. Kits may also be entered but will receive fewer points. If you have original ideas or design, etc, please send a schematic/notes to Ken, W4DU by April 15. Photos are welcome.

The OPEN

We will again host an OPEN event where you may bring a personally designed new rig or a kit built rig. This is similar to what we have had in the past. If original design, we would appreciate some notes to Ken by April 15.

Radio Show

This is the area where you can exhibit any of your collection of rigs/keys/mikes/antennas/accessories - think of it as a Science Fair display of your prized artifacts.

The St. Louis Vertical, Radial, and Express: Fallacies and Facts, Part II

By Ade Weiss, W0RSP *email: aweiss@usd.edu*

[In Part I of this paper, I analyzed three St. Louis designs as shown in Fig. 1 (QRP Quarterly, October, 1999, p. 36) labeled "St. Louis Vertical," "St. Louis Express," and "St. Louis Radial." The first "design" was mislabeled. It actually shows the antenna discussed in QRPp, Summer 1998, p. 12, left column, paragraphs 2, 3, 4, and 5. Paragraph 2 introduces the evolving SLX design thus: "A folded 40m radial used under an original SLV quickly found temporary work as the SLX radiator." This is followed later by "The twinlead radiator for the SLX radiator loaded...." Actually, the "design" is not the "original St. Louis Vertical," but rather, an unnamed version of the "St. Louis Express" constituting the intermediate stage of evolution between the "Birdical" antenna described on p. 11 and the finished "St. Louis Express" antenna described on pp. 13-16. An appropriate name would have been, using the article's terminology, "the then incomplete SLX design."

Regardless of the name confusion, the dimensions are correct for the antenna discussed on p. 12, QRP Summer 1998. The antenna that was both computer modeled, built, and measured for resonance and base impedance as discussed in Part I of this paper is that specific antenna. (For those without access to the original article in QRPp about the design which is the actual "original" version of the St. Louis series of verticals, see the NORCAL WEB site -- click the "Projects" button on the home page, and that will take you to "The Original St. Louis Vertical" article as well as another items about its resonant frequency.)]

(1)

In reading through Part I of this paper after the October QRP Quarterly arrived, I realized that I had committed a "fatal error" in writing for newcomers and antenna novices. When writing the article, I inserted a long paragraph, left column, p. 37, "This relation may puzzle newcomers..." to give the basic principles about resonance and clear up the mystery of the notation in which impedances are expressed, i.e., "Z=36-j21.5 Ohms". It occurred to me that, while the explanation is fine, it leaves unanswered even more basic questions that newcomers will puzzle about. Many of the numbers in the article state impedances, sometimes simple impedances such as "Z=46.9 Ohms" while others state complex impedances such as "Z=36-j21.5 Ohms". I can imagine many newcomers asking in frustration "where did you get that number?", "what difference does it make in the performance of a real antenna?", "what about the SWR -- I know about SWR?", and finally, a plain old "so what?", then flipping the page to the next article. I apologize for the frustration! This time around, let me try to get down to the "real basics" Elmer 101 level, using the same group of antenna designs.

In Part I, I provided the results of measurements of the "then incomplete SLX design" and compared them to the results obtained from a computer model of the antenna using W7EL's EZNEC antenna modeling program. As shown in Fig. 2 of Part I, the measured resonant frequencies of the antenna tracked the EZNEC calculations except for a roughly 500kHz difference in frequency (top line = measurements of test antenna, bottom line = EZNEC calculated frequencies). Across the bottom of Fig. 2, the radiation resistance is plotted against the stub length and the resonant frequency lines on the graph. Now that I look at Fig. 2, I wonder where I got the idea that an antenna novice would have the slightest idea of what all these lines and numbers meant!

Now, the main point of Fig. 2 is that, when both the actual measurements of resonant frequency and the EZNEC calculations are plotted, both methods show that the "then incomplete SLX design" is seriously non-resonant on 40 meters, it lowest "design frequency". The resonant frequency of the design (20-ft of radiator, 14-ft of folded back radiator) in the original setup was found to be 9520kHz with the base of the twinlead radiator about 16-in off the ground. The graph shows how the resonant frequency changes as the length of the stub is changed. At a later date, the same measurements were taken with the base of the radiator on the ground with sixteen 8-ft radials fanned out symmetrically. The resonant frequency was found to be 9633kHz. This affirmed the conclusion stated in Part I, namely, that the electrical length of a folded back radiator does not equal its linear conductor length, i.e., the 34-ft of wire in the "then incomplete SLX design" does NOT represent an electrical length of 34-ft, which is roughly a quarter-wave on 40 meters. To a newcomer, folding back 14-ft of a 34-ft radiator to produce a linear length of 20-ft might seem to make numerical sense, but it does not make electrical sense.

To place the "then incomplete SLX design" into context, the term RANDOM WIRE is applied to any such radiator that is severely non-resonant at the intended operating frequency. This design resonates at 1.6mHz above the intended 40m operating frequency. And it does not resonate at any other frequency, including all the ham bands above 40m.

Where do all these numbers about resonance, radiation resistance, loss resistance, and reactance come from in the first place?

It should be clear that they can be calculated for a given antenna. Back in the "bad old days" before the PC, and the "even worse old days" before the square-root hand-held calculator, most of us had to settle for nothing more than the most basic antenna length calculations using a simple formula. Figuring out what difference 4 vs. 16 radials made in the base impedance as well as radiated field of a vertical was well-nigh impossible for non-engineers without slide-rules. All that has changed with the PC and antenna programs like W7EL's EZNEC. As Fig. 2 shows, a given antenna can be modeled on the computer and its electrical characteristics and performance determined. In fact, most top-notch antenna types begin every antenna in a modeling program, find out about it, and then either build it or trash it depending upon what the modeling program reveals. An increasing number of antenna articles include the results of modeling.

Why "build" an antenna in a modeling program instead of stringing it up and seeing how it works? The modeling program calculates a multitude of variables that we cannot even measure -- at least not without a phenomenal antenna test range. For example, how do you measure the vertical radiation pattern of an antenna unless you have a helicopter to fly circles around the antenna at a range of altitudes? A few antenna types have actually tried this -- it is difficult to fly a perfect circle while maintaining an exact altitude, so the resulting radiation patterns are kind of lopsided and only give an approximation.

Antenna modeling itself is perhaps the best learning tool for anyone who really wants to know antennas, but it also is a learning experience in itself -- learning the various parameters of an antenna and the program's procedures and limitations and how to make it work! In fact, Fig. 2 represents one of my new learning experiences. Until you do what I did for Fig. 2, you don't really "trust" the modeling program. You think: "well, this is just a computer model -- what would a real antenna do?" Believe me, for an old antenna buff like myself, W7EL's EZNEC has been a revelation. In fact, it has become my favorite all-time computer "game"! Don't get me wrong -- it is a dead-serious engineering program, but it is so much fun, I'd rather "play" with it than shoot down ME109's or MIG-29's! I have found that its replication of real antennas depends entirely upon how accurate and precise my model is. I trust it -- but I get fed up with myself for being too lazy to do a really precise modeling job.

Obviously, I needed real numbers to judge the EZNEC results. Where do you get real numbers for a real antenna? You take measurements of the antenna. This requires test and measurement instruments. Now, the ubiquitous SWR meter has been around forever, and SWR persists as standard of performance -- which it is not! The SWR reveals nothing more than the magnitude of the Standing Wave Ratio -- but it can be a very valuable indicator of efficiency if several other numbers are known, as we'll discuss later. The GDO, or Grid Dip Oscillator, has long been used to find an antenna's resonant frequency, but it provides no other information, and what's worse, a GDO can dip the antenna plus anything else that couples into it at the same time. Fortunately, manufacturers have finally responded to our need for something more than the SWR meter and the GDO. Two categories of antenna instruments are available.

1) Simple Resistance and/or "Impedance". The first category includes devices which usually measure SWR and r.f. resistance. These devices are not capable of differentiating resistance from reactance. The "resistance" or "impedance" measurement they show is the resultant of the combined resistance and reactance. So, they cannot actually indicate the exact resonant frequency of an antenna where no reactance exists. In other words, the only number that they can provide is a simple "Z=36 Ohms" which includes both resistance and reactance. This is not enough.

The MFJ Antenna Bridge (MFJ-204B; about $85) requires an external frequency counter or receiver to determine the frequency at which a measurement is taken, and then the measured resistance has to be extrapolated from a calibration label on the rear or by substituting resistors for the antenna. The AUTEK RF-1 RF Analyst (about $135) is a popular unit and much more sophisticated with built-in frequency counter and digital display. (Dan McGuire's program RF1CHAR.BAS permits using the RF-1 to determine feedline characteristics, a very useful capability.) But it too only reads a simple impedance. A method has been devised, based upon three readings with capacitors in and out of the antenna feedpoint, for splitting the resistance and reactance components, but it is a rather complicated procedure.

2) Complex Impedance. The second category includes devices which differentiate resistance from reactance, and hence, are capable of finding resonant frequency at the zero reactance point, or alternately, determining the resistance and reactance at a given non-resonant frequency. In general, such devices usually specify "R+X" or "RX" or "true impedance" or "noise bridge" in their advertising. This is the kind of device needed to take the measurements and produce the numbers that are found in Part I, here, and in other antenna articles. The basic kind of unit generates a broadband noise signal across the h.f. spectrum. The antenna being tested is connected to one side of the bridge, and a receiver to the other side. Then the resistance knob and the reactance knob are adjusted for a null in the noise detected by the receiver. The resistance and reactance at a given frequency correspond to the deepest null that can be obtained by adjusting the knobs. The amplitude of the noise generated in the bridge can be a problem in regard to the sensitivity of the receiver. For example, unless the 20dB attenuator is switched on in my QRP+, the deepest null is still an S6! Switching the attenuator in permits attaining a perfect noiseless null. If your receiver and RX noise bridge combination are like the QRP+, then it is a simple matter of breadboarding a 20-dB resistive 50-Ohm attenuator to stick in the line to the receiver.

In this category, the MFJ RX Noise Bridge (about $65) is a good choice at the price. (Palomar used to market a noise bridge similar in design to the MFJ unit but I'm not sure it is still produced -- you infrequently can find them at fleamarkets.) It is a basic unit that permits making fairly accurate measurements. The receiver it is used with is a limiting factor in terms of sensitivity (like the QRP+ case) and coverage. A general coverage receiver like the QRP+ permits finding the resonant frequency anywhere. However, the point of antenna measurements and adjustment is to achieve resonance at a desired frequency within a hamband. Getting a receiver to the antenna used to be a serious problem. For example, I used to haul my Argonaut 505 and then my 515 up on the roof to take measurements! But now, I just toss my SST or another QRP transceiver in one pocket, a gell-cell in the other pocket, a set of phones on my head, and it's a piece of cake! Ground or roof, it is easy to make the measurements that reveal whether the antenna is too short or too long for the given frequency.

At the high end of the scale is the MFJ-259B SWR Analyzer (about $265) with the meters (MFJ-249B at $245 without the meters). No receiver is needed -- the built-in frequency counter takes care of that. This unit's large LCD display provides a variety of read-outs -- the resistance and reactance at the desired frequency is the most important. This is a lot of money, but it makes antenna measurements so easy. I don't have one yet -- I still like adjusting knobs and reading dials and calculating the values. Besides, I'm a tightwad when it comes to spending big bucks!

Now that the source of the measurements numbers is clear, let us turn to their meaning. The resonant frequency of antenna is by definition the frequency at which no reactance appears in its impedance, e.g., "Z=36-j0.0 Ohms". The basic question is: how does one achieve resonance in an antenna? And what about the claim that all of the St. Louis designs are "remotely tuned" because an antenna tuner is used at the transmitter end of the feedline? In other words, can the complex impedance that is measured at the base of a vertical (or at the feedpoint of a horizontal antenna) be changed by an antenna tuner at the transmitter?

In simple terms, this fallacy ignores the most basic principle of antenna theory. The electrical length of a radiator, plus any loading devices connected in or to it (e.g., a base loading coil, a capacity hat etc.), determines its resonant frequency. To change its resonant frequency, either its length or the value of any loading device must be changed.

For example, to change the resonant frequency of the W6MMA Vertical from 80m to 40m, the radiator's physical length remains the same but the electrical length must be made longer by moving the slider to include more turns on the center loading coil in the radiator. Or, to put the W6MMA Vertical on 20m where a quarterwave is shorter than the 20-ft length of the 80/40/30m radiator, the coil must be shorted out and the radiator itself must be shortened either physically or electrically. In the latter approach, a 20m trap could be used to cut off the part of the 20-ft radiator beyond the 16.6-ft 20m quarterwave point.

Note that two non-resonant situations exist: the antenna can be either too short or too long for the frequency of operation. To change the resonant frequency of an antenna, SOMETHING MUST BE DONE TO THE ANTENNA ITSELF, such as adjusting its electrical length with a slider on a loading coil, adding a capacity hat, connecting a detuning stub, inserting a trap, inserting a capacitor to shorten it, trimming off or disconnecting a portion of it, and so on.

BUT, NOTHING CAN BE DONE AT THE TRANSMITTER END OF THE FEEDLINE to change the resonant frequency of this or any antenna. If the radiator is a random wire (i.e., too short for 80/40/30m operation) like the St. Louis designs relative to the intended frequencies of operation, it cannot be made to resonate on those frequencies by adjusting an antenna tuner at the transmitter. An antenna tuner merely transforms or matches the impedance presented at the end of the feedline to the impedance that the transmitter likes to see. When coax feedline is used with severely non-resonant vertical antennas such as the St. Louis designs, the severe mismatch that results causes extreme power loss regardless of whether the antenna tuner can match the feedline to the transmitter (see later discussion).

One method of changing an antenna's electrical length and hence resonant frequency is the folded back section. A folded back linear loading section positioned at the TOP of a short vertical radiator can replace a missing portion of a quarterwave vertical radiator in terms of resonant frequency. But there is a limit in terms of the amount of missing radiator that can be replaced as a means of lowering the resonant frequency of a shortened vertical by this method.

For example, a resonant frequency of 9633kHz calculates by formula to a linear radiator length of 24.6-ft. The "then incomplete SLX design," with its physical length of 20-ft, thus is missing 4.6-ft of a resonant quarterwave radiator, but 14-ft of folded back radiator is required to replace that missing 4.6-ft! In other words, when a portion of a linear radiator is folded back, the amount of physical conductor length required to replace the missing portion exceeds the physical length of the missing portion by an increasingly large factor. In the case where the linear loading section is at the END of the radiator, the radiator section ends where parallel wires of the loading section begin. As the length of the folded back section increases, the length of the radiator decreases proportionately. Obviously, the END of a radiator is NOT the best place for connecting a linear loading section.

A second limit to the length of the folded back section should be noted. The efficiency of such an antenna decreases relative to the increasing length of the loading section. EZNEC modeling shows that, beginning with a full-size quarterwave radiator exhibiting around 2.5dBi gain, folding back an increasing amount of the radiator while maintaining a given length (i.e., 20-ft high) eventually drops that gain figure to below -4.5dBi. In other words, linear loading at the END or TOP of a short vertical radiator presents a very serious trade-off in regard to efficiency. That is why the standard position for a linear load section is at the BASE of the short vertical radiator, or alternately, at the FEEDPOINT of a balanced radiator such as a dipole.

Now that we understand how the resonant frequency of an antenna is established, another question arises: what is so important about an antenna being resonant?

Actually, this is a trick question. An antenna is exactly resonant at only one extremely narrow frequency -- move a few kHz, and it becomes non-resonant. Given its coupling into the environment, move it up or down a douple of feet, and it becomes non-resonant. Once you start taking measurements with an RX bridge, you will be amazed at how narrow the null at resonance actually is! If the null is broad, start looking for losses. So, virtually all ham antennas are operated off-resonance. The simple fact is that a non-resonant antenna will radiate as well as a perfectly resonant antenna within certain limits. The actual problem is transferring the r.f. power from the feedline to the antenna. The r.f. power in the feedline exhibits an impedance, that is, a ratio between the voltage and current components of the wave. If the feedline impedance is the same as the antenna's input impedance, then the r.f. wave power smoothly slides from feedline to antenna. If not, well then we have some of the power reflected from the antenna input and that causes loss. The real issue with a non-resonant antenna is: how much mismatch and hence how much loss of power?

We can use the measurements and calculations for the "then incomplete SLX design" to provide an answer to that question. And this is where the numbers become very important. We must know the complex input impedance of the antenna, and the characteristic impedance and loss figure of the feedline in order to determine the amount of power loss. For example, how well will the "then incomplete SLX design" perform at 7040kHz, or 1.6mHz below its resonant frequency when either coax or twinlead feedline is used?

The procedure to follow in answering that question involves four steps. (1) First, we use an RX bridge or the more sophisticated MFJ-259B to measure the base impedance as Z=14-j150 Ohms at 7040kHz. Even without any calculations, it is obvious that a serious mismatch with 52-Ohm coax will occur: the ratio of the resistances alone is about 4:1. So the best SWR that could be expected if there were no reactance is around 4:1. The -j150 Ohms reactance is extreme and could be expected to really raise that SWR by a whopping amount. (2) Second, we select a feedline and look up its characteristic impedance and loss figure for the given frequency and length in an antenna book. (3) Third, we calculate the resulting magnitude of mismatch, or SWR. Luckily, computer programs are available to do this. Dan McGuire's "ZIZL" program makes this step easy, and does the fourth step as well. (4) Fourth, we look up the amount of power loss for this SWR in an antenna book, or let Dan's "ZIZL" figure it out for us.

Suppose we compare low-loss RG8X coax and low-loss 300-Ohm twinlead in this manner to determine how the "then incomplete SLX design" will perform. Let us consider each feedline case separately.

In my setup, a 50-ft run of feedline is needed to reach the base of the vertical, and I use low-loss RG8X. Given the measured base impedance of Z=14-j150 Ohms, the mismatch between 52-Ohm coax and antenna base impedance produces an SWR of roughly 30:1! Take note that this level of SWR would not be measurable on the standard analog SWR bridge -- the highest SWR tick I've ever seen is 10. In other words, it has to be calculated! (Of course, an MFJ Antenna Analyzer with digital readout would probably read it.) Given this degree of feedline mismatch and the loss figure of RG8X coax, "ZIZL" shows that the actual SWR loss through the coax will amount to 4dB!

Some explanation may be helpful to newcomers who are unfamiliar with the concept of "SWR loss." When a mismatch between feedline and antenna occurs at the feedpoint, a portion of the incident wave power is reflected back toward the transmitter, where it is reflected back toward the antenna and sums algebraically with the next r. f. cycle's incident wave power which is being fed into the feedline. SWR loss occurs when incident and reflected waves travel to-and-fro along the feedline because all feedlines exhibit Ohmic resistance in their conductors (and shield braids) and dielectric loss in whatever dielectric is used in the feedline. During each journey, a portion of both the incident and the reflected waves is burned up in the Ohmic resistance and dielectric loss of the feedline. In severe mismatch conditions, the r.f. power in a given input cycle must make a multitude of to-and-fro trips. Eventually, all the power that is fed into the feedline and not burned up in SWR loss will radiate.

The physical construction (conductor size, dielectric material, and spacing) of the feedline determines the amount of power that is burned up in this manner. The feedline's basic loss figure is given for a specific frequency and length -- a measure of how much power is burned up when this length of feedline is terminated in a perfect match. In this ideal situation, no reflected waves are produced and thus the SWR is 1:1. Once a mismatched condition exists, a portion of each r.f. wave must do multiple trips to-and-fro, incurring loss on each trip. The Standing Wave Ratio (SWR) permits direct conversion of the feedline's basic loss figure to that which is actually taking place. Most antenna books include charts for this conversion. Or, "ZIZL" will do the job.

To return to the coax case, the 4dB SWR loss number translates into a very large loss of power. When 5 watts are fed into the 50-ft piece of coax connected to the "then incomplete SLX design" on 7040kHz, 3 of the 5 watts are burned up in the coax! In other words, for 5 watts in, you get 2 watts out! Now, the RG8X is low-loss coax. What happens if a 50-ft piece of RG-174U, the industry standard for maximum-loss coax, is substituted for the RG8X? The SWR loss will rise to 8.9dB. Of the 5 watts fed into the feedline, only 0.64-watts will remain for the radiator! Backpackers and others who aim for maximum weight and space saving should take note of the trade-off involved here! For newcomers, any reference in an article to RG-174U as an acceptable feedline is a bright red warning-flag that says: "this article ignores the basic principles of antenna efficiency. Don't read any farther." What about the popular computer ribbon that has been recently promoted on the QRP-L as a feedline? Measurements show that it can be twice as lossy as RG-174U (see below)!

So, will the "then incomplete SLX design" work on the air? Rephrasing the question, will 2 watts to this non-resonant random wire radiator fed thru 50-ft (or other length) of RG8X make contacts? Of course. Recent milliwatters in various contests have demonstrated that 250 milliwatts will produce a lot of contacts with a variety of antennas.

Next, let us consider substituting 50-ft of low-loss 300-Ohm twinlead for the 50-ft of RG8X coax. Now, the SWR is still outrageously high at 24:1, BUT, the SWR loss figure of the twinlead is far below that exhibited by the coax. As a practical result, the twinlead feedline will show almost 3dB advantage over the coax in this case. Only 1.2 watts of the 5 watts fed into the 50-ft of low-loss twinlead will be burned up, leaving 3.8 watts for the radiator. Substituting 50-ft of twinlead, in other words, almost "doubles the power" that is left to be radiated. Another advantage is mechanical -- 50-ft of twinlead can be coiled much more compactly than coax if space is a major concern.

Again, will the "then incomplete SLX design" make contacts when fed with 300-Ohm twinlead? Of course 3.8 watts to this radiator will make contacts.

So, the issue boils down to the degree of mismatch SWR loss produced by the coax or the twinlead. Now, the "then incomplete SLX design" radiator will radiate a given amount of power identically regardless of whether it comes from coax or twinlead. But to put 3.8 watts into it from this coax feedline means that the transmitter output would have to be increased by about 4dB! At 5 watts from the transmitter, the twinlead is going to produce almost an S-unit (6dB) difference in signal strength. To claim that a non-resonant antenna such as this (or the "St. Louis Express") works equally well when fed with coax or twinlead reveals a serious mis-understanding of feedlines as well as a flawed approach to comparing antennas.

This brings us to a major fallacy that floats around the QRP-L periodically as well as appearing in the original articles about the St. Louis designs, namely, the nature of "on the air testing."

The time-honored and accepted method of "on the air testing" DOES NOT and NEVER HAS consisted of filling a log with contacts. In fact, it consists of comparing the performance of a test antenna with a REFERENCE ANTENNA. Both test antenna and reference antenna must be in place with a means of switching between the two. This is the only way to measure on the air performance. Two kinds of testing can be performed.

First, the two antennas can be compared by making field-strength measurements. Second, receiving and/or transmitting comparisons can be made by switching quickly between the two antennas. Either the test antenna is better or it is worse than the reference antenna for a given path to a given station. The reference antenna test situation permits comparing the overall performance of the two antennas on many paths to many stations and reaching general conclusions about relative performance. Given different radiation patterns, the test situation thus permits finding the strengths and weaknesses of each antenna relative to the other. BUT, both antennas must be in place at the same time! Similarly, one cannot claim that an antenna works equally well with either coax or twinlead unless the feedlines can be switched on the spot and a comparison made.

A typical claim that antenna B, which is being used in November, produces more contacts in the log than antenna A, which was used in October, proves absolutely nothing about which antenna is the better of the two. Such a statement ignores the basic realities of ionospheric propagation such the seasonal variations at the fall equinox, the 28-day solar rotational cycle, and geomagnetic conditions. Antenna B may SEEM to "really work well!" compared to antenna A simply because the solar flux has notched upward 80 points, the A-index has been under 7 in the meantime, and MUF contours have shifted to produce a more efficient path to areas of higher activity. In short, the "fill up the log" approach simply cannot produce comparative results.

Next, what happens to that portion of the power fed into the feedline never which reaches the radiator? In summary, the lost power is: (a) dissipated in feedline Ohmic resistance and dielectric absorption (i.e., SWR loss); (b) dissipated in lossy antenna tuner components; (c) absorbed in the ground resistance via the radials.

The feedline is not the only culprit though. The Ohmic and r.f. resistance of the radiator and any dielectric loss in the radiator then become the issues because both can dissipate some of the 2 watts (RG8X case) or 3.8 watts (twinlead case) that are left after the feedline SWR loss takes its toll.

It should be noted that three different types of Radio Shack 300-Ohm twinlead were tested in the "then not complete SLX design" configuration: (1) the lowloss flat type with #18 conductors embedded in foam dielectric; (2) the type with #22 conductors and a thin flat dielectric connecting the tubular foam dielectric around the conductors; and (3) the clear dielectric "cheapie" type with #22 conductors. The "cheapie" type exhibited a noticeably higher loss resistance than the other two.

Given the #18 stranded conductors in the low-loss twinlead used in this setup, that loss will be virtually non-existent at 7mHz (and, in fact, on up to 28mHz). Tiny wire sizes like #28 add significantly to the overall loss regardless of frequency. When relatively short lengths are involved such as the 20-ft of the "then incomplete SLX design," #18 conductors are perfectly adequate. However, purists will use the heaviest conductor possible at the bottom end of a quarterwave vertical where the current is highest. Verne Wright, for example, advises using flattened coax-braid below the center-loading coil of the W6MMA Vertical. Computer ribbon as radiator is a special case which will be discussed below.

(2)

Some discussion of radials should be added to that presented in Part I. The base impedance noted earlier ($Z \approx 14-j150$ Ohms) was the measured value over ten 24-ft radials; it is insignificantly different when measured over ten 24-ft + 20 8-ft + two 33-ft radials, that is, a barely detectable difference, if any, in the resistance and reactance components occurs when using these various combinations. It should be noted that the pair of full-size quarterwave radials produced no measurable difference when added to the mix. As noted in Part I, the general principle is: when radials are on the ground, they do not exhibit resonance characteristics. So, the length is immaterial in practice except when very short radials are used, and then the number has to be increased.

However, the number of radials IS important when the antenna is resonant or nearly so. The resonant frequency of the radiator is determined primarily by its electrical length. However, mutual coupling into environmental objects, including the ground, the radials, another vertical element, or large nearby metal objects, causes an interaction which affects the base impedance of a vertical radiator as calculated by the regular formula for the length of a resonant vertical radiator. This interaction causes reactance to appear in the base impedance, which makes the vertical radiator look too long or too short for the resonant frequency. Resonance is defined as the point at which no reactance is present in the base impedance (or feedpoint impedance of a horizontal antenna).

For example, if the W6MMA Vertical is tuned to resonance (zero reactance) at 10.1mHz over ten 24-ft radials, and the radials removed, it becomes highly reactive (capacitive), or, its resonant frequency appears to shift upward. Adding 4, then 7, then all 10 radials brings the resonant frequency back down to zero reactance, with a corresponding (and radical) drop in the magnitude of the resistance component as ground loss is eliminated. However, above the ten radial level, and especially above the 20 radial level, the changes in resistance and reactance components is so minor (if measurable) as to have virtually no effect on the resonant frequency and base impedance, so the coax will see virtually the same mismatch. The beauty of the W6MMA Vertical is that it is rather finely tunable -- stick it over 4 radials, 7 radials, 10 radials, etc. of whatever size, adjust the coil slider, and a non-reactive, purely resistive base impedance is easily obtainable in seconds.

As noted in Part I, the St. Louis Radial does not resonate on 40m either on the ground or in the air. In fact, the radiator of the "then incomplete SLX design" is actually is an "original St. Louis Radial" mounted vertically. In general, references to the need for quarterwave "resonant" radials for ground-mounted systems frequently appear in the ham literature although the seminal research by G.H. Brown has been available since 1937 and has become standard information in the ARRL ANTENNA BOOK for many years. In general, radials are simply not resonant on the ground. John Devoldere ON4UN's reference to resonating ground mounted or buried radials (ANTENNAS AND

TECHNIQUES FOR LOW-BAND DXING, 1994, p. 913) is puzzling in this context.

So, that reference called for measurements. I had a pair of 18-ft of radials on hand and measured them at increasing heights to determine the influence of altitude. At ground level, they resonated at 6420kHz; at 18-in, the resonant frequency rose to 11130kHz; at 40-in, 11515kHz. A trend is clear. Now, the calculated resonant frequency for the pair of 18-ft radials connected as a dipole is 13000kHz. Presumably, at some altitude, the ground coupling effects will decrease to the point where that frequency would be measured. My sticks were only 40-in high, so I did not attempt to gain more altitude and see where that point was. EZNEC modeling suggested that at 5-ft radials begin to exhibit resonance effects and hence could be trimmed to resonance for use at a given height over a given quality of ground. Whether 5-ft is the magic altitude for resonating radials cut for 20m by trimming them remains a moot question as far as my measurements are concerned.

Finally, the claims about the amount of radial wire in a "St. Louis Radial" must be addressed to clear up that fallacy. Suppose that four 20-ft ribbons, each containing 5 conductors, are placed under a vertical. How many radials does this add up to, 4*5=20, or just 4? In fact, it adds up to four radials and 80-ft of wire. Parallel closely spaced conductors with the identical angular relation to the radiated field share the current and count as a single radial. (See below about the three conductors in the "St. Louis Express" radiator ribbon.) Replacing the four ribbons with four single wires has no noticeable effect upon the base impedance of the vertical. Adding 16 more single wires (for a total of 20 wires) has a profound effect on base impedance.

(3)

At the time I did the testing and measurements discussed in Part I, I did not have a 20-ft hunk of computer ribbon to use for actual measurements. Hence, the data for "The St. Louis Express" was computer generated using W7EL's EZNEC antenna modeling program. (As I noted, this was a rather ignorant undertaking since modeling such closely spaced wires is not advised for any of the modeling programs.) Since then, I picked up a small roll of computer ribbon and have been able to do actual measurements of "The St. Louis Express" design as described in QRPp Summer 1998, pp. 13-15. As it turns out, the actual physical antenna is much worse than that modeled by EZNEC.

As per the article, the three conductors of a 20-ft piece of computer ribbon were shorted at the top (as shown in Part I of this article). The feedline was attached to the center conductor at the bottom end of the ribbon, and measurements taken over 10 24-ft radials. The resonant frequency was found at 12150kHz with a base impedance of Z=52-j0. (Incidentally, the resonant frequency seen by EZNEC at 18.5mHz as noted in Part I p. 39 could not be found in the actual antenna.)

Using the procedure combining measurements and the other numbers described above in discussing the "then incomplete SLX design", the performance of the "St. Louis Express" on 7040kHz can be characterized as follows. First, using a radiator constructed as per the article consisting of a 3-conductor computer ribbon, the base impedance of the "St. Louis Express" at 7040kHz was measured as Z=40-j293 Ohms over 10 24-ft radials. The SWR and resultant SWR loss with 50-ft of RG8X low-loss foam coax are calculated as:

SWR = 39:1 SWR Loss = 4.7dB

In other words, of the 5 watts fed into the feedline, only 1.7 watts of r.f. power remain for radiation. The SWR and resultant SWR loss for 50-ft of 300-Ohm twinlead are calculated as:

SWR 300-Ohm = 14:1 SWR Loss = 0.8dB

In this case, of the 5 watts fed into the feedline, 4.2 watts remain for radiation. Again, the superiority of twinlead over coax in the severe mismatch situation is obvious.

Next, the unexpectedly high resistive component of the base impedance led to a comparison of the computer ribbon "St. Louis Express" with another radiator consisting of 20-ft of 300-Ohm low-loss foam with two #18 conductors tied together at the top. The resulting measurement is quite illuminating. The base impedance of the twinlead version was measured as Z=19-j193 Ohms at 7040kHz. The resulting SWR and SWR loss calculates as:

50-ft of RG8X: SWR = 36:1, SWR Loss = 4.5dB For 5 watts into feedline, 1.8 watts to the radiator.

50-ft 300-Ohm twinlead: SWR = 21:1, SWR Loss = 1.1dB For 5-watts into feedline, 3.9 watts to the radiator.

The measurements showed a major difference between the resistive parts of the computer ribbon (Z=40-j293) and the twinlead (Z=19-j193) versions. What caused the difference? Theoretically, a linear loaded vertical shortened by a factor of about 40% should exhibit a base resistance of under 10-Ohms. The resistive part of the base impedance consists of the sum of the radiator's actual radiation resistance, plus any loss in the conductor and dielectric of the radiator, plus ground return loss. As explained in Part I, the power coming from the feedline into a vertical is dissipated proportionately in the radiation resistance (radiated power) and various loss resistances (burned up power). The Ohmic and r.f. resistances of the wire used in the radiator burn up some amount of power. When heavy guage wire or tubing is used as a radiator, this kind of loss is almost non-existent. In the twinlead version, the apparent radiator and ground loss thus amounts to approximately 9-Ohms. However, published data shows that, with just 10 radials, the ground loss should be between 9-Ohms and 18-Ohms (see ARRL ANTENNA BOOK, 15th edition, 8-22). So, it is likely that the actual ground loss is slightly higher than the measured 9-Ohms. Readout on the 1.5-in dial on my RX bridge doesn't go down to 3 decimal places! But that does not seriously affect the magnitude of the difference measured between the twinlead lead and computer ribbon version. Since the ground loss remained constant under both the twinlead and computer ribbon radiators, it can be inferred that the 3-conductor ribbon exhibits around 21-Ohms more loss resistance than the low-loss twinlead. This is an incredible amount of loss for a 20-ft radiator! In electrical terms, the "St. Louis Vertical" radiator is a stretched-out 21-Ohm resistor!

Needless to say, I was totally puzzled and repeated the measurements on a couple of occasions -- one advantage of making measurements is that you discover unsuspected facts about an antenna. Then Ed Loranger WE6W posted his measurements of the r.f. characteristics of computer ribbon on the QRP-L (available from QRP-L archives, heading "Feedline Measurements -- Computer Ribbon Line," dates 19990816 and 19990819 -- perhaps Ed will write up his results and publish them here in the QRP Quarterly) and it all began to make sense -- this stuff is really lossy. Furthermore, WE6W's measurements demonstrate that computer ribbon does not perform consistently across the h.f. spectrum in terms of its characteristic impedance. In a later post, WE6W quoted the tests results on computer ribbon that another QRP'r e-mailed him in response to WE6W's original postings. The loss was found to be about 2dB per 10-ft of computer ribbon! RG-174U tested at about 0.5dB per 12-ft. Computer ribbon, in short, exhibits about twice as much loss as RG-174U, and six times as much loss as RG8X, when used as a feedline! When used as a radiator, 20-ft of computer ribbon exhibits 21-Ohms greater loss than twinlead!

The simple fact is that computer ribbon is not manufactured for r.f. applications requiring the kind of lengths involved in feedlines and radiators. It is very light, can be coiled very economically, does not kink readily, and so on -- but these are MECHANCIAL, NOT ELECTRICAL advantages. When it comes to feedline and radiator applications, computer ribbon is, plain and simple, unadulterated junk!

For newcomers and antenna novices, the lesson is obvious -- forget about building any antenna that uses computer ribbon. Stick to antennas that use wire or tubing, and to feedlines that are manufactured as feedlines. A case in point is the "NORCAL Doublet" which uses a 24-ft hunk of computer ribbon as the feedline. The loss figures cited above will permit readers to mentally calculate the approximate amount of power that never reaches the horizontal radiator in that antenna. The irony here is that "cheapie" Radio Shack clear dielectric 300-Ohm twinlead could eliminate almost all of that loss, and hardly add to the space and weight of the system..

A lesson is to be learned from WE6W's passion for measuring everything in sight with his prized Autek RF-1. Let me toss a out question that each reader has to answer: what is the actual loss that your coax feedline exhibits? Have you measured it? Now, IF your answer is, "no, I don't have to because it's low-loss RG8X and the book says the loss figure is ...." -- I GOTCHA! Not all pieces of RG8X are equal -- different manufacturers and quality of materials makes it so. Now, you probably would have to run it over with an 18-wheeler and torch it in a couple of places to make it as lossy as RG174U! But when efficiency is the objective, the fact that 50-ft of coax A drops the power from 5 watts to 3.8 watts at 14060kHz, and coax B only drops it from 5 watts to 4.8 watts is very important. And measuring the actual loss of a piece of coax is quite simple -- all you need is a standard QRP wattmeter and a dummy load.

The test is simple. First, connect the input of the wattmeter to the rig with a very short piece of 52-Ohm coax -- 4-inches or so -- and connect the dummy load to the output terminal of the wattmeter. Measure the forward power (the SWR should be 1:1 with a 52-Ohm dummy load -- 50-Ohms is close enough). Then, replace the short connecting piece of coax with the actual feedline you want to test. The SWR should still be 1:1 -- if it isn't, then the coax has a problem. Next, measure the amount of power now going into the dummy load. The difference between the first measurement and this one shows how much power is being burned up in the test coax. You can convert that into dB with a chart showing power ratios, or use the standard formula. But actually, all that really matters is how much power is wasted -- the amount in dB is icing on the cake. I've been amazed at the variations. My "best" piece of coax is a 22-ft hunk of fleamarket Radio Shack which wastes about 0.1 watt (4 watts in) on 10.1mHz. Another fairly new 50-ft piece of Radio Shack RG8X foam shows 3 watts in, 2.5 watts out on 10.1mHz. A new 50-ft piece of RG213U shows 4 watts in, and roughly 3.9 watts out. Furthermore, you can't always tell the ELECTRICAL condition of coax from its MECHANICAL appearance.

This brings up the perennial argument about "how much of a difference does a dB make?" Another version is: "if it doesn't amount to a whole S-unit, what's the point?" We'll never settle the argument. Personally, I aim for maximum efficiency, which means minimum loss. I don't care if I never find out that saving 0.3-watts for the radiator helped me make more contacts. If the power is there to save, why waste it -- just in case it does make a difference? So, from my perspective, using RG174U or computer ribbon feedline just doesn't make sense -- why would anyone want to waste so much power before the signal gets off the ground?

In the overall antenna system, the total loss can accumulate -- slightly-off piece of coax, a poor solder connection or corrosion, #24 wire instead of #16 and so on. If I can pick up 1.1dB by using a better piece of coax, I'll do it. If putting up a fullwave center-fed for 30m theoretically gets me another 1.9dB compared to a dipole, I'll do it despite the effort. Can I say whether any of my 112 countries on 30m is truly due to the fullwave's extra 1.9dB? No. Never will know either! But I get enough "sri om vy weak" comments from DX stations after several unsuccessful QRZ attempts to wish that I could squeeze another 0.5dB out of my system. Just maybe that 0.5dB would drop the ratio of the "try agn later" responses.

Is coax a bad choice in general? Of course not when it matches the antenna. Ladder line will usually exhibit less loss in a given situation, but if the coax to antenna match is very good, then the loss in high quality coax like RG213 is negligible. But coax does pin you down to the band on which the antenna resonates -- unless traps or stubs resonate it on several bands.

One advantage of being able to make test measurements is to determine what is actually happening in an antenna. For example, in Part I, I noted that the three conductors of the "St. Louis Express" do not add up to 60-ft of radiator as claimed in the original article. But I was wrong in stating that they add up to 40-ft (see p. 39). Measurements allowed me to discover that they actually represent just an electrical 20-ft of wire in this application. In terms of basic theory, the two downlines are exactly parallel and very closely spaced. Current arriving at the top junction splits 50% into each down conductor and both exhibit the same phase and magnitude. The down conductors thus function electrically as a single wide wire. But do they add 20-ft to the overall radiator length?

This question was answered by measuring the resonant frequency with three different connections at the top. (1) As noted earlier, with the three conductors shorted at the top, the resonant frequency was measured as 12150kHz. (2) One outside conductor was disconnected at the top, leaving one up and one down conductor in the circuit. The resonant frequency was measured as 11930kHz, a shift of about -180kHz. The reason for the shift is readily apparent: the disconnected downwire is still in place and couples into the other two. But it is no longer carrying a current whose phase and amplitude differs from the current in the upwire. In general, mutual coupling of conductors causes detuning from the resonant frequency. If the downwire actually added 20-ft of length to the radiator, it would cause the frequency to shift to below 40m. (3) Next, both downwires were disconnected, leaving only the center conductor in the circuit. The measured resonant frequency dropped to 11700kHz. Next, a 20-ft wire was run up the pole and its resonant frequency was measured as 11850kHz. Finally, the resonant frequency for a quarterwave vertical 20-ft high was calculated as 11700kHz.

In short, the actual electrical length of the 3-conductor computer ribbon radiator of the "St. Louis Express" is about 20-ft, the same as a single wire of roughly the same length.

Finally, does the "St. Louis Express" push the concept of linear loading to its extreme, i.e., is it a linear loaded radiator? The simple truth is: no. A linear loading section consists of parallel wires which have to have something to load, i.e., a radiator of some kind -- a single wire radiator, a piece of tubing, a tower. The "St. Louis Express" has no radiator section to load. There is no radiator section either above or below it. It is a linear inductor connected to the feedline. Linear inductors are superior to lumped inductances, i.e., loading coils, because they exhibit extremely low loss, and more importantly, because they will radiate a signal from the r.f. current passing thru them. That is why the "St. Louis Express" will make contacts and a simple coil will not -- or at least not very far from the backyard.

SUMMARY. The "St. Louis Express" is severely non-resonant on any hamband, causing extreme feedline loss when 52-Ohm coax is used. (Similarly, the "Original St. Louis Vertical" with its 51-ft or so of twinlead wound around the first section of the SD-20 pole to form a helical loading section was found to be resonant far below 40 meters.) The only reasonable choice is to feed it with twinlead to minimize losses. Bear in mind that the twinlead and antenna tuner combination does not resonate the antenna. It is clear that the computer ribbon adds significantly to loss, so a second improvement would be to eliminate the computer ribbon and use a piece of #16 copper wire for the radiator. Finally, each "St. Louis Radial" ribbon, regardless of how many conductors are in it, is electrically equivalent to a single wire radial.

In general, the "then incomplete SLX design" and the "St. Louis Express" as well as the original "St. Louis Vertical" are mechanical designs that ignore basic electrical principles that have long been known to be essential for radiation efficiency in vertical antennas. The most basic design criteria for an efficient vertical include some method of resonating the radiator and matching the feedline to it. The criteria for the St. Louis designs do not include such criteria, but rather, rely on the mistaken notion that an antenna tuner at the transmitter end of the feedline can take care of the electrical aspects of the system. As a result, the St. Louis designs can be classified as mechanically designed "novelty" antennas based upon the SD-20 fishing pole's 20-ft length, not on sound vertical antenna principles. Ironically, efficient vertical systems based upon such principles are easily obtainable using this pole. The W6MMA center-loaded Vertical is such an antenna (available from Vern Wright, 1606 Pheasant Way, Placerville, CA

95667, 1-916-622-2390, at around $80; the center-loading coil in either the 40meter or 80 meter size might be available separately -- I'm not sure -- query Vern). Several other design possibilities exist as well.

Obviously, the glowing testimonials of the great successes of these antennas show that they do make contacts on the air. Those who are satisfied with their "St. Louis Express" and "St. Louis Vertical" antennas can continue to enjoy them as before -- perhaps even with a greater degree of pride, knowing that if radiated power were the criterion, quite a few more KM/W awards would be found in their logs than they had suspected. But these testimonials also make the antennas quite attractive to newcomers who are unaware of the trade-off of power-loss that is involved. As one defender of the designs remarked, "they weren't designed with efficiency in mind." Indeed! Hopefully this article will alert newcomers and antenna novices to that trade-off and re-emphasize the need for efficiency in the antenna system. QRP'rs have recognized, for at least 75 years, that the antenna system is the key to success with QRP. That will still be true 75 years from now -- if ham radio is still around.

ACKNOWLEDGEMENT: all feedline calculations were done on Dan Maguire AC6LA's great little program "ZIZL" discussed in QRPp, Spring 1997, 10-21, downloadable from the NORCAL website as RF1V2.ZIP or RFFUN.ZIP (may have been updated since I downloaded it -- check descriptions to find it). You enter the RX impedance at either the line input or the antenna feedpoint, pick the feedline type and length, the frequency, and the input power, and it spits out all the numbers. The program also does very nice graphs of the various parameters so you can see the variations of E, I, R, and X along the feedline for a couple of wavelengths. Thus, it is a great learning tool as well as a practical necessity in working with antennas.

Adrian Weiss W0RSP 526 N. Dakota St. Vermillion, SD 57069

Awards

Steve Slavsky, N4EUK *Awards Manager* *email: radioham@erols.com*

I congratulate each and every one of you who have earned a QRP ARCI operating award during this past year. I know the task is not easy at QRP levels and that many of you add to the handicap by taking the milliwatt challenge. Our awards program is booming, and I am very happy to report that I am receiving several applications a week now (November, 1999). This is a big increase over the trickle I received last winter and spring. Participating in QRP or any contest, for that matter, can really help you earn an award.

We have made one change to the awards program to incentivize DX QRPing. In addition to the standard QRP DXCC award at 100 countries, we are now offering an initial award at 25 countries with endorsement certificates at 50, 75 and then the regular 100 countries. This is similar to what we offer for the WAS award, where the initial award can be earned for 20 states, with endorsement certificates at 30, 40 and 50 states. I hope more of you will apply now that you don't have to wait until you have worked 100 countries (and that can be quite a wait with having to get QSL or other confirmation of the contact) before qualifying.

We also want to make sure you know that award endorsements are available for a variety of achievements. The first, and one really worth the effort, is for making all contacts at the milliwatt level. This is available for all our operating awards. Not many awards of that type have been issued, so you will certainly be a member of an exclusive club. Other endorsements are for single band, cw, ssb or other mode and two way QRP. If you can think of others, I will be happy to consider them.

Our most popular award remains the 1,000 mile per watt award, which is also issued with endorsements for milliwatting, mode and two way QRP. This just takes one QSO, so it is a great way to start collecting QRP wallpaper.

In my last article, I left out one 1,000 mile per watt record for 5760MHz:

5760MHz W1VT 155uW WB1FKF QRO 37
238,700mpw SSB 960622

This was earned by Zack Lau and stands unbroken.

We also have one new record – Jim Hale, our ardent milliwatter, has broken the 24MHz record as follow:

Old Record:

24 MHz JL1FXW 2.0w A35QC QRO 4,889
2,445mpw SSB 900731

New Record:

24 MHz KJ5TF 100mw SM0CCE QRO 4,814
48,140mpw CW 991103

I hope you all have a great year in 2000, for your families, for your jobs and for ham radio. Please e-mail me if you have any questions, suggestions, gripes, etc. about the QRP ARCI awards program at radioham@erols.com and check out the complete awards program at http://www.qrparci.org. It is still my goal to issue all awards within 30 days of receipt. I had hoped to get this down to 14 days, but the number of applications coming precludes that for the time being. I look forward to issuing all of you an award in 2000 – but you have to apply first.

72/73 Steve, N4EUK

QRP Clubhouse

by Doc Lindsey
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Welcome to the QRP Clubhouse. There has been at least one big change since the last edition came out. Jim Stafford W4QO has passed the reins to me. This is a challenge and a big honor, and I will do my best. Please send me whatever news you have from your club. Every club is important to the QRP community, and I want to include as much as possible in every column. I am assembling a comprehensive listing of all the various clubs and whatever projects they do. Please help by sending me information about your club soon and often. If you have a printed journal, please send it along. If yours comes out electronically, let me know that, too. Thanks.

MN/QRP Society - The Minnesota QRP Society is celebrating its third anniversary. By the time you read this, they were expecting to have over 100 members. The majority are in Minnesota, but anyone is welcome to belong. There is no cost for this membership. Claton Cadmus KA0GKC (his friends call him "Cla") originally formed the group. The society meets the first Saturday of every month, and the well-attended meetings are open to any interested ham. This club has scored highest in the FYBO contest two years in a row. To join or learn more about MNQRP, check out their web page at http://www.qsl.net/mnqrp or email Cla at KA0GKC@arrl.net

EPA - The Eastern Pennsylvania QRP Club has released their 1st Annual QRP Contest Calendar. This club project lists all the QRP contests and those with QRP categories. This valuable calendar is in fold out format and designed to hang on the shack wall next to your rig. The calendar includes lists to Web sites, postal mailing addresses for non-Internet users, rules for the QRP contests, and more. I believe this is an invaluable club project. Just imagine being able to plan your QRP contest schedules for all of 2000. Cost of the calendar is $10 in the USA and $12 for DX and must be paid in US funds, written against a major US bank. Prices include shipping. Order your copy by emailing Ron Polityka N3EPA at wb3aal@talon.net, filling in the subject line with "QRP Contest Calendar 2000". In the body of the message, indicate how many copies you are ordering. Your check or money order should be made out to "Ronald J. Polityka, N3EPA" and mailed to him at the Eastern PA QRP Club, 1155 Robeson St. 2nd Floor, Reading, PA 19604-2151, USA.

QRP Cheeseheads ARC - The Cheeseheads club is a very new organization. In fact, their first contest entry was during BUBBA 1999! They have also participated in the Spartan, QRP ARCI, Sweep Stakes and Michigan sprints using their club call of NQ9RP. They plan to compete in the FOX hunt on March 1, 2000. This will be a club effort, a multi op single transmitter. The Cheeseheads are also service oriented. Their first club project is the FOX hunt QSL Buro for the 1999-2000 season. Check out their web page at http://www.qsl.net/nq9rp/foxburo.html. You can also contact them via Brian Cieslak AE9K at kcieslak@execpc.com.

FPqrp Club - The "Flying Pigs QRP Club, International" was formed over the Internet in early August 1999. Rick WB6JBM and Dieter WB8QY were looking for a local (Cincinnati, OH) club so they could do Field Day activities and assist each other with antenna installations and testing. When their search proved fruitless, they formed The Flying Pigs over the Internet. After only 3 eyeball meetings and over 500 emails, the FPqrp Club has 23 members in 11 states, and one member in the UK. Their upcoming project is a 10 Meter qrp kit, which they hope to have available by the end of 1999. They will also soon be installing a monster 550 loop antenna at Dieter's home QTH. Check FPqrp out at their web site http://www.mpna.com/fpqrp/.

QRP-C - The QRP Canada Club was created over a year ago and has been growing ever since. They are once again planning to have their Spring Bouquet event this year during the month of April. Keep a listen for the special event Province stations that will be calling "CQ SB" on both cw and ssb. Please check out the website at http://www.rac.ca/qrpcan.htm for a look at the certificate and for more details as April approaches. QRP-C also sponsors the QRP-L Foxhunt Team Plaque. The plaque was made through a combined effort by Bruce Rattray, VE5RC, who donated the materials and Ken LaRose, VE3ELA who did the stunning hand carving of the fox and the engraving of the name plate. The first team to receive this was the "Houston Hounds, Dan, KK5LD; Terry, KQ5U; Bill, K5ZTY; and Bill, W5SB.

Membership is free and all are welcome to join. Browse the website for details about their reflector or send a note to Bruce Rattray, VE5RC, 128 Durham Drive, Regina,SK S4S4Z2 CANADA.

The Foxhunt plaque is presented to the top scoring "hound": team each year.

GQRP - The GQRP club convention was held at club president George Dobbs' (G3RJV) parish church (St. Aidan's) in Rochedale. Club members planned a surprise presentation and acknowledgment of George Dobb's founding of the club which he has lead effectively for a quarter century. Chief "plotter" Dick G0BPS dragged George onto the stage where they presented him with a plaque marking the occasion. The club also gave George a special bottle with a label with the words "old" and "malt". Hmmm :-). Also honored was the organization's long serving membership manager John Leak G0BXO. President George Dobbs noted, "John was the perfect club officer. He never complains and we don't have to pay him anything." Another highlight of this annual convention was when club members met in the church hall to visit vendors' booths and mainly to hold eyeball QSO's for "show and tell" and tall tale swapping! I hope to be able to visit this festive occasion some year. The club publishes a highly regarded QRP journal called SPRAT. They just passed a significant milestone with SPRAT number 100. The Internet web address is http://www.gqrp.demon.co.uk. Membership inquiries should be sent to John Leak G0BXO at G0BXO@btinternet.com.

HI QRP Club - The Hawaii QRP Club, with its "World Headquarters" at Hilo, Hawaii, invites anyone visiting the Big Island to attend their DAILY (wow!) meetings. They assemble from 8:30-10:30 a.m. at the Hilo Jack in the Box Restaurant, at mile marker 2 on the Volcano Highway. Details of club events may be found on their club web page http://chem.hawaii.edu/uham/hiqrp.html. Dean Manley KH6B says they also always welcome extra operators for their club events.

IA QRP Club - The Iowa QRP Club publishes an interesting and helpful monthly electronic news journal. The most recent issue contains several article of interest to the QRPer. Among them are a backup power supply, a 40 Meter inverted L antenna suitable for small lots, DDS and amateur radio, modifying the Norcal SST for 10 Metres (!), building a K2 rig, HLS registration, and building a "Fractal Wing Loop" antenna for low profile settings. Their articles are illustrated and well written. Check out this and earlier issues at their FTP site = ftp://divis17.ped-gen.uiowa.edu/pub/iaqrp-l/journal. The newsletter is available in Word97 or PDF format.

NJ-QRP Club - The Jersey QRP guys have been really busy this fall. They have two big new projects on the streets now, with another one sitting in the breech ready to go. The major news is that the NJ club has created a new QRP publication called "QRP Homebrewer". QRP Homebrewer is being published on a quarterly basis (Nov/Feb/May/Aug) and everyone can subscribe! There's a dual theme: (1) homebrewing of QRP equipment, gadgets & gizmos, antennas, tools, and other accessories used by QRPers every day,; and (2) projects, information, ideas and common sense construction techniques suitable for the beginner homebrewers. QRP fever is hitting epidemic levels now and the thirst for this basic knowledge is growing like crazy. Subscribing information is on their club website at http://www.njqrp.org or you can contact the editor/publisher George Heron N2APB, 2419 Feather Mae Ct, Forest Hill, MD 21050, or by email at n2apb@amsat.org.

The other major project that's kept the Jersey guys burning the midnight oil has been the kitting of the Tuna Tin 2 kits in preparation for the big QRP events over the Halloween weekend: the Zombie Shuffle (NorCal) and the Black Cat Special (ARRL). Over 200 kits of the venerable "TT2" transmitter project were provided for QRPers for a very modest price and stock was nearly depleted. If interested, you can contact the club to see if there are any more kits available. The club's technical guru Joe Everhart, N2CX (of "Joe's Quickies" fame) has been focused on getting the next big NJ kit off the bench and into people's hands: The Fireball "SOP" Receiver ... a 40m or 80m DC VXO receiver with a good front end, options for use on 20m-10m, a fabulous option for a Freq-Mite audible frequency dial, and yet another option for pre-cut PCB material and instructions to make your own homebrew enclosure. Again, see the club website or contact N2APB for further details. The NJ-QRP Club is once again sponsoring the "Atlanticon QRP Forum", being held the weekend of March 24-27 in Philadelphia, PA.. The Jersey QRPers meet on the last Saturday of each month in the Princeton area. Why not stop by if in the area?!

Announcing! Atlantic 2000 QRP Forum

By George Heron, N2APB

"Atlanticon 2000" is a QRP forum organized by the New Jersey QRP Club, being held in **Philadelphia, PA** on the weekend of **March 25-26, 2000**. Last year, over 125 QRPers from up and down the eastern seaboard came to Baltimore, Maryland to attend this first-ever major east coast QRP event.

And this year, Atlanticon is being held in another exciting location that promises easily travel access, and interesting local attractions for the whole family. We're expecting over 200 QRPers to converge in the "city of brotherly love" to listen to an exceptional lineup of QRP's top experts and elmers giving presentations all Saturday. A complete printed collection of the author's papers will be presented to all QRPers in attendance.

During the Friday and Saturday evenings we have something called an "**open house**" where all QRPers gather in a large ballroom to mingle and chat about projects, clubs, activities, and to just plain enjoy each other in person. Just think, you'll get a chance to meet and talk leisurely with the buddies with whom you've only communicated on the air, or in the contests, or on on the QRP-L reflector! You'll be able to browse around the various QRP vendor tables and see/buy the new products they have available this year. This "social" has been very popular with other QRP conferences.

There will be a **special event on Saturday night** ... in the past we've had construction contests, instructional sessions, and product demonstrations. Saturday's event this time around will offer a novel event that is sure to be of interest to all attendees. More details on this are coming soon.

All Saturday morning and afternoon is the main event: seven major **QRP presentations**! Held in a conference format, each author will present his material to an audience of about 200 QRPers, replete with overhead slides, handout material and live demonstrations. The preliminary lineup of speakers is just phenomenal!

Atlanticon badges will be handed out to all pre-registered attendees when they arrive at the Friday and Saturday QRP events at the hotel. These colorful badges are cleverly designed and each one contains a unique "Atlanticon registration number" that identifies the QRPer for the many prize drawings to be held throughout Atlanticon. The badges were a big hit last year and will likely again be a collector's items, similar to the NorCal Zombie badges, Pacificon badges, etc.

And speaking of **PRIZES**, there will be a series of drawings done throughout the Atlanticon activities on Friday and Saturday. The pre-registration numbers on your Atlanticon badges will be the way you'll know if you're a winner. Fabulous prizes are being contributed by clubs, vendors and individuals.

The hotel location and special reduced-rate room reservations are currently being negotiated for Atlanticon attendees so everyone can conveniently stay in the same hotel as all our event activities. Stay tuned to the Jersey QRP website for reservation details.

To reserve your seat at the Atlanticon 2000 QRP Forum this coming March 24-25, contact any of the organizing members below. Stay tuned to the Jersey QRP website (http://www.njqrp.org/atlanticon2000/ for full details as they develop. If you don't have website browsing capabilities, you may request that an info package be automatically sent to you by email. Send an email to EMBOT@NJQRP.ORG and put SEND ATLANTICON2000 in the body of the message. Almost immediately an email will be returned to you containing all the latest information on this net event. If you wish to get on a ground mailing list, contact George Heron, N2APB, 2419 Feather Mae Ct, Forest Hill, MD 21050.

The organizing chairman for Atlanticon is George Heron, N2APB (n2apb@amsat.org); the pre-registration chairman is Dave Maliniak, N2SMH (dmaliniak@penton.com); and the technical chairman is Dave Benson, NN1G (bensondj@aol.com) ... you may contact any of these guys with questions concerning this NJQRP-sponsored event.

The "Georgia Sierra" QRP Transceiver

Mike Branca, W3IRZ 2880 Camary Place Dr., Conyers, GA 30094 email: w3irz@att.net

The Sierra QRP Multiband Transceiver was developed by the Northern California (NorCal) QRP Club a few years back and offered as a club project kit. Its design is also featured in the ***ARRL Handbook***. I want to thank the folks at NorCal and the ARRL for presenting such an interesting project. Many of us dreamed of building the Sierra but were held back by two problems. First, it had to be cheap and second it should be able to be built from scratch from easily available parts. My version does this for about $150 for 160 through 15 meters. I also made some improvements such as a variable bandwidth filter and tuning with a 10-turn pot instead of a variable capacitor. But the biggest change was to completely re-frequency it to use all computer crystals. I achieved my goal at the expense of a few "birdies" in the tuning range which are received only and are not transmitted. After testing I felt that this was not a problem. See the "birdie analysis" on the next page. I believe that this is a very worthwhile project even though it is considerably more work than the kit version. Since I am only showing changes, you must also use the information in the 1996 (or later) ***ARRL Handbook***.

I started with a couple of assumptions. First, that the IF would be a round number so that a simple frequency counter could be used to read kHz directly and second, that it not be so far from the original that major changes would have to be made. Since Dan's Small Parts had 4.000 MHz crystals at 10 for $3.50, I had a good start. Based on the available computer crystals for pre-mixing, the VFO worked out to 5.8 to 6.0 MHz. Since my frequency counter reads premixed frequencies there is no count-up/count-down problem and what you see is what it is. Dan had a counter board small enough to fit into the box for $3.50 that needed a $25 counter chip to make it work—not too bad. I also found that the SA-602 (NE-602/NE-612) didn't care if you use a half frequency crystal but I could not get it work with a 3rd overtone crystal.

Following is the frequency scheme. The numbers in parentheses are Digi-Key part numbers.

- 160 meters – runs direct from the VFO using a jumper on the band module from pins 18 to 23.
- 80 meters – pre-mix 7.7–7.5 MHz; crystal 13.5 MHz (SE3427-ND).
- 40 meters – pre-mix 11.2–11.0 MHz; crystal 17.0 MHz needed, 8.5 MHz used (X418-ND).
- 30 meters – pre-mix 14.2–14.0 MHz; crystal 20.0 MHz (CTX062-ND).
- 20 meters – pre-mix 18.2–18.0MHz; crystal 24.0 MHz (CTX091-ND).
- 17 meters – pre-mix 22.057–22.257 MHz; crystal 16.257 MHz (X039-ND).
- 15 meters – pre-mix 25.0–25.2 MHz; crystal 19.2 MHz needed, 9.6 MHz used (SE3418-ND).

Tuning is forward on 160, 17 and 15 meters and reverse on the other bands, but the counter is always correct. And any error in the premix frequency is compensated for by the VFO and the counter again is correct. The VFO overlap is 15–20 kHz on each end so there can be quite a bit of slop in the crystal frequency.

During construction, always keep in mind that this is not a kit and you have to *think* and understand *every* step you take. The circuit boards are available from FAR Circuits; be sure to mention W3IRZ. The following board prices are correct at this time but may change in the future: The main board is $22.50 and the band boards are $3.75 each. Because the boards were designed for plated-through holes and FAR doesn't do that, there are a number of places where you have to solder a component on both sides; just mount them 1/8 inch higher. Inspect the boards for shorts when you receive them; my +8V line was shorted and boy the 78L08 got hot before I found it, and one of my band boards had a short. The 25-pin connector was difficult to solder on the top side and I suggest that if you can find one with longer pins or wire wrap type then soldering may be easier (some IBM PC power supplies used one with longer pins). Solder this connector in first and check with an Ohmmeter. At any rate, bolt it to the board as high as you can and still solder the bottom before soldering and use metal spacers to the bottom of the cabinet to relieve stress when changing bands. The IC sockets presented a problem and I found that most machined pin sockets could be soldered on the top of the board. Several IC's (U6, U3, U9 and U1) could not use sockets as they would cover the only area that could be soldered; 0.1 inch header strips can be used or you can break up sockets. Save your time and money by not getting the board mounted controls and switches as their only advantage is when using a pre-punched cabinet. Think of the time you will save if you don't have to precision drill the front and back panels. I spent a day getting this right. I had a drifting RIT that was traced to a bad pot and it was quite a chore to change. Put a 56 pF NPO capacitor under the board from the connector pin 23 (spare) to the junction of C59 and R22 to pass the VFO to the 160-meter module.

For the band boards, spend an evening just wiring the front to back jumpers on pins 5-10 and 13-25. Carefully file the ends so that there is a perfect fit into the socket; don't guess. For the trimmers, use the cheaper ones from Dan's which are Murata 6 mm 6-70 pF, ten for $3.50. Mount them with a slight upward tilt. Since there are a lot of them you will get the hang of it pretty quick. All of the trimmers are not necessary. For example, since we are using a counter, you can replace C70 with a jumper and on the 160-meter module, C64 and C66 can be left off. On the 160 – 30 meter modules, C1 can be replaced with a fixed capacitor—see the new coil chart. The band modules can be hot-switched (with power on) but it is probably better to power down first. Build the 160-meter band module first to test the VFO. Then build either the 80, 40 or 30 meter module to test the main board.

The counter and preamp should be built first as it serves as test equipment for the pre-mixer and it is hard to test if you don't know where you are. Set the 7216 counter range by connecting the 100K resistor from pin 14 to pin 5 for normal kHz count or to pin 3 for actual (test only) full frequency count. In fact, putting a SPDT switch (full count and kHz count) here for testing the pre-mix frequency could be really handy, especially if you don't have a good bench counter. Dan's display only has one decimal and it is in the wrong place for our purposes, so leave out the 100K resistor from pin 5 to pin 13 and Q7 and R10. Dan's drawing shows the collectors and emitters reversed on Q3 – Q6. The new preamp for Dan's counter is shown in Fig.1 and was copied from my S&S frequency counter. It is wired ugly-style. My version of ugly uses a piece of tin can as a substrate and when I am done I fold the ends up to box it in. Less experienced builders may choose to build a regular counter kit rather than to modify Dan's but an offset counter is not needed. You could also use your bench counter but then you would no longer have a portable rig. Because of this wacko scheme, manual calibration would be a nightmare. The counter is connected to the drain of Q8, the pre-mix amplifier, through a 0.01µf disc capacitor.

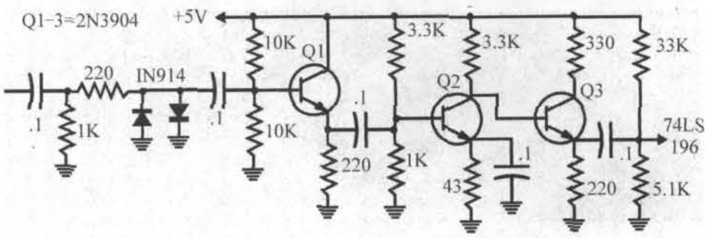

Figure 1. Frequency counter preamplifier.

On testing, I noticed that loud audio was distorted and I found that the LM386 modulated the +8 Volt line. So I changed C75 to 470 µF, cut the foil and added a 10-Ohm decoupling resistor. This helped, but when I changed to varactor diode tuning, the VFO FMed pretty bad so I had to add an extra 78L08 just for the frequency control pot *[a good idea in any case –W1HUE]*. Maybe if I had connected the VFO to the new regulator I could have left C75 alone. The new VFO is shown in Fig. 2. Linearity is not too bad with about 4.5 turns for the first 100kHz and 3.5 turns for the second 100kHz. Drift in the VFO occurred in the first minute or so and none was noticeable after that. I moved the VFO coil from its original position to the left rear variable tuning capacitor (not used) hole for better mechanical stability. The variable bandwidth feature is shown in Fig. 3. Leave the variable bandwidth feature out until you get the receiver working and tested. It runs fine with C7, C8, and C9 missing as they just narrow the bandpass.

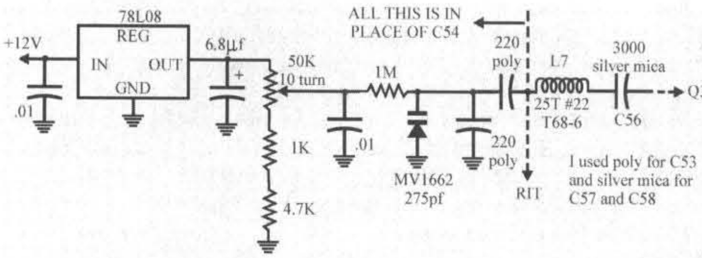

Figure 2. Varactor tuned VFO. Although not shown, the original C53 must be included (see schematic in the ARRL Handbook).

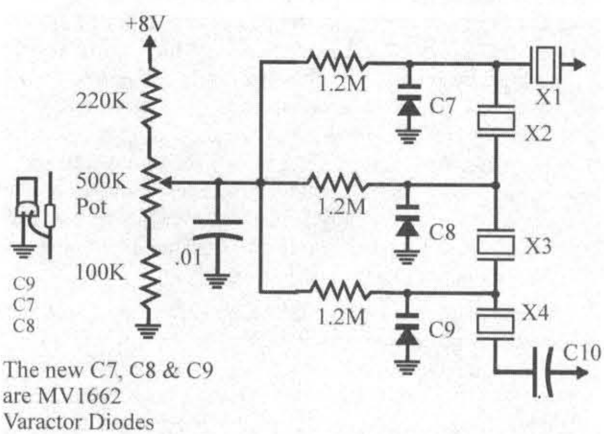

Figure 3. Variable bandwidth IF filter.

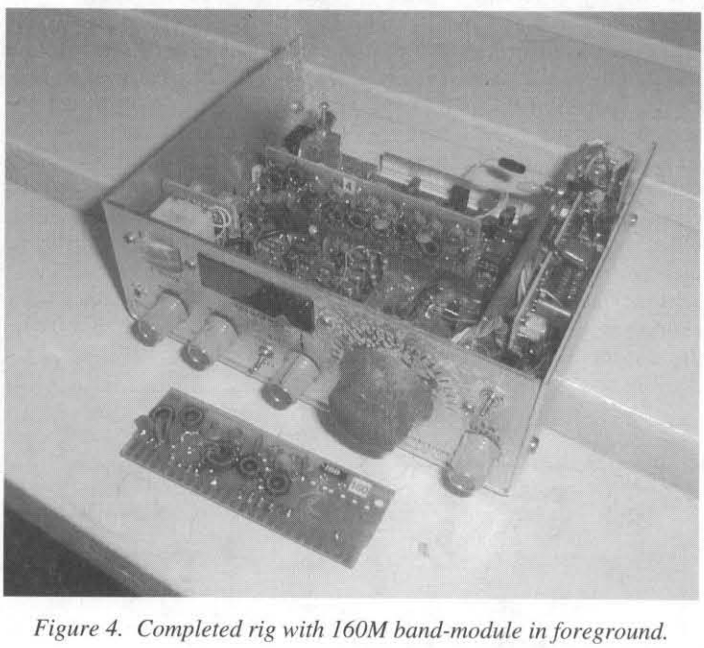

Figure 4. Completed rig with 160M band-module in foreground.

This is a work in progress and we are currently in the midst of a group build in the Northern Georgia (NOGA) QRP club. Six Georgia Sierra's are being constructed by NOGA members and our club web site (www.qsl.net/nogaqrp) will have the latest updates including final details on the 15, 12 and 10-meter band-modules.

"Birdie" analysis – measured results

- 160 meters: none.
- 80 meters: 3.704 MHz very weak, can't hear with antenna connected; 3.670 MHz.
- 40 meters: 7.0022 MHz; 7.1025 MHz; 7.1272 MHz, very weak, can't hear with antenna connected; 7.190 MHz.
- 30 meters: 10.000 MHz, out of band (counter crystal) - makes it easy to calibrate against WWV.
- 20 meters: none.
- 17 meters: 18.144 MHz.
- 15 meters: still working on this module.

Coil chart changes

Only changes are shown. Use chokes for L1. Two coats of clear nail polish will glue the toroids down but test before you glue.

- 160 meters: L8/L9 not used; C1 = 150 pF; L1 = 47 µH; C47/C49 = 0.0015 µF; C48 = 2x0.0015 µF; T1 = 40T #28 on FT50-61 with a 3T link and add 15 pF across C2; L5/L6 = 31T #28 on T37-2; L3/L4 = 34T #28 on FT37-61; C32/C35 = 47pF; C65 = 6pF.
- 80 meters: C1 = 100pF; L1 = 22µH; L8/L9 = 14T; C32/C35 not used.
- 40 meters: C1 = 47pF; L1 = 10µH; L8/L9 = 27T; add 22pF across C64 and C65.
- 30 meters: C1 = 39pF; L1 = 5.6µH; add 22pF across C64 and C65.
- 20 meters: L1 = 5.6µH; L8/L9 = 19T.
- 17 meters: L1 = 3.6µH; L8 = 19T; L9 = 17T.
- 15 meters: L1 = 2.2µH (still working on this module).

Capacitor check-off list

C3, C11, C13, C18, C21, C24, C25, C30, C40, C55, C60, C72 – 0.047µF
C4, C29, C31, C63 – 5µF
C5, C73, C74 – 47pF
C6, C7 and C8 are replaced with varactors
C10, C17, C39 – 270pF
C12, C14, C61 – 150pF
C15, C23, C43, C76 – 2.2µF
C19, C20, C22, C45, C46 – 0.1µF
C26 – 3.3µF
C27, C44 – 22µF
C28, C75 – 100µF
C37, C67 – 39pF
C42 – 0.22µF
C50, C59, C62, C78 – 0.01µF
C51 – 10µF
C69, C71 – 68pF
C68-C77 – 27pF

Resistor check-off list.

R2 – 1.2K
R3, R9, R10, R19, R20, R21, R23 – 47K
R4, R18, R24 – 100
R5 – 10M
R6, R22 – 3.6K
R7, R16, R100 – 5.1K
R11, R26 – 12K
R12 – 390

R13 – 22
R15 – 56
R25 – 1K

Diode check-off list.

D1, D2, D3, D4, D5, D9, D100 – 1N914
D6, D10 – 1N5817
D7 – 1N4753A
D8 – MV2104

Dan's Counter parts list

IC1 – LM7805
IC2 – 74LS196
IC3 – ICM7216DIPI
IC4 – CA3028
R6 – 100K (range set)
R7 – 10K
R11, R12, R13, R14, R15, R16 – 15 Ohm
R18 – 10Meg
From +12V to counter – 10 Ohm 1/2W, x2

C2 – 0.1µF
C6 – 39pF
CR1 – 5 - 50pF trimmer
D1 – 1N914
Q3, Q4, Q5, Q6 – 2N4402 (or 2N4126)
10.000 MHz Xtal

Counter preamp parts list (Fig. 1)

Q1, Q2, Q3 – 2N3904
1 – 1N914
2 – 1K
3 – 220 Ohm
1 – 330 Ohm
2 – 10K
1 – 3.3K
1 – 43 Ohm
1 – 5.1K
1 – 33K
4 – 0.1µF

Edited by W1HUE

Bitten By the Bug —

Profiles in QRP

Rich Arland, K7SZ
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In this edition of Profiles In QRP we feature an interview with one of the best known and "most heard" QRP contesters on the planet, Bob Patten, N4BP. I have to admit, I am a "closet contester". I do like to contest but I also realize that I do not have what it takes to be a world-class contester.

Bob graciously edited a contesting chapter in my second volume on QRP. Things have changed a bit since 1993, but you can still find Bob in the thick of things on most contest weekends. Whether it's the CQ WW DX test, or a QRP contest, N4BP is always in there slugging it out. Bob is one of the best contesters I have ever had the pleasure to personally know. He makes it look easy.

The following interview with N4BP should provide contesters and wannabees with some sage advice on how to do it and do it right.

QQ: Bob, with that 2 letter callsign you've been around a while. Please give our readers a thumbnail sketch of your ham radio background and what you do for a living.

Like our local bald, teenage disk jockey Rick Shaw puts it, "I've been around longer than dirt"! My mother taught me Morse code in 1955 and my technical Elmer was W1VFY, a crop duster in my hometown of Wareham, MA. I was 15 when I received WN1GIV and never worked anything but a couple of xtal frequencies on 80M. It wasn't until I passed the General test that I discovered that 40M was also a useful band. Finished high school, a couple of years of college, got married and had four daughters before moving to South Florida. The FCC assigned me W4OZF, which I used from 1967 to 1976. In '76, the FCC opened their first "vanity" program and I was awarded my first choice of N4BP.

I've worked in TV Engineering since 1961, first at a UHF station in MA, and for the past thirty-two years at WPLG-TV in Miami, which is run by Post-Newsweek. Currently, I'm working an overnight shift where my duties include recording satellite feeds to videotape, shading cameras and tapes for our 90 minute "Daybreak News", programming our commercial playback machine, and other duties as assigned. As in Ham Radio, I've seen many changes over these years, unfortunately many for the worse. But being able to observe the changes in the technology first hand has certainly made it worthwhile. I'm now looking forward to retirement in two to three years.

QQ: I know that you do a lot of contesting. Obviously contesting is one of your primary interests. I'll also bet you are a DXer, am I right?

Well, yes and no! I've gone through several phases during my 45 years of hamming. One of them was to collect the QSL's to qualify for 5BDXCC and 5BWAS. But several years ago, I lost interest in this aspect of the hobby and dedicated my time to contesting. I still pursue new countries, but as contest multipliers rather than a notch in a DXCC belt. I no longer actively collect QSL cards, but still answer ones that I receive.

QQ: What are your country totals with QRP, both worked and confirmed and how do you manage the QSL paperwork?

I can't give you "worked and confirmed" numbers since I stopped doing the paperwork several years ago. I did achieve the usual QRP awards for DXCC, WAC, and WAS and should have the certificates stuffed in a drawer somewhere. My DX interest peaked when I worked toward solar powered DXCC with a one amp panel directly powering an Argonaut 509. Most of this was done on 10M a couple of cycles ago and I recall that my country total was somewhere over the 200 mark. QSL's were collected the usual way with IRCs and "green stamps" and I still have all my QRP cards stuffed in a desk drawer. QSL's for QRO contacts, I don't usually save.

QQ: Do you find that working the major DX contests like the CQ WW DX Test, the ARRL DX Test, etc., improve your DXCC totals?

No *(grin)* !! But for those interested in increasing their totals, working the major contests is mandatory. Most of the rare DXpeditions are scheduled to include one contest or another. Although I don't collect the cards, I've often logged well over 100 countries and/or 50 states in a contest. Just now glancing through some contest summaries, in the ARRL DXCW Contest this past February, I worked 107 countries on 10 Meters, but admittedly, not with QRP.

QQ: Recently there has been an upsurge in interest in the QRP community about petitioning the ARRL to include a QRP DXCC endorsement on their long running DXCC program. Many within the QRP Community feel that this is long overdue. The ARRL has raised objections, sighting cost and extra processing time in order to accommodate a small group of ham radio operators. As a world recognized QRP DXer and contester, what are your feelings on this topic?

Again, this is not my field of interest. But I would have to agree with the arguments of the QRP Community. I think ARRL does issue a QRP WAS award and they do offer plaques to QRP winners in the DX contests. It's not much of a stretch to offer a QRP DXCC award. In the DXCC program as it now exists, they take entrants at their word that they used "legal" power to earn the award. Why not simply take the QRPer's word that he/she made all contacts with 5W or less.

QQ: Seemingly contesting and DXing go hand in hand within the ham radio hobby. Most people believe that you need high power to do either. How do you make QRP work to your advantage when contesting and DXing?

Following the propagation is most important if you are to have any success with QRP. My rule of thumb is to be on the highest frequency that will produce results. I've already made a couple of references to 10 Meters. As we near the peak of Solar Cycle 23, 10 Meters should be the primary band for QRPers. A transmitter putting out one watt or less from stateside can lay in an S9+ signal to Europe on almost any morning right now. I've been getting on 10M in the early afternoons lately with my new Elecraft K2 and easily filling log pages with DX contacts. In cracking pile-ups with QRP, of course timing is of the essence. This has been discussed in depth on the QRP-L reflector, so no need for me to reiterate. Oh, and think LOUD. Don't be timid, and realize that your one watt could really be S9 at the other end!

QQ: What are the most important things to consider when you decide to start serious QRP contesting, and please rank them in priority order starting with the most important first.

- You MUST enjoy contesting otherwise there is no point to it.
- Work on your antennas, they are the most important part of your station.
- Work on your code speed and operating skills. This is best done by simply jumping in with both feet! Ability to copy higher speeds comes quickly during a contest.

QQ: Your callsign continues to appear in the Top Ten, year after year, QRP contest after QRP contest. How do you do it? What keeps you from burning out?

Very simple! I enjoy the activity. As a side benefit, I can compare contest results with previous years to determine how best to improve my station (and myself). The activity itself could be compared to other sports, like tennis, basketball, etc. In fact, there is a July contest called HF RadioSport.

QQ: There must be a lot of self-imposed pressure to constantly improve your performance from year to year when contesting. How do you psyche yourself up prior to and during a contest to keep your performance levels high?

Try to be well rested going into a serious effort. This is not always easy for me after working my overnight shift. Thoroughly check out the station equipment so there will be no surprises during a contest. In a major high-speed contest like Sweepstakes, I sometimes load up NA in its "practice mode" to get myself in gear just prior to contest start. This also ensures that the logging software isn't going to let me down. Usually, I will have my previous year's contest results next to me so I can map my progress. This can also be an aid in knowing which band to be on at different times, where to head the beam, etc. In a very long session, every few hours I will get out of the chair and operate standing for a few minutes. This gets the blood circulating again to those areas that have been deprived. Other minor changes in operating also help maintain interest. I'll get rid of my glasses from time to time. I'll alternate between copying on headsets and speaker. Anything to slightly change your physical condition seems to help.

QQ: Are you an advocate of computer logging and record keeping? If so, which program(s) do you prefer and use on a regular basis?

Absolutely! This seems like a strange question to be answering since I was using paper logging when you asked me to write a chapter for your "Low Power Communications" series of books. I now use NA exclusively, even for my daily logging. Information not directly accepted on screen can be saved in a "note". NA also uses a "Template Editor" to allow it to be configured for contests not directly supported. The advantages to computer logging are most notable at contest end. With a few keystrokes, your entry is ready to send to the contest sponsor with no elaborate paperwork sessions.

QQ: I notice in several pictures of your shack, you use commercial high power HF rigs almost exclusively. Obviously, you crank the power back to achieve QRP output levels. Why commercial rigs?

In many of the major contests, I run legal limit. Long ago, I became addicted to "rates". For me, this is part of the thrill of contesting. Sweepstakes is a good example. During the first hour or two, I'll generally work stations at a 90/hour or better rate. Also, I must maintain a many years run of 1000+ QSO in SS. :-)

The FT-1000MP is my "main" rig. It has a fantastic receiver with a full compliment of CW filters. One of the menu options sets power output maximums of 10, 50, or 100 watts. In the 10W maximum setting, I can easily adjust the power out to under one watt.

I also enjoy using homebrew gear though. I've used the SST-20 for several single-band efforts and am now having a ball running my new K2 (sorta homebrew!!!)

QQ: Do you feel that using commercial transceivers gives you an advantage over other QRPers who use only homebrew gear?

I would have to admit that there probably is a slight advantage in achieving contest scores. But homebrew gives you the advantage of that feeling of accomplishment when making contacts with something you built with your own two hands. Some of the more elaborate kits on the market today are quite competitive with the higher priced commercial rigs. Bottom line though, I've always felt that operating skills are much more important than the quality of the rig - for example, the best CW filter is the one between the two ears.

QQ: I know that you also use non-QRP power levels when DXing and in certain contests. There are those in QRP Land who would say that you aren't a "Real QRPer" because you do that. What would you say to these folks?

This is another of those topics that has been discussed extensively on QRP-L. There are also those that feel that "Real QRPers" must use low wire antennas. Still others feel that all equipment should be homebrew. I feel that while I'm running five watts or less (the "real" definition of QRP), I am a "Real QRPer". As far as I'm concerned, no matter if I choose to maximize my signal with the best antennas that I can manage, or if I choose to run a KW at times. I have only myself to please and, I'd wager that I get as much satisfaction when I am running QRP as those who use it exclusively.

QQ: A few years ago you graciously provided me with an entire chapter on QRP contesting for my second volume of Low Power Communications (Ed note: now out of print). Can you capsulize this for our readers, please? (Be REALLY brief, here, Bob....just the high points, please)

Most of the points brought out in my chapter have already been covered in this interview. Mainly it dealt with operator and station preparation. At that time, I had a ritual worked out of clearing the operating position and thoroughly checking out the station. It boiled down to the K.I.S.S. principle to avoid visits by OM Murphy. Preparation was definitely the key word! Know your station, yourself, and the rules of the contest you are entering. There, is that brief enough!?!?!?!?

N4BP SHACK

QQ: There is one thing I can count on every time I enter a DX contest or a QRP QSO party: hearing "N4BP QRZ" on at least 3 or 4 bands. It seems like you're everywhere! Give us an overview of your antenna farm, please.

In a nutshell: TH7-DXX @ 65 feet, 40M dipole @ 35 feet, 40/80/160M dipole on one feedline @ 60 feet. The low bands have always been my downfall, partially due to the high noise levels in South Florida. By the time any of this is in print, I should have a working Hy-Gain 402BA (2el 40M Yagi) at about 50 feet fixed to the NW.

QQ: Bob, there have been times that the bands have been closed down...I mean D-E-A-D. I tune around and hear your station, still bravely calling "CQ QRP de N4BP". If I listen more than a few seconds, you'll inevitably work someone! Is there a special Propagation God you pray to prior to these contests? You seemingly work stuff that most of the rest of us don't hear. Enlighten us, please.

The most important ingredient is antennas! But often, what you perceive as a dead band is only dead because nobody is making any noise. This happens MUCH too often on 10 Meters. Often, I've called CQ on a "dead" 10M and had someone half way round the world come back. Don't presume a band is dead just because you don't hear anyone! Make noise.

QQ: Anything you want to impart to our readers as a parting shot?

Is this where I put in my "shameless beg" for you to work me in the contests? (BIG grin) Thank you Rich, for the Q's in the ARCI Fall QSO Party this past weekend. Not too often that I have the honor of putting your call in my log!

Seriously, since the main topic of this interview has been contesting, I would again suggest you only get into the arena if you get enjoyment from it. But if you haven't tried it, you don't yet know whether or not you would enjoy it.

....

My thanks to Bob for taking the time out of his busy schedule to participate in this interview. Hopefully his insight into contesting will inspire others to jump into the fray and give QRP contesting a try.

Till next time....73 Rich K7SZ

(Editors Note...Congratulations to Rich on his new book "Low Power Communication, The Art and Science of QRP" and for his new QRP column that will be appearing in QST magazine. . .de NA6E)

What is *DX* for The QRPer?

Leighton Smart, GW0LBI, 33 Nant Gwyn, Trelewis, Mid Glamorgan, CF46 6DB, Wales

"What a stupid question" I hear you say! Well, maybe not so stupid. For most amateurs, "DX" is defined as "long distance communication," something all licensed amateurs are familiar with, it being for the most part the reason why many wanted to get on the air in the first place. But surely "DX" is relative? I mean, what is "long distance" to one may be a "local" contact to another!

Imagine this scenario: amateur "A" operates a station running 400W on 20 meters to a 3 element Yagi mounted on a tower at 60 feet. With this setup he works Australia, Japan, New Zealand etc. every morning, has done so for the past 10 years, and he no longer considers this to be DX.

However, amateur "B" operates a station running 1W on 20 meters into a wire dipole at 20 feet. No matter how hard he tries, he just can't work the "DX" although he has heard of others doing it. He's unhappy about this and checks his station thoroughly. But everything is in fine working order. He therefore thinks that his station is just not up to working DX at all, so he makes do with working stations in the region of 500 to 2000 miles (or even sometimes 3000 miles) distant, which he does with varying success and failure, depending on conditions.

But Amateur B has failed to recognize something—that he *is* already working "DX"! If he stood back and took into account the low antenna height and its resultant high angle of radiation, coupled with his low power output, he would realize that his station is more than capable of working DX – it's just not what amateur A would consider to be DX, that's all! Working distances of around 2000 miles with just one Watt and a simple antenna counts just as much as "DX" for B as 12000 miles with 400W into a beam antenna does for amateur A. Not convinced? Think I'm 'moving the goalposts? Then let's take it one step further.

Suppose that B was keen on 80 meters, and used the same type of system already described. His 80m dipole up at just 20 feet would radiate at an angle even higher than his 20m dipole, thus reducing his effective range even more. Let's assume therefore that his station would be working others in the region of 50 to 600 miles distant. He is still working DX, believe it or not. With contacts at around the 600-mile mark, his 1W on the 80m band is working wonders, considering the band and the type of operation he is involved in.

Of course, there will be times when B cracks a new continent with his 1W, or his list of new countries grows. And *that* is the essence of DXing, I reckon. As with all types of radio operation, DXing is a way of measuring your *own* performance as well as that of your peers!

For my own part, I fall into the category of amateur B, and have since I became a full time QRP operator. I guess that QRP is not just low power amateur radio – it's more a state of mind!

Edited by W1HUE

VERTICALS WITHOUT VERTIGO - Part 3

Ten Questions You Always Wanted to Pose to Your Vertical, But Were Afraid to Ask

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

This is the last installment of a three-part series on vertical antennas based on a talk given by L. B. Cebik, W4RNL, at the "Four Days In May" symposium held in conjunction with the 1999 Dayton Hamvention. Parts 1 and 2 appeared in the July and October 1999 issues of the ***QRP Quarterly.*** *The last three of the ten questions bout vertical antennas posed in Part 1 are answered here.*

Be sure to visit LB's web site at http://www.cebik.com *for a wealth of information on antennas and antenna modeling.*

8. How can we make verticals directional?

I have not stressed any particular gain figure for the sample vertical antenna systems shown because actual gain will depend on too many variables for any generalized figure to make any sense. 1/4λ monopoles with ground plane at or near the earth's surface require large numbers of radials for maximum efficiency. Slightly elevated radial systems require close attention to symmetry to avoid pattern distortion. Gain also varies with the soil in the immediate antenna location for near-ground monopoles. The gain of both monopoles with highly elevated radial systems and vertical dipoles depends as well upon the soils in the Fresnel or reflection zone.

Whatever our initial gain for a single vertical antenna, we can improve upon it by applying standard techniques for creating directional antennas from two or more vertical elements. In the process, we may gain a significant reduction of gain to the rear of the array of elements. In short, we may create vertical beams.

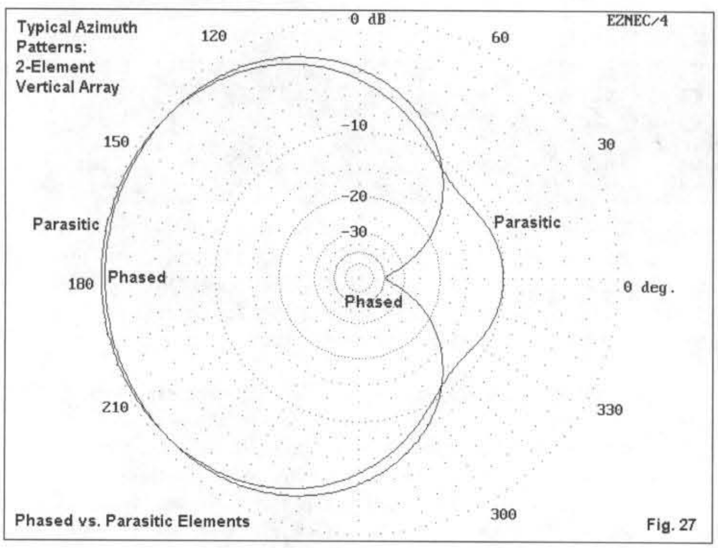


Fig. 27

The two most common techniques for creating vertical arrays involve either phasing the current among the elements or using parasitic elements. **Fig. 27** shows in a broad way the differences in anticipated performance. Phased elements can deliver a deep null to the rear, often exceeding 30 dB relative to the maximum forward gain. However, the deep phased array null extends only over about 60□ of the horizon. The front-to-back ratio of parasitic arrangements rarely exceeds about 10-12 dB. In exchange for accepting a lesser front-to-back ratio, the builder of parasitical arrays has a simpler building task, since phasing techniques require extensive calculations and careful construction.[8]

A 2-element array gives a broad forward lobe. Even with beam reversal techniques, much of the horizon remains outside of the main lobes. The simplest technique for covering the entire horizon with fixed vertical elements is to use three in a triangle and to switch them. Let's briefly examine a full-size and a shortened array of vertical dipoles to see what is involved.

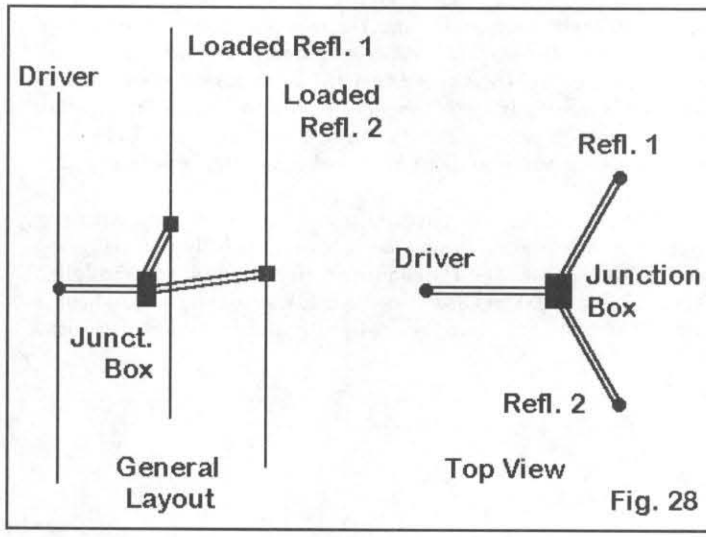


Fig. 28

Fig. 28 sketches the outlines of three vertical dipoles set 10' above ground at their bases. For 40 meters, the dipoles are 65.9' long, and for 30 meters they are 46.3' long. The 40-meter triangle is 22' on a side, while the 30-meter triangle is 15.5' on a side. From each dipole, a 50-Ohm coax stub (RG-213, VF=0.66) extends to a center junction box. The 40-meter stub is 16.4' long, while the 30-meter stub is 11.7' long.

For each direction, one stub is connected to the shack feedline. The other two stubs are shorted to form inductive reactances that electrically lengthen the elements to proper reflector size. A typical switching box is shown in **Fig. 29**.

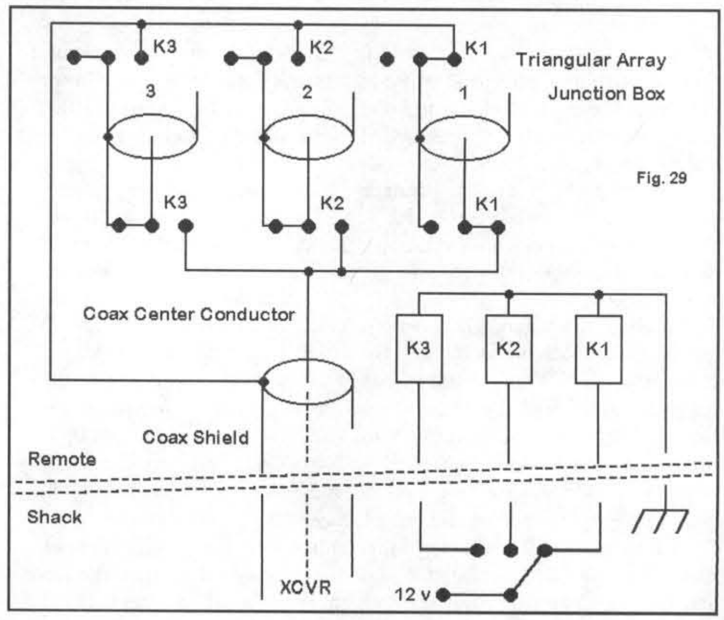


Fig. 29

The result is a 3-direction switchable array that can cover the entire horizon, as shown in **Fig. 30**.

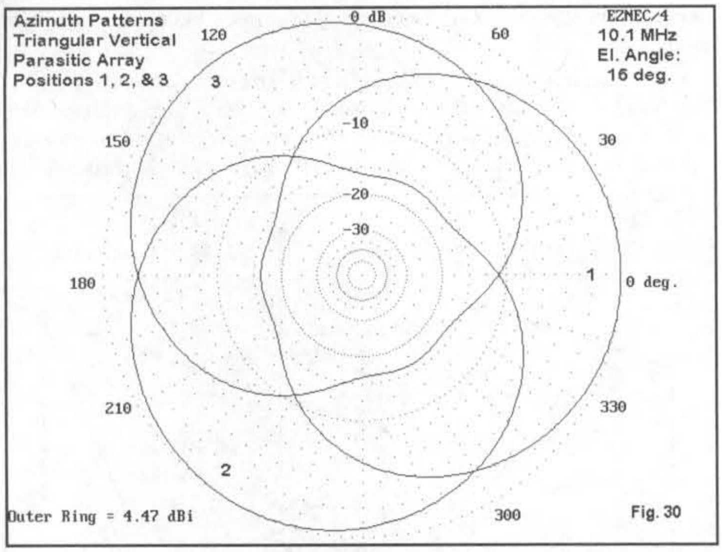


Fig. 30

The array gain is about 3 dB greater than a single vertical dipole at the same height. The dual reflector system provides about 12 dB of front-to-back ratio. Although the array is about as simple as one might imagine, its chief drawback is finding supports for the tall vertical dipoles.

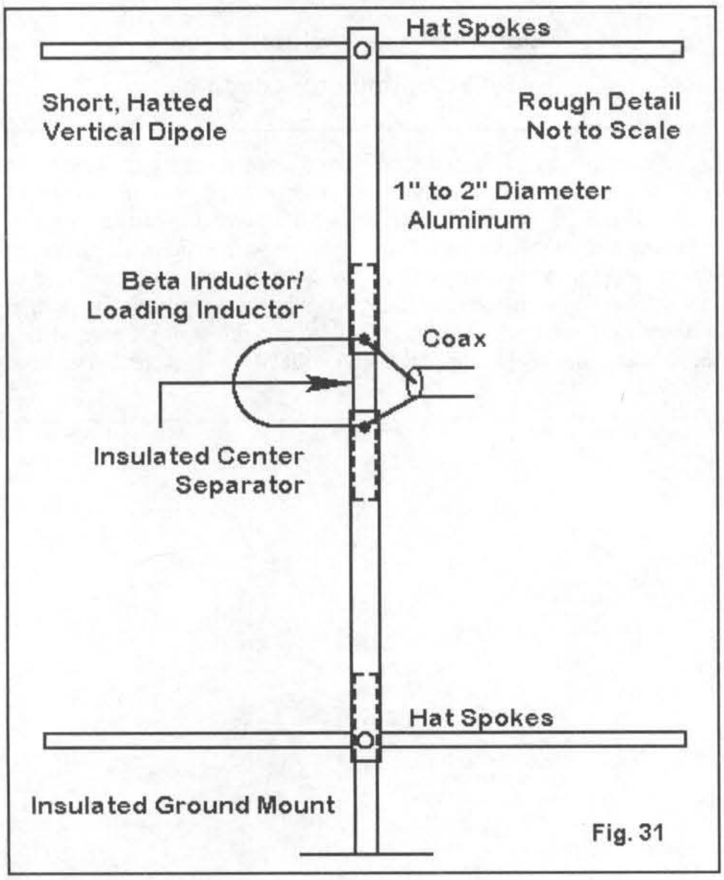


Fig. 31

We can also make an array from the short hatted vertical dipoles we briefly examined, using essentially the same 22' per side spacing of elements employed for the full size array. However, the elements can be supported from below, as suggested in **Fig. 31**. The sketch also hints at another change in arrangements.

The feedpoint impedance for the driven element will be about 25Ω. By setting the length of the vertical (or of the hat spokes) a bit short, the driver impedance becomes capacitively reactive. If we introduce a hairpin (a shorted transmission line section) or a coil across the feedpoint, we effect a beta match to bring the impedance to 50Ω for coaxial feed.

We leave the beta hairpins or coils across each feedpoint. Using the same switchbox that we used for the full sized array, we switch in a 1/4λ section of coax from the box to the driver. The 1/4λ sections from the other elements are shorted at the box, creating an open circuit at the element. The hairpin or coil now becomes a small inductively reactive load, electrically lengthening the element for reflector service.

Once more, we can cover the horizon with a 3-position switch. The gain of this short array is about 2.5 to 3 dB over the gain of a single short vertical, with better than 12 dB front-to-back ratio. Although the short array cannot match the forward gain of the much taller vertical array, it can certainly be useful with respect to adding a directional dimension to one's operating.

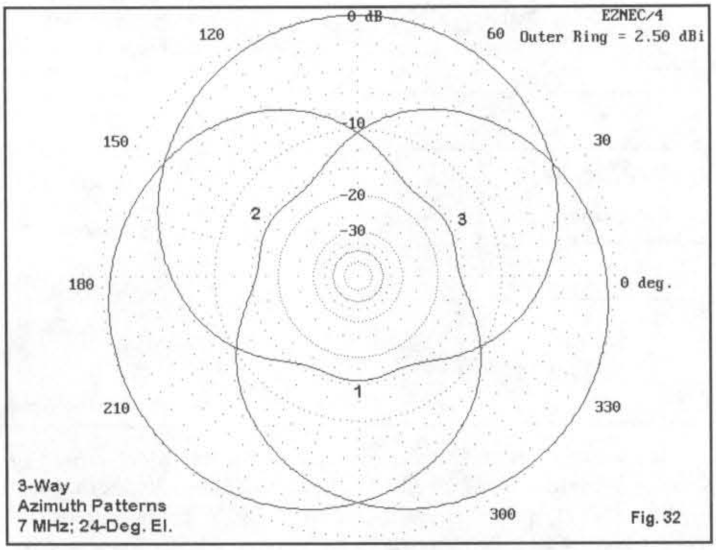


Fig. 32

More complex arrays are certainly possible using five elements for a four-cornered, three-element parasitic beam system. The center element can be a voltage-fed 1/2λ tower used to support upper HF beams, with the guy wires used for parasitic elements under proper switching conditions for electrically lengthening and shortening them. In fact, directional vertical arrays for lower HF use are limited only by the electrical and mechanical ingenuity of the builder.

9. How can we make verticals out of wires that are mostly horizontal?

Vertically polarized radiation patterns need not come only from vertical elements. We can construct vertically polarized antenna from wire loops, generically known as SCVs (self-contained vertically polarized large wire loops). **Fig. 33** shows the out line of several different types.

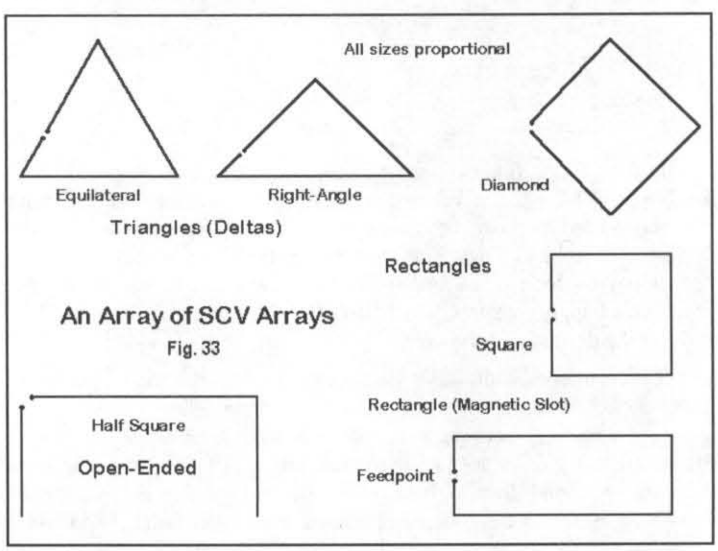


Fig. 33

Each of these single loop versions of the SCV produce a bi-directional pattern, ranging from a broad oval for the delta loops to a peanut-shaped pattern for the rectangle and the half square. All of the antennas have a feedpoint 1/4λ from the top center, which maximizes vertically polarized radiation. The connecting wire between the feedpoint and a point exactly opposite it on the opposing side structure acts as a phasing line by being a 1/2λ line in which the current phase reverses. The voltage and current at the opposing points are equal in magnitude and opposite in phase, creating a pair of quarter wavelength verticals in phase. Radiation is broadside to the array. The antennas are self-contained and require no ground plane or soil treatment beneath the antenna structure.

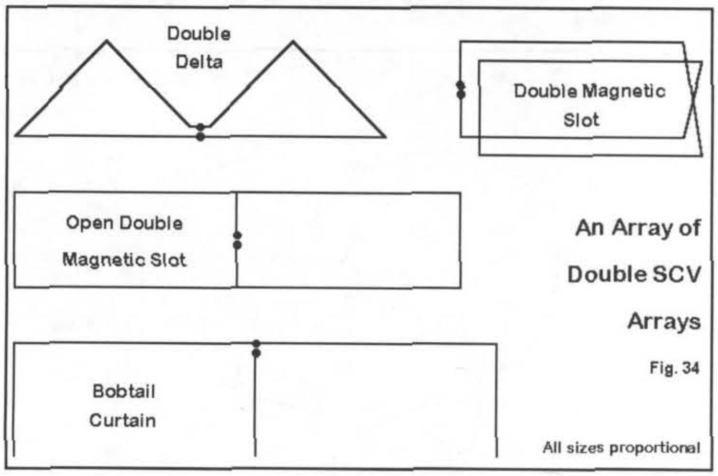


Fig. 34

If space permits, the builder can develop "double-wide" version of some SCV configurations for additional gain and directivity, as shown in **Fig. 34**. Some names originally given to SCV configurations are misnomers. The table below provides a very general indication of relative performance by listing the gains of some common configurations at 7 MHz with a 50' maximum height.

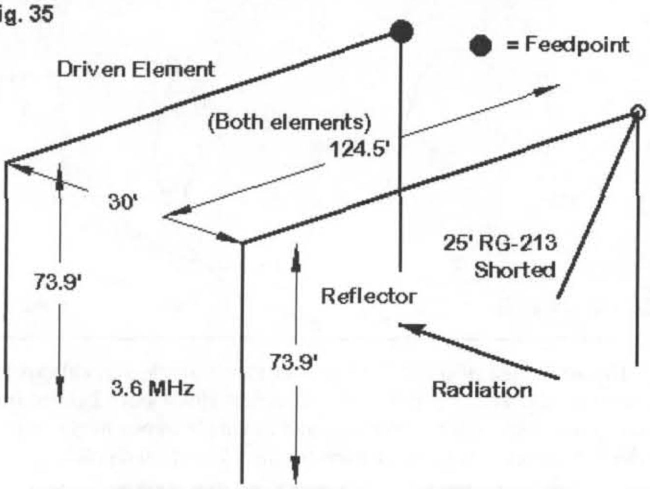
Antenna Name	Gain dBi	Front-Side Ratio dB	TO Angle degrees	Feed Z Z=RΩ
Equi. Delta	1.5	- 3	18	135
R.-A. Delta	1.9	- 5	20	60
Dbl R-A D.	3.7	-12	20	40
Sq. Quad	1.6	- 4	18	145
Dia. Quad	1.5	- 4	16	135
Rect. (MS)	3.0	-12	17	15
Dbl MS	3.3	-12	17	80
Open DMS	4.5	-25	16	30
Half Square	3.4	-15	18	65
Bobtail	5.0	-28	18	40

In the charted figures, not all of the antennas are at optimal height. Each type of SCV has an optimal height range. Below that range, ground interactions reduce gain significantly; above that range, the gain of the lowest lobe drops as a new higher-angle second lobe forms. Since SCV's are employed to take advantage of the low angle of radiation with rejection of higher-angle QRM and QRN, the secondary lobe actually reduces the desired performance.

Two cautions about SCVs are necessary to get the most from them. First, do not have improper expectations of them. They are capable of gain and directivity relative to a vertical monopole or a vertical dipole. However, that gain is not the gain of a horizontal dipole that is at least 1/2λ above ground. Instead, because the elevation pattern is typically the low-angle, single lobe pattern associated with monopoles, wise users expect better signal-to-noise ratios from DX signals, but not necessarily a more power signal.

Second, design carefully. Casual design and construction of an SCV may yield disappointment. Besides having an optimal height range, each SCV type also has an optimal shape for maximum gain. In some cases, the ratio of the vertical to horizontal measure may vary with frequency.[9]

Fig. 35



2-Element Parasitical Half Square
with Stub Reflector Loading

Although any of the basic SCVs is already an array of 2 elements phased, it is fairly straightforward to create a parasitic beam from a pair of SCVs. **Fig. 35** shows an example, a 3.6 MHz reversible half-square pair. The length of coax from the reflector is match with a similar line from the driver feedpoint to a center junction box. By switching from direct feed to a short, the line changes from a simple feedline to an inductively reactive shorted stub that electrically lengthens the non-driver to reflector status. Similar schemes can be applied to any of the SCVs to obtain a reversible beam.

Azimuth Pattern of a 2-Element Half Square

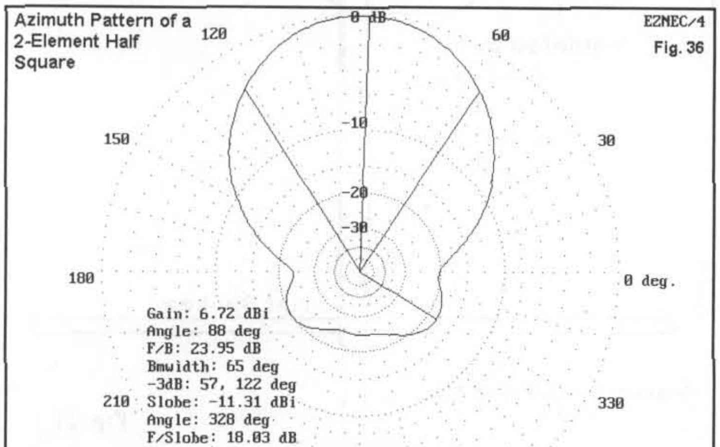


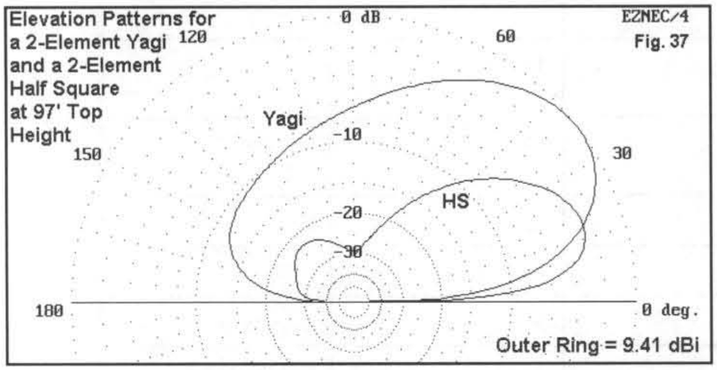
Fig. 36

Fig 36 shows the anticipated performance from such a beam when placed at an optimum height above ground. With a forward gain of about 3 dB over a single half square and a worst-case front-to-rear ratio of over 18 dB, the antenna offers excellent low angle (DX) performance for the amateur with the space and supports for the array. This last statement presumes, of course, that we point the antenna in the right directions.

Because SCVs require only wire and accessories, they form an attractive alternative for some locations to erecting complex aluminum structures. For each band, their height requirements are modest compared to the height needed for an equally effective horizontal antenna. On the other hand, we still need some tall trees or structures to hold up the wire.

10. Just how "good" is a vertical?

The answer to this question depends on what is going to count as good. If what we want is an antenna for the lower HF bands that maximizes low angle radiation and reception to yield a higher signal-to-noise ratio—but not necessarily more power—for DX operation, then one or another of the vertical antennas we have surveyed may prove a superior candidate. For example, the half-square beam we have just examined will outperform a Yagi placed at the same 95' maximum height relative to DX, although not for shorter skip contacts. **Fig. 37** tells the story.



The Yagi has more raw gain, but most of its power is at too high an angle for most DX, since the antenna height is only about 1/3λ. The half-square beam at the same height promises more power at the lower angle.

More modest installations can expect lesser performance, but similar patterns of performance: better contacts over longer paths and weaker signals closer in. However, even these installations must use careful construction and well-designed structures to achieve all that a vertical can give. For a monopole that is ground-mounted, four radials will yield something, but 30 radials will yield a lot more—and 60 or more will yield the most that the antenna can give.

Installation also requires close attention to surroundings. Ground and near-ground mounted verticals tend to be susceptible to signal absorption by ground clutter and to noise from man-made sources. A clear field for at least a wavelength—and hopefully a lot more—is necessary for best results. Moreover, a naturally quiet location is a big help.

For the city and suburban dweller, an elevated mounting may be best, if feasible. A rooftop at least 20 to 30 feet up can reduce local noise and improve signal strength on both transmission and reception, especially for multi-band trap verticals. However, if the antenna is a 1/4λ monopole, one must use a radial system. I personally recommend at least four radials for each band (using something like multi-wire flat rotor cable, or similar, or a radial fan of single wire radials spread across the roof) arranged as symmetrically as possible.

Elevated city and suburban installations must give attention to system grounding for lightning and static charge protection, but for most elevated verticals, providing RF isolation from the ground line will prevent diversion of signals into the ground. Simple RF chokes of sturdy construction usually suffice.

Whether circumstance forces us to use a vertical antenna or whether we choose to use one to achieve certain operational goals, the key to successful construction and operation is a better understanding of how verticals work and how various competing vertical possibilities compare in potential. My goal in these notes has been to cut away some outmoded ways of thinking about verticals, including some downright harmful and ignorant ways of talking about them.

Even when approached with thoughtfulness, vertical installations still remain subject to an array of variables that will normally defy precise analysis short of long-term operating experience. Soils that affect far field patterns are often beyond analysis for most ham installations. Some aspects of the operation of ground planes are undergoing re-analysis and re-measurement. In the interim, certain facets of ground planes are vocally disputed, as if loud voices could make the measurements come out as desired. Alas, we must wait patiently for results to emerge before making any final pronouncements—for example, on how Christman elevated radial systems compare with surface ground plane systems.

That does not mean that we cannot learn more about verticals. And it does not mean that we cannot use them effectively. Clear thinking goes a long way to avoiding that dizzying vertigo that has in the past infected the study and use of vertical antennas.

Edited by W1HUE

Notes (For all three installments)

1. If you are serious about studying vertical antennas, begin with any recent edition of *The ARRL Antenna Book*, although the information is scattered in many chapters. The ARRL *Antenna Compendium* series has many good articles as well. *The Amateur Radio Vertical Antenna Handbook*, by Paul Lee, N6PL, is by now a classic, as is *All About Vertical Antennas*, by Bill Orr, W6SAI, and Stuart Cowan, W2LX. *Vertical Antenna Classics* from ARRL is a collection of relevant articles. For lower HF applications, the most complete study remains *Antennas and Techniques for Low-Band DXing*, by John Devoldere, ON4UN.

2. The following table may help you appreciate soil differences better. The table represents an adaptation of values found in *The ARRL Antenna Book* (p. 3-6), which are themselves an adaptation of the table presented by Terman in *Radio Engineer's Handbook* (p. 709), taken from "Standards of Good Engineering Practice Concerning Standard Broadcast Stations," *Federal Register* (July 8, 1939), p. 2862. Terman's value for the conductivity of the worst soil listed is an order of magnitude lower than the value shown here

Soil Description	Conductivity in S/m σ	Permittivity (Dielectric Constant) ε	Relative Quality
Fresh water	0.001	80	
Salt water	5.0	81	
Pastoral, low hills, rich soil, typical from Dallas, TX, to Lincoln, NE	0.0303	20	Very Good
Pastoral, low hills, rich soil, typical of OH and IL	0.01	14	Good
Flat country, marshy, densely wooded, typical of LA near the Mississippi River	0.0075	12	
Pastoral, medium hills, and forestation, typical of MD, PA, NY (exclusive of mountains and coastline)	0.006	13	
Pastoral, medium hills, and forestation, heavy clay soils, typical of central VA	0.005	13	Average
Rocky soil, steep hills, typically mountainous	0.002	12-14	Poor
Sandy, dry, flat, coastal	0.002	10	
Cities, industrial areas	0.001	5	Very Poor
Cities, heavy industrial areas, high buildings	0.001	3	Extremely Poor

3. The best compact treatment of soils and antennas is Chapter 3 of *The ARRL Antenna Book.*

4. See *Antennas and Techniques for Low-Band DXing*, by John Devoldere, ON4UN, pages 9-30 to 9-31.

5. Here is a convenient, but neither authoritative nor exhaustive, set of ground types or classifications that may be useful in sorting out various aspects of ones antenna system:

G1. The DC and static discharge ground

G2. Circuitry common buss (ground)

G3. Lightning ground

G4. RF ground

G5. Far field reflective ground

G6. Antenna-completion ground

Only the last type of ground is under discussion, and it does not require THE ground to function. It is in the near field of the antenna, but is not itself the near field ground in the same sense in which we speak of the far field ground. The only time THE ground comes into play is when the antenna-completion ground—or plane—is under, on, or very near THE ground.

6. All models of verticals with ground planes have gone through a thorough development to avoid some modeling pitfalls. They originate with free space dipoles, with their standard 72-Ω feedpoint impedance. Then, the model replaced the lower leg of the dipole with a set of radials (ranging from 2 through 64 in various steps), in each case, with the radial lengths adjust for resonance. At each step, the models were convergence tested (that is, the number of segments per unit length increased in steps) to establish the internal coherence of the model. Models were also checked to assure that the feedpoint represented as closely as possible the maximum current position on the antenna, with the sum of the adjacent segment currents equal to the source current.

7. The notion that a radial-plane monopole has a feedpoint impedance of 36Ω arises from the theoretical exercise of modeling a monopole as a simple vertical element above a perfect ground, thus automatically giving an impedance of 1/2 that of a dipole. In fact, modeling programs will yield the same result, since they create a mathematical image antenna beneath the modeled one. In fact, the source impedance of a real radial-plane monopole varies considerably due to factors not accounted for in the dubious image-antenna calculational convenience. The ratio of diameters of the main element and the radials plays an important role in the feedpoint impedance, as it also does in determining the length of radials for resonance. We obscure these facts with assumptions carried into the field site and also by laying radials and them adjusting the monopole height to achieve resonance. Under these conditions, one rarely if ever achieves maximum current at the feedpoint.

8. The best sources for basic information on phased vertical arrays is *The ARRL Antenna Book*, Chapter 8, and *Low Band DXing*, Chapter 11.

9. More complete details on the SCV family of antennas can be found in a series of article appearing in 1998 and 1999 issues of *The National Contest Journal*. The articles can also be found at my web site:

http://www.cebik.com/

New QRP Publication ... QRP Homebrewer

by George Heron, N2APB *n2apb@amsat.org*

The NJ-QRP Club is pleased to formally announce the creation of a new nationally distributed QRP publication called "QRP Homebrewer. "The concept has been germinating within the Jersey QRP Club for some time this year and has now come to fruition with our premiere issue recently going to the printer. The QRP Homebrewer will be published on a quarterly basis (Nov/Feb/May/Aug) by the New Jersey QRP Club as a service and benefit to the entire QRP community. You don't need to be a member of the NJ-QRP in order to subscribe; and we encourage article contributions from QRPers all around the world.

We have a **dual theme** for QRP Homebrewer. The first part is, you guessed it, about homebrewing of QRP equipment, gadgets & gizmos, antennas, tools, and other accessories used by QRPers every day. We'll have occasional operating-related and other non-construction articles, but the focus of each issue will be targeted for the technical homebrewer in each of us.

The second part of our theme deals with the experience level of our target audience. We're hoping to provide projects, information, ideas and common sense construction techniques suitable for the beginner homebrewing readers. Can you recall when you had (what now seems like) real basic questions about component lead length, which type of capacitors to use in a VFO, how to string a dipole in the trees, how to make neat enclosures, etc.? Well, QRP fever is hitting epidemic levels now and the thirst for this basic knowledge is correspondingly growing like crazy. That "beginner QRPer and homebrewer" audience is the one we will mostly address with our articles. But here too we'll occasionally have some advanced topics tossed in to keep everyone's interest along the way.

We hope to help meet the demand for this information along with the other fine QRP publications: QRPp, SPRAT, QRP Quarterly, The Pennywhistle, The Lowdown, and others. In fact, our publication dates are offset from the dates of most others (we re set for mid-season) in order to provide a continual flow of information for QRPers throughout the year.

Our first issue of QRP Homebrewer is a very special one for us in that it addresses in a major way the fundamental question each one of us has asked along the way: Which kit should I buy and build? What's the best bang for my dollar/pound/peso? We're very pleased to have Doug Hendricks, KI6DS contribute his wonderful piece describing the decision making he goes through in evaluating the various equipment on the market. Granted it s only one man's opinions, but it gets our own juices flowing to consider our particular needs. This is a fabulous piece for the newcomer to QRP!

We have a bunch of contributors from the NJQRP gang: Joe Everhart, N2CX, our technical guru and my mentor, describing antennas to build for success in the field. Other member-authors include WA2DJN, AA1MY, W2GUM, N2GJU, WB3AAL, and N2CQ. Let us know if you enjoy this issue! The Winter issue is already on the drawing boards and is going to be a knock-out!

Get a load of the neat articles we have in our Fall 1999 Premiere Issue ... 64 pages chock full of homebrewer-focused material!

Which Kit to Build?, by Doug Hendricks, KI6DS. Like I said above, this major contribution by Doug substantially addresses the first question most of us had when we started. (And many of us continue to have this question!) This is an authoritative reference work. Thanks Doug.

Homebrewing your Own Printed Circuit Boards, by Gary Diana, N2GJU. When Gary Diana heard through the grapevine that we were doing a new publication to specifically address beginner homebrewing, his was one of the first emails in my Inbox requesting to submit an article. Gary brings a tried 'n true success track record with Brad Mitchell at Embedded Research, and he shares a very cool way to make pcb's at home.

Build a T -type Tuner, by Dave Ottenberg, WA2DJN. Dave is one of the more active homebrewers in the Jersey QRP gang, and he's personally assisted me on some of my antenna projects (Small Transmitting Loop antenna.) Dave actually submitted 3 articles for our first issue of QRP Homebrewer, but we had to leave out the third one due to space limitations ... just too much good stuff was submitted for our premiere issue!

Portable Antenna Success, by Joe Everhart, N2CX. Joe is amazing. He's my technical hero and I'm so very proud to have him as a friend and a mentor. Doubly so because of his guiding "guru" influence with us in the Jersey QRP group. Joe contributes this major article overviewing the variety of different antennas in the field, the benefits and uses of each, and what his recommendations are under various circumstances. Like Doug's, This is one from N2CX is one super reference article!

Super Field Day Antenna, by Dave Ottenberg, WA2DJN. Dave does it again with a neat construction article ... actually an "instantiation" (as we say in the software field) of one of the antennas Joe mentioned in his preceding piece.

A Beginner s Guide to the Jersey Fireball 40, by T.J. Skip Arey, N2EI. Skip really dived into the construction aspects of the Fireball 40 QRPp transmitter project and he shares some of his experiences with us. Nice augmentation perspective to the existing material ... you'll want to look at this one, even if you don't have an FB40.

Bringing QRP to the Field, by Seabury Lyon, AA1MY. "Seab" is a great story teller. (What else would you expect from the guy who put together the QRP Antenna Kite at Atlanticon this past March?!) He tells us all sorts of details of how he's found success in getting his radios operating out in the field. There are *many" non-obvious aspects to think about, and many homebrewing aspects of going to the field.

Universal Time Coordinated, by Ken Newman, N2CQ. Ken is our contest guru in the Jersey group, and he shares some of his thoughts on the importance of consistent use of UTC on QSL cards, skeds, correspondences, etc. Nice, simple & direct piece!

Introducing The Eastern PA QRP Club, by Carter Cragie, N3AO and Ron Polityka, WB3AAL. We plan on spotlighting a different *QRPclub* in each issue. Tell of the club's activities, interests and personnel capabilities. Who knows, perhaps there's a new QRPer sitting in your local town and he'll get plugged in by reading out publication. This time it's the overview of the EPA QRP Club.

The Gummer Winder, by Tony Colaguori, W2GUM. "Gummer's Gizmos" ... that's what we've called "Tony the Gummer's" contributions of little toys he whips up in his workshop. This issue's piece is very cool, and his articles in coming issues will be of great interest to all.

Books, Utilities and Websites for the Homebrewer, by Ron Polityka, WB3AAL. Ron has been pumping this reference information around on the mail lists for some time (i.e., "look at this", "check out htis program", etc.). Well, I put him to the test and he's stepped up just wonderfully with what may turn out to be a regular review of tools, software programs, websites, and literature that most of us fond so enjoyable.

The Tuna Tin 2 QRPp Transmitter (revisited), by Doug Hendricks, KI6DS. As most of you know, we (NJQRP) have been collaborating with KI6DS and NorCal for some time on the Tuna Tin 2 project. Recent news is that we're offering the TT2 kits to the general QRP public, and this article is a bit of a revamp of the original information on the websites.

Atlanticon 2000 Announcement, by Dave Maliniak, N2SMH. Dave shares some of last year's rosy glow and some planning issues on the table for this year's Atlanticon QRP Forum. Wait 'til you read where we plan on having it!

QRP Homebuilder Workshop Ideas, from the QRP Homebuilder website (great complement to our newcomer to QRP and homebrewing theme ... what components to stock up with, ways to organize the bench and more!

The Ugly Weekender Revisited, from the QRP Homebuilder website. This project is a favorite of mine, as it inspired our design of the Fireball Plus the 1.5W amplifier built onto the Fireball 40 transmitter pc board. W7ZOI has graciously allowed the NJ-QRP Club to use his material and he advised us during our design cycle. For these reasons we 're pleased to put this article in our first issue of the QRP Homebrewer.

SUBSCRIPTIONS to QRP Homebrewer are now officially being accepted. Domestic subscriptions (US and Canadian addresses) are $15 per year, delivered by first class mail. DX subscriptions are $20 per year, delivered by airmail.

To subscribe send cash (or a check or money order made out to George Heron, N2APB) to: George Heron, N2APB, 2419 Feather Mae Ct., Forest Hill, MD 21050. Funds must be in $US and the check/M.O. must be drawn upon a major US bank. Subscriptions start with the first available issue and will not be taken for more than 2 years. Membership in the New Jersey QRP Club is free and is not required for, or included in subscription to QRP Homebrewer.

If you want to give this first issue a try, send along $2 (per instructions given above) and we'll send the Fall 1999 issue along to you by mail. If you like what you see, and enough to subscribe, this issue becomes your first and you'll get 3 more throughout the next 9 months.

Well, we're excited about our QRP Homebrewer ... hope you also are after seeing it. A lot of hard, personal work went into this by many members of the Jersey QRP group and others. Please let us know what you think.

Thanks & 72/73 George Heron, N2APB

Technical Review: The Elecraft K2 Transceiver Kit

Russ Carpenter, AA7QU   *47227 Goodpasture Rd., Vida, OR 97488*   *email: russ@natworld.com*

This is a summary of an in-depth technical review of the Elecraft K2 multiband transceiver kit. The complete review appears on the web site of the Adventure Radio Society (www.natworld.com/ars/) in the October 1999 issue off their on-line magazine, ***The ARS Sojourner.*** *See the complete review for details on measurement procedures used and comparisons with other HF transceivers. -W1HUE*

The K2 has received a flood of favorable commentary during the past half year, which it clearly deserves. Your author built K2 number 218 and agrees that the K2 is a stellar performer, reflecting the extensive operating experience of its designers.

If you decide to build the K2, figure out how to beg, borrow, or steal about 50 hours of time. The manual is outstanding, and so is technical support (both from Elecraft and from fellow hams in the Elecraft mail list). But this is an ambitious project, and you will get a lot more pleasure and knowledge from it if you can set aside some quality time.

The K2 breaks new ground for QRP transceiver kits in many ways. One of the most dramatic is the degree to which the radio is controlled by firmware. This is a double-edged sword. It is fascinating to see what can be accomplished by a firmware genius like Wayne Burdick, N6KR. On the other hand, sometimes you won't be able to peer under the hood. Some aspects of this radio will remain inscrutable.

Elecraft's web site (www.elecraft.com) contains a complete listing of the radio's specifications, options, and prices, and we won't repeat them here.

Transmitter Tests

Power Output

Rated output for the K2 is 10 Watts. Our unit produced about 11.5 Watts on all bands.

Power Requirements on Transmit

With a 13.8-volt power supply, our K2 drew 1.6 Amp with 5 Watts of RF output and 2.1 Amp with 10 Watts of RF output. Both tests were performed on 14 MHz.

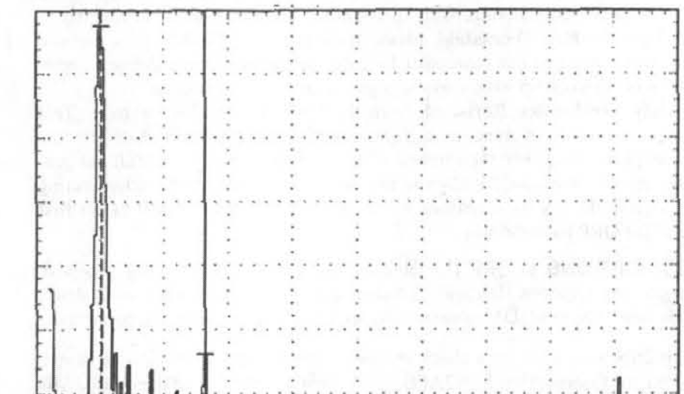


Figure 1. K2 spectral purity plot for 30M. The carrier is indicated by the dashed line and the second harmonic (at 20.25 MHz) by the solid line. The second harmonic is approximately 50 dB below the carrier.

Spectral Purity

FCC regulations require the spurious emissions from a 10-Watt radio used in the amateur radio service to be at least 40 dB below the carrier, and the K2 easily exceeded that requirement on all bands.

We performed these tests with a Tektronix TDS 380 'scope with Fast Fourier Transform capability. The complete review contains spectral plots for all bands. Figure 1 shows the plot for 30M, which is typical.

Receiver Tests—When No External Signals are Present

Spurious signals

There were only three "in-band" birdies in our K2, and two of them were of little consequence, because they were at the extreme edge of their bands. The three birdies were located at 3.591, 4.000 and 7.000 MHz. Given the amount of atmospheric noise at these frequencies, only the birdie at 4.000 MHz is likely to be audible when an antenna is connect to the radio.

Power Requirements on Receive

The K2's firmware allows the user to make a number of modifications to conserve power (for example, the display backlight can be turned off, the meter can be disabled, and so on). When our K2 was running in its most power consuming mode, it drew 207 mA on receive. When we took all the power conserving steps, the power consumption on receive dropped to 175 mA.

Receiver Tests—When One External Signal is Present

Minimum Discernible Signal

On 14 MHz we measured an MDS of −131 dBm with the preamp off, and -135 dBm with the preamp on. We used the nominal 700 Hz IF filter. The complete review shows comparisons with MDS measurements made on other HF radios.

Phase Noise

We consider this to be one of our most important tests. We measured a carrier to noise ratio of 125 dBc/Hz for our K2 (14 MHz). Our test frequency was separated 10 kHz from the carrier. We would rate this performance midway between "Fair" (120 dBc/Hz) and "Good" (130 dBc/Hz).

IF Rejection

The K2 had outstanding results with IF rejection. We measured IF rejection of 136 dB without the preamp, and 147 dB with the preamp.

Image Rejection

Our sample had an image rejection of 77 dB without the preamp and 76 dB with the preamp.

Audio Output

At a room-filling volume, we measured power output of 1.1 Watts into 4 Ohms, and total harmonic distortion of 2 percent. .

Receiver Tests—When Multiple Signals are Present

Selectivity

In this report we've introduced a new analytical tool—a computer-based AF spectrum analyzer, named SpectraPLUS. We have used SpectraPLUS and a calibrated noise source to examine the K2's IF and AF response at four different filter settings. The results are shown in Figure 2. The graph actually shows impressive performance, for three reasons:

- All four of the filters peak at the same audio frequency (the 650 Hz tone we had set with the K2's firmware);
- The insertion losses from the narrow filters are moderate; and
- The sides of the curves are steep.

There is a fourth virtue to the K2's filters that isn't documented in the chart, but is really important. These filters produce nice, clean audio, with little ringing. Some narrow filters torture the ears, but these sound fine.

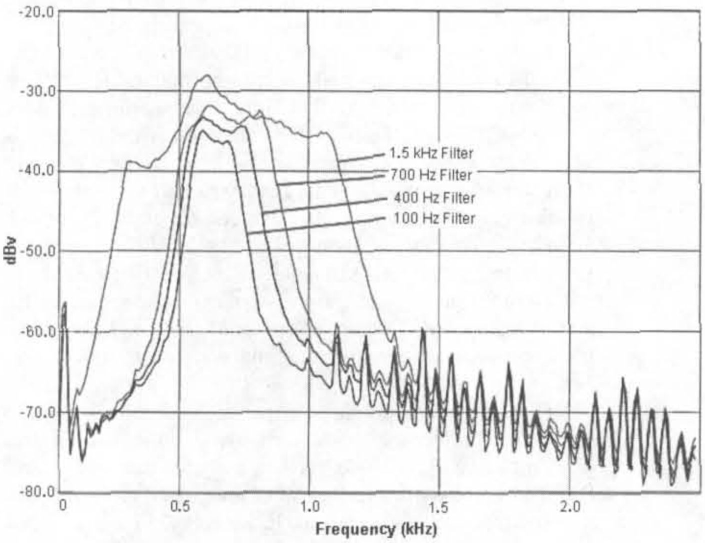


Figure 2. AF response curves for various IF filter settings.

Blocking Dynamic Range

We were unable to measure blocking dynamic range for the K2, because the test was noise limited (noise from reciprocal mixing dominated our measurement).

Third Order IMD Dynamic Range

In one of the more important tests of our review, the K2 gave impressive results. We measured a third order IMD dynamic range for the K2 of 96 dB with the preamp off and 95 dB with the preamp on (14 MHz). These results are similar to what the ARRL lab measured on an FT1000MP and a Ten-Tec Omni VI. Comparisons with other popular rigs are shown in the full review.

Third Order IMD Intercept Point

We calculated third order intercept points for our K2 of 13 with the preamp off and 7.5 with the preamp on (14 MHz).

Second Order IMD Dynamic Range

Although this test was ignored in earlier times, it is now receiving increasing attention. We measured an excellent second order IMD dynamic range of 99 dB with the preamp off and 101 dB with the preamp on (14 MHz). These results are even better that what the ARRL lab measured on an FT100MP and Omni VI! (See complete review for a comparison chart.)

Second Order IMD Intercept Point

We calculated second order IMD intercept points for the K2 of 67 dBm with the preamp off and 67 dBm with the preamp on.

In-band IMD

Another test that hasn't received much attention. But we have a hunch it will be important for the low power community, because it may shed light on the superhet/direct conversion trade-offs, and because it may help us quantify the poor audio we see in some simple transceivers. The K2 met the prevailing criterion for "good behavior" in this department, with IMD products about 33 dB below the test tones. The spectrum display is shown in Figure 3.

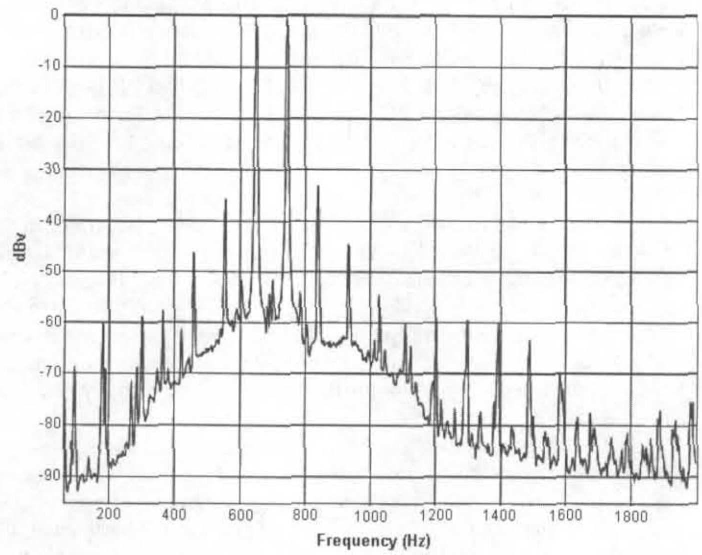


Figure 3. Two-tone IMD display.

Conclusion

We close with a thank you to the ARRL lab. The ARRL has produced a wealth of incredibly valuable testing procedures and information. We're about to wear out our copy of the ARRL Lab Manual. We owe them a huge debt.

Edited by W1HUE

MODEL MN9 QRP Transceiver Kit

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

At Pacificon, QRPers at the QRP Hospitality Room gave my new rig the eagle eye...and it was VERY encouraging to get their feedback about physical appearance and the analog design. However, quite a few comments came my way about the large number of interconnections between boards. On the very next day following Pacificon, I made the decision to completely redo the MN9 Kit PC boards at the possible expense of missing out on a lot of the early interest sales.

I have worked long hours and had a nightmarish experience with hidden software problems that caused about two added weeks of rework time in doing these new PCs. But, I'm pleased to say that the new boards have no soldered wires between boards, allowing independent work on front and rear panel assembly. Layout was finished 11/20/99 and they are due from the PC house on Wed. Dec 1. By December 30 kits will be shipped to HSC Electronic Supply. PC Headers are now in place between two vertical and one "mother" horizontal board.

A 6 crystal 9 MHz CW filter with individual trim caps will be ready by December 15. It is on a small PC with two PC headers that plug into the rear vertical PC. Circuits for control of switching from SSB to the CW filter are now built into the upcoming boards whether or not a CW filter is ordered. A position was added to the front panel mode switch for it.

I have also included a CW softness op amp RC integrator in the CW RF amp keying circuit. The kit comes with a soft on/off keying envelope. A simple change of either the R or C of this integrator will give an individual the opportunity to select CW keying rise and fall time over a considerable range. MANY good things have been added to this kit since the original April 99 article, and there is enough good "stuff" to make up for or justify my obvious kit delivery delays of several months.

To those who have sent email, I greatly appreciate the words of encouragement including your many congratulations as well as favorable comments about the "hands on", analog design of this rig.

Since the functional sections are explained in the kit manual, I'm sure that each user will find it easy to "tweek" circuits to fit individual preferences. Highlighting a few circuits that can be "tweeked"

1) RF and AF AGC sources are rectified and then applied to 2 op amp input weighing resistors, allowing simple resistor value change to vary the weight of each source and thus the effects that each source has on AGC action and listening quality.
2) The front panel RF Gain control feeds bias to an NPN/resistor input signal attenuator. In tests, it looks like the range of attenuation is approximately 60 dB via the RF Gain pot. With a simple change, the RF Gain wiper can be fed to another dual input op amp, in place on the new PCs, with AGC applied to the other input. This op amp output can then be applied to the input of the first IF receiver amplifier, a Motorola MC1350 IC. Tests so far indicate that this change is very worthwhile, but I am leaving it as a "tweek" item. Weighing of these two signals is easy to do by simple resistor changes giving a very effective combo of AGC and RF Gain pot control of the RF section. The kit theory of operation covers these details technically. Incidentally, I have moved the rf tuned circuit to the front end of the receiver RF amplifier...it used to be at the output of this amplifier. I like the improvement in signal handling with strong QRM present.
3) X/RIT range of coverage on either side of zero is easy to change; again, op amp resistor change is all that is needed. The range of X/RIT possibilities are so broad that this control could easily be used, as a 2nd VFO source and this point will be explained in the kit manual. Incidentally, I have incorporated a center detent pot on the front panel X/RIT Adjust pot to make "spotting" easy...a term we used to use for operation of "spotting" a separate transmitter for zero beating with received signal.

In a series of upcoming articles, I will include added functional-section tech info about this rig. HSC has given the OK to make some parts available to those that want to build their own rig from scratch. (I have given them exclusive right to market and sell the full kit). I might, if time permits, also prepare a package of schematic and layout drawings plus the 3 abandoned PCs which are about 80% useful to anyone who wants to start from scratch and build this rig, doing so at a very reasonable price tag.

I hope to have essentially the entire kit manual "cranked" onto the HSC Web Page by 1 Jan. Within the next month, Delta Circuits of Carson City, NV, is going to quote a cost to assemble the PC boards. If this quote is reasonable, I will probably offer the choice of MN9 kits, one with and one without assembled and tested PC's.

Keep those email comments coming.

72/73/88 de Frank, W6MN

Ramblings of a Displaced Cajun

*Joel, KE1LA *ex WA5CVM) in Main* *email: jamjose@juno.com*

Hi y'all again... U kneaux there has been a lot of noise over this new K2 radio and I was wondering if Yew ever heard 'bout my B4....? No, even B4 that! Well, let me told u a bit about qrp in the marsh....of south Louisiana... Cajun qrp... how to ham and catch ur supper at the same time...... First u got urself two good strong poles about as high as u can get them and lash them to ur pirogue.... then u gonna need some rope and a coupla inner tubes from some old tractor tires.....

U see.... U take a piece of plywood and tie it to the inner tubes soes u can rest them long poles on top of the plywood... (keeps everything from sinking in the marsh). I takes some rope and ties it to the poles and then to some marsh grass for support... Then u string ur antenna up between them two poles....

Did I mention? U gotta string the antenna across a bayou cause u gonna tie some string to the wire and let the string drop into the water... then U tie a fish hook on the string and bait the hook... on a good 40 meter dipole u can gets lots of lines in the water... Now when u thru hamming u just paddle the pirogue along the lines and pick up ur fish supper... Fresh fish straight from a low rf field.... oh my cajun mama likes that....

U kneaux my Cajun Mama flew up heah last winter and before she came I set up the cajun qrp marsh special in one of the local bogs, (marshy area) and brought my cajun mama to see this.... When we got there the cold weather done froze everything in place... they told me the thaw would be about the middle of March... My Cajun Mama was still laughing when she boarded the plane for her flight back home....

Gotta geaux.... working on a ten meter ant... maybe give a report on it next time

God bless . . . 72/73 Joel Kella

QRP Elegance

Jim Giammanco, N5IB *giamman@rouge.phys.lsu.edu*

During the past year I have enjoyed building several QRP kits and packaging them in wood "recipe boxes." No claims for originality are made here. The boxes were cheap, they could be worked with tools I had available, and they had a certain elegance when finished. My bride of 27 years, Gloria (WD5CMA) will even permit a QRP radio to be displayed on the mantle when built in the manner described. In leiu of any better-organized way of explaining the process, I'll just tell the story step-by-step, in the order I have performed them.

A well-known recipe for making cajun chicken gumbo begins, "First, steal a chicken." To put a QRP radio in a wood box you need to obtain the box. There are several possible sources. A variety of sizes of what are called "recipe boxes" or "trinket boxes" are available from hobby and craft outlets such as *Hobby Lobby* or *Michaels's Crafts* or from vendors of woodcraft items on the internet. Don't overlook the boxes use to package today's trendy cigars. Office suppliers may still have the old fashioned wood index card file boxes. And you can always "roll your own" if you have even modest woodworking skills and simple tools. The project I will describe uses a 7" x 4" x 3" recipe box with a hinged lid. It was made of what I can best describe as "white pine."

The first step, presuming you already have confirmed that the circuit board, controls, and connectors will actually fit in your chosen box, is to give it a light sanding inside and out and a couple of coats of a clear sanding sealer or wood finish. Final finishing will come later, but this preliminary sealer coat will protect the wood from picking up stains or smudges during the operations to follow. I have settled on a water-based clear polyurethane satin finish. It dries quickly, so several coats can be applied in a day, there are no noxious fumes, and cleanup is with soap and water.

Next, a rabbet should be cut into the rim of the lower portion of the box to recieve the front (actually the top) panel of the radio (see Fig. 1). This allows the panel to be inset into the box so that the edges are not exposed. The rabbet should be slightly deeper than the thickness of the panel (I use 1/16" PC board stock, so I rabbet slightly less thn 1/8" deep) and need only be about 1/8" wide. Remove any hinges or latch hardware. A router with a 1/8" straight cutter, mounted on a router table, is a good way to cut the rabbet. You will need to clamp some stop blocks to the table since the cutting takes place inside and beneath the box when it is inverted over the cutter. It could be done with a hobby knife and a steady hand. I have the advantage of access to a vertical milling machine, which makes the job a snap. Now the panel itself must be cut. PC board stock is a good choice of material, as it will provide shielding, is very sturdy, and relatively easy to cut and drill. PC stock with copper cladding on one or both sides may be used, but the double-sided is recommended. If single-clad stock is used, the inside of the panel should have the copper cladding for shielding and grounding purposes. Measure the rabbeted opening carefully and cut the blank panel so it makes a nice snug fit. You may need to cut the panel sightly oversized and then do some work with a file or emery cloth to fine tune the fit. Figure 2 shows a box with a blank panel fitted to it.

Figure 1. Note the rabbet around the rim of the box nd the partial copper foil covering.

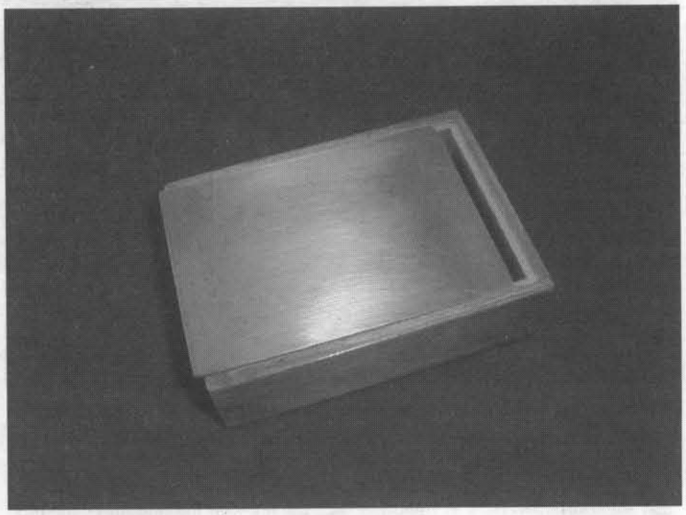


***Figure 2.** Fitting the blank PC board panel.*

The layout of the controls and connectors, the drilling guide, and the labels and logos is most easily accomplished with some form of computer graphics drawing program. It is important to use a program that allows dimensions to be specified, to a resolution of at least 1/8". I use Corel Draw, with which I can position objects in increments of 0.1 mm. The printed layouts (using an HP inkjet printer) appear to be accurate and reproducible to well within 1 mm over a 4" by 6" panel. As will be discussed later, the program should also be capable of performing a mirror-image reversal of your layout. Pictured in Fig. 3 is a (not yet inverted) Corel panel layout with drilling centers marked, ghost outlines of controls and knobs, and lettering and artwork. Be sure to locate the holes for the screws that will attach the panel to the box. Later, all but the labels, artwork, and one or two small alignment marks can be deleted.

Figure 3. Corel Draw ® panel artwork and drilling guide.

I would heartily recommend making a mockup of the panel using stiff posterboard and *actually mounting the controls and connectors* and fitting it onto the box. Many fit and clearance problems can be avoided before you've invested the time in drilling and finshing the real panel.

Once fit and clearance is confirmed, drill the required holes. Print a copy of the panel layout and fasten it (use tape) to the blank PCB panel to act as a drilling guide. I like to print the drilling guide on clear ink-jet transparency film. This makes aligning and squaring the drilling guide to the panel edges a much simpler job. Center punch each hole before drilling. Larger sized holes (more than 3/8") may be best accomplished by drilling and following up with a hand reamer. This is especially true if you use SO-239 coax connectors rather than BNC. A hobby rotary tool may also be used, though ragged edges are likely to result. De-burr all holes.

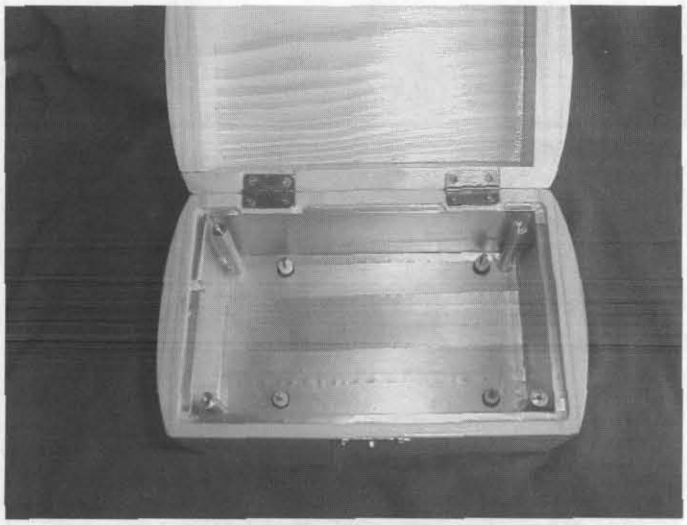


Figure 4. Spacers and standoffs installed. Copper foil covering completed.

The panel will be attached to the bottom of the box with screws and stand-off spacers. It is important that the holes in the bottom of the box be aligned with the holes on the panel. This alignment is easily accomplished by fitting the drilled panel into the rabbet box (be sure the top side is up!) and drilling through the panel holes for the stand-offs all the way through the bottom of the box. Do this on a drill press so that there will be a precice vertical alignment between the holes in the panel and the holes in the bottom of the box. Turn the box over and countersink the holes where they exit the bottom of the box so that flat-head machine screws may be used. I make my own stand-offs of the exact length needed by cutting aluminum rods to length, and drilling and tapping each end to accept 4-40 machine screws. You may also use stock spacers and cut or shim (use nuts and/or washers) them to fit. At this time you may also drill the bottom of the box for the screws that will be used to attach the assembled circuit board to the box.

Prepare the panel for finishing by removing any photoresist coating that may be on the PCB stock. Vigorous scrubbing with steel wool works fine. You can use a solvent, but be careful of fumes - they can be both toxic and explosive. I use medium steel wool and then a fine emery cloth to make sure the copper cladding is clean and bright. The panel will be spray-painted, so the fine emery cloth leaves the panel with something the paint can "grip." Clean both sides of the panel if it is copper clad on both sides, since you may need to ensure electrical contact to the back side. Wash the panel with hot soapy water, rinse it well, and let it dry thoroughly.

The panel should be spray painted white or some other light color. That color will be the background color which will show through the transparency containing the labelling and artwork. Two or three light coats of

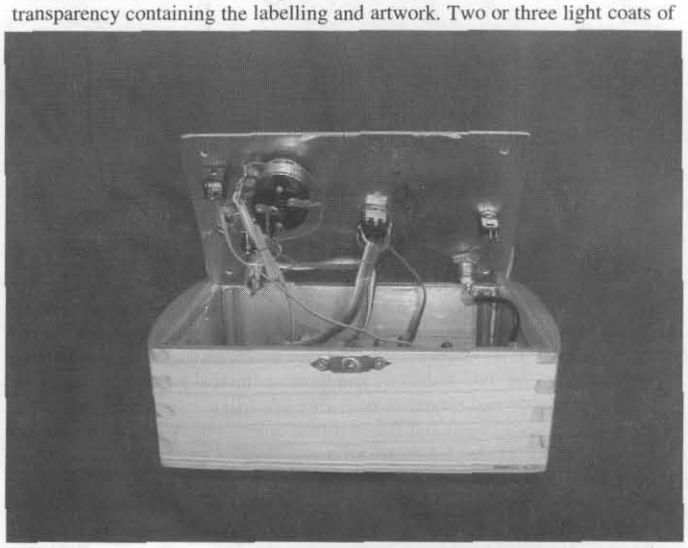


Figure 5. Controls mounted. Note how the copper foil wraps over the rabbeted edge to make contack with the underside of the panel.

an enamel spray such as Krylon are usually sufficient. If any overspray reaches the back side, it can be scaped or sanded away. When the panel is fully dry dust it lightly with talcum powder and brush away the excess. This will prevent the transparency from sticking to the panel, resulting in a "bubbled" appearance.

Print a finished copy of the panel artwork and labelling. Be sure to invert the image so that the inked side of the transparency will be down, against the panel. Allow the transparency's ink to dry completely. I usually set it aside for a few hours or overnight before handling it. Trim the transparency just slightly larger than the panel (the excess can be trimmed later) and temporaily secure the transparenct to the panel with masking tape. Use a hobby knife to cut out the holes for screws and controls. With the transparency held in place against the panel, the panel cutouts serve as cutting guides for your knife.

With all the holes cut, mount all the controls and connectors needed as shown in Fig. 5. Be careful as you tighten screws and nuts that you do not cause the transparency to twist under the screw head or nut.

For the first one or two projects I fastened the transparency to the panel using spray-on photo-mounting adhesive. The result was acceptable, but did show some slight mottling of the backgound. On subsequent projects I have allowed the transparency to be held in place only by the mounting screws and control shafts that penetrate it. As long as the rabbet in the edge of the box is deep enough that the panel is inset far enough that its edge is not exposed, there appears to be no long-term tendancy of the transparency to lift or curl, and the insetting prevents a stray fingernail from getting underneath the transparency.

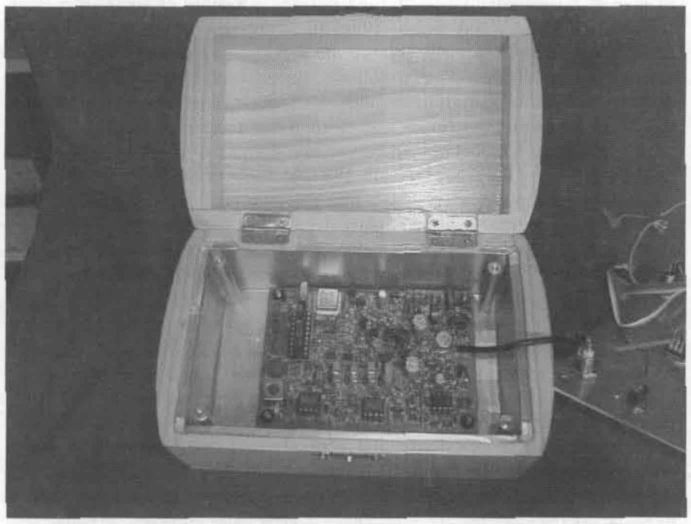


Figure 6. Circuit board installed on spacers.

Final wood finishing should be done before the circuit board, panel, and hardware are installed. I have used several coats of the clear water-based urethane finish, followed by an application of paste wax and a good buffing. A nice feature of wood enclosures is that the nicks and scratches that come with age and use are usually considered "character" rather than "blemishes." For this reason, light finishes are probably better than darker stains, especially when using softwoods.

Before mounting the circuit board into the box (Fig. 6) it may be wise to provide rf shielding by covering the inner surface of the box with copper foil tape. This tape can be obtained from several sources, including Digi-Key. One inch wide tape comes in 18 yard rolls. It's fairly pricey, about $40 for a roll. But one roll will do about a dozen boxes of this size. The adhesive backing of the tape is conductive, so where the tape overlaps electrical contact is maintained. The tape should continue up and over the rabbet in the rim of the box so that it will make electrical contact with the back-side copper cladding of the panel when the panel is tightly secured in place. Earlier photos (Figs. 1 and 4) showed the partially, and then fully foil-covered interior.

Mount the circuit board into the bottom of the box on its standoffs, using flat-head screws through from the bottom of the box. connect the front panel controls to the circuit board and secure the panel in place onto its standoffs. I have chosen to use oval-head #4 macine screws and finishing washers (cup washers, see Fig 8). These allow the mounting scews to be tightened firmly without marring or twisting the transparency. Reassemble

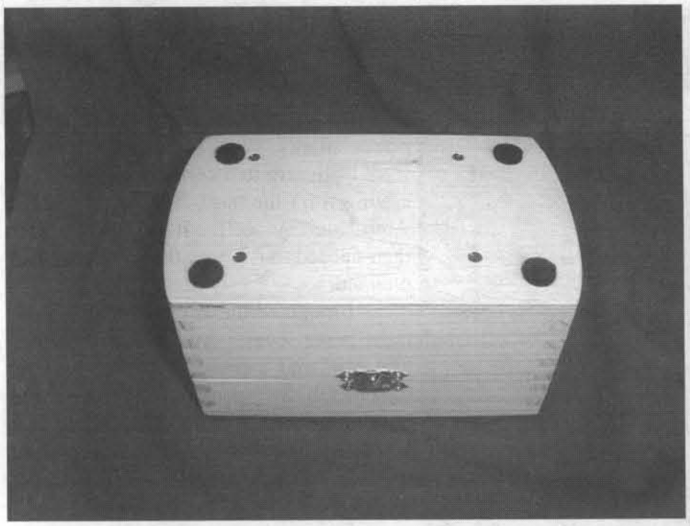


Figure 7. Felt pads cover the mounting holes for the panel standoffs. Countersunk holes for PC board spacers are visible.

the hinges and latches and your elegant radio enclosure is complete. Apply some press-on felt pads to the bottom of the box (Fig. 7) for a final finishing touch.

As a personal preference I have chosen to have all controls and connectors emerge through the front panel. When the lid of the box is closed, nothing protrudes - elaegantly stealth QRP. The radio appears to be simply Grandma's Recipe Box, suitable for display among the family heirlooms. As a practical benefit, all controls and connectors are protected from damage while in transit. There is, of course, no electrical or mechanical reason (save for the thickness of the wood sides) why connectors could not emerge from the back or sides. Some counterboring might have to be done if controls do not have long enough bushings for thick panel mounting.

Don't overlook the space under the lid of the box for potential storage of accessories or for other information or artwork. On some of the rigs pictures here I mounted a map of the USA with the states worked using that rig colored in. It never fails to provoke the question, from hams and non-hams alike, "What are the colored states for?" That gives me an easy segue into a QRP sales pitch. The maps are also printed on transparency film, inverted so the ink side is against the wood, and fastened in place with a dot of clear cement in each corner. The wood grain shows through the transparency for a very pleasing appearance. Dial calibration charts, DXCC lists, or other information could be displayed in a similar manner, even your personal QSL card.

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First licensed in 1963 as a Novice class licensee, WN5IBT. Extra Class since 1982. Instructor of Physics and Astronomy at Louisiana State University in Baton Rouge, and trustee of the LSU club station, W5YW, which has been continuously licensed since the 1920's (originally as 5YW). Member of the Baton Rouge Amateur Radio Club.

Figure 8. Finished panel installed. Note cup washers at each corner

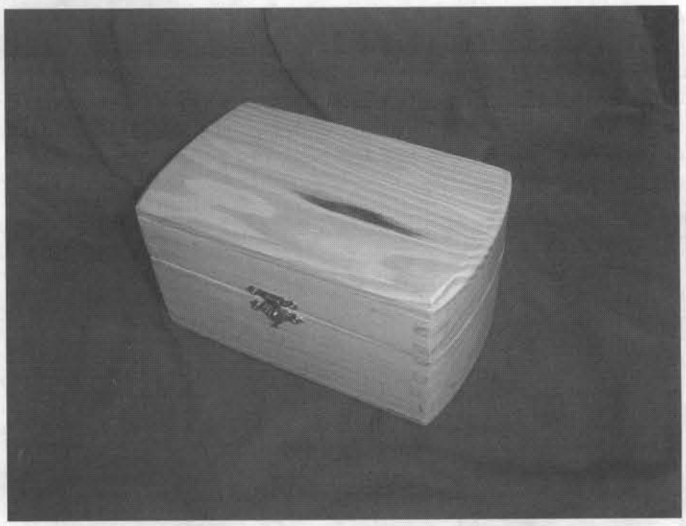


Figure 9. The stealth QRP rig. It looks like Grandma's recipe file.

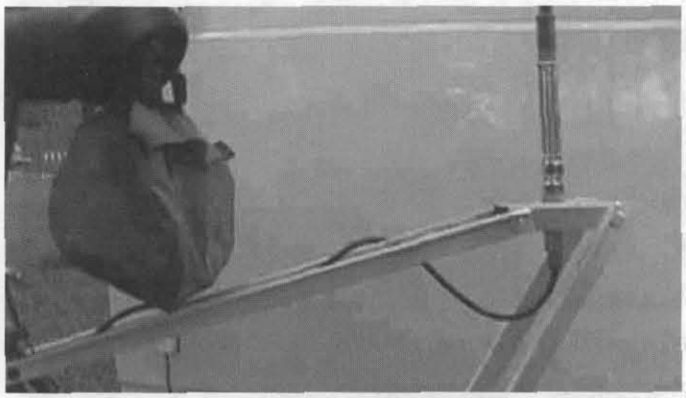
Figure 10. N5IB and WD5CMA family portrait. Clockwise from bottom: Herring Aide for 30 m, Small Wonder Labs DSW-40, Small Wonder Labs DSW-20 (USS Kidd version), NorCal 38 Special. Not pictured - Small Wonder Labs Green Mountain 30 (a bun in the oven).

Bicycle Mobile QRP CW—Its Easier than You Think!

Wes Spence, AC5K email: ac5k@ih2000.net

For years, I have wanted to combine my two favorite hobbies—amateur radio and bicycling. There were so many obstacles to overcome that I never got very far with the project. Suddenly, things started to change. At the June '99 Hamcomm convention in Arlington, Texas, I saw the new DSW-40 rig produced by NN1G at Small Wonder Labs that Chuck, K7QO had built. That rig (in the 20-meter version) was just what I needed for a bicycle rig. The DSW-20 overcame the toughest obstacles to my goal. The DSW-20 is small in size, uses very little current (so batteries can be smaller), it has a built in keyer (so everything is in one box), it covers the entire band, and the digital tuning is not going to change when the bicycle hits bumps in the road. I ordered my DSW-20 kit as soon as I returned from the convention and soon had it on the air.

The three photos should give the reader some idea of what I have done for my complete bicycle CW station. The full bike photo is to give you a sense of scale. The bicycle is an off-road type that was bought used for a good price. The antenna is difficult to see, but it is about 7 feet long, so a good overhead clearance is needed.



The most difficult part of a bicycle mobile station is the antenna system (see photo). I was just plain lucky and easily got the antenna to tune with no added tuner needed. The mount for the antenna is made of aluminum angle stock that is ¾ inches on each side. The bracket is bolted to the bicycle at four points: two on the seat tube and two by the rear dropouts (standard rear pannier rack mounting points). The center of the antenna mount is a steel standoff plate that was liberated from some retired rack-mounted communications equipment. The reader should be able to easily construct something similar. The antenna is mounted to a standard 3/8 inch fitting with a SO-235 on the bottom. Note: I tried to use a similar mount to a standard commercial pannier rack on my road bike, but it was far too flimsy to support a full size HF antenna. The mount shown here is rock solid. The angle of the angle stock as it approaches the antenna may be one of the reasons that the antenna tunes easily. (Remember the trick of drooping the radials from a quarter-wave vertical at 45-degrees to raise the base impedance to ~ 50-Ohms? The actual antenna is a Ham-Stick. I used a quick disconnect connector on the bottom to allow easy removal. Be sure to mount it far enough rearward to allow easy mounting and dismounting on the bike.

The photo of the handlebar bag shows how I handled the actual radio, battery and key. The bag has a towel in the bottom to act as a shock absorber and suppress rattling noises.

I used a custom enclosure for the DSW-20 I salvaged from an old power supply. The enclosure raises the front of the rig to a correct height for operating from the bag. The battery is a 4 Amp-Hour gel cell. It is much bigger than needed, but it was the smallest I had on hand.

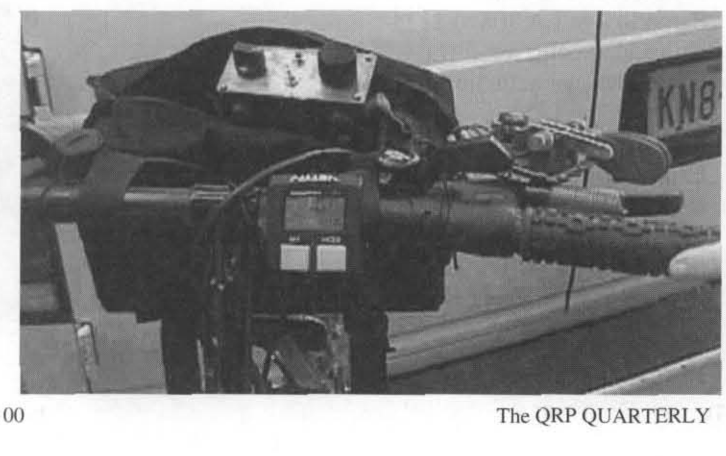
I mounted the keyer paddles on the right brake lever. It is mounted with a "P-strap" and a piece of garden hose is underneath for spacing and to grip the bottom the key tightly. The paddle is a Ham-Key brand that was removed from its base to try on the bike. The finger pieces are a bit too long for comfort and I am debating whether to grind them down or look at other keys for the bike. Note: I had to replace the original spring in the key with a stiffer one. The paddles would bounce and send random dits and dahs while hitting bumps in the road. (Bicycle CW beacon mode?) The new spring solved most of the unwanted keying.

To most readers, this system may look "hay-wired". That is somewhat valid, but I was not at all sure how well (or if) I could actually make QSOs with this thing, so I was not going to do a first class job before I tested it. The bottom line is that it does work and works well. I have worked stations all over the US and Canada in casual operating. I have also had some long QSOs with fellow QRPer KT5X in New Mexico. For a two-Watt radio and minimal ground plane for the antenna, I am constantly amazed at how many stations can hear me. I have even had moderate success calling CQ!

One word of caution: Do not attempt bicycle mobile CW operating unless you are completely proficient with CW. A marginal CW operator trying to operate from a bicycle in motion will most likely result in a dangerous crash. My first QSO from the bike in motion was complicated by two dogs attacking just as it was my turn to send. Many years of CW operating experience allowed me to keep going through that challenge. It is also interesting how many of the operators I have worked while on the bike never understand that I am actually on a bicycle—perhaps they just never consider that something like that would work.

With the new age of super small radios upon us, bicycle mobile CW operating will be easier than ever. I sincerely encourage anyone that is interested to give it a try. It will add a new dimension to your recreational riding and allow you to get some exercise while enjoying our fantastic hobby. Share your results with QRP Quarterly. I will see you on the air. Photo credit for all of these photos and those in my two direct solar articles goes to KD5QI.

72, Wes, AC5K/bike/m



In Search of . . . The Perfect Contest

by Monte "Ron" Stark, KU7Y 3320 Nye Drive, New Washoe City, NV 89704 email: ku7y@dri.edu

Oh boy, there's a contest this weekend! Wheeee goes the cry. 48 hours later after much lost sleep, poor food, QRM, QRN and a few visits from Murphy, how many of us still run through the house crying Wheeee? That's what I thought. I had often wondered where the "Wheeee" went and thanks to the Internet and QRP-L, now I know.

Watching the posts after a contest is interesting. I'll only look at CW contesting for this example. There are people who say that the code speeds were too slow, too fast and a few who think they were just right. That's to be expected and has been around for years. Add to that all the griping about the RTTY or SSB QRM right there in the good old CW band, that new dimmer switch the better half just made you put in and so it goes.

The other thing that has been around is talk about making a contest "fair" for everyone. But is that really what we need to do? Lets look at a few things that might be "wrong" and how we can fix them. When we are done, we will have the Perfect Contest!

First thing we need to do is make a class for those of us that don't have monster towers with multiple yagi's hanging all over them. At the other end of the scale are the indoor antennas. So, from this we can see that we will need two broad classes, indoor and outdoor. Within those two classes we need to have something for those with only one tower or one antenna or a short tower or what about a tall tree? Maybe we need to go by the type of antenna that is used. First off there is the yagi's that we all know so well. At least we think we do. But is that a multi band yagi or a single band yagi? Is that a trap design or not? What about the boom? How long is too long? What happens when we stack some yagi's? No, not vertically as in up and down the tower, but like Force 12 does, all along the boom! Oh, yes, you're right! We do need to think about those who can stack yagi's vertically up and down the tower.

Some yagi's get rotated while others are fixed in one direction. Then there are those who put a wire dipole up in some tall (or not so tall) trees. At night, when no one is looking, some of them sneak out and put up more wire behind and in front of that little dipole. No boom, just lots of rope. Is that a yagi?

Gee whiz, this is getting confusing already and we haven't even figured out what to do with all those simple yagi's yet! Let's leave antennas for now and look at the shack. That should be simple. All we need is a radio, right?

Some of us like to use nice big radios with lots of whistles and bells (AKA Good RX) while others like to use home brewed equipment. Some of the home brew box's are very nice and will hold their own with anything on the market. And others are more of a lark than they are competitive, like the Tuna Tin II and a Desert Rat Regen RX! Lots of things here that need to be done to make it all fair. Lets look at that new rig sitting there. It sure has lots of knobs and buttons on it! But what about the guy with the old FT-101-EE? There's no way he should be in the same class as someone with that multi-kilobuck rig! Let's see, we can have analog rigs with analog displays or digital displays. One VFO or two VFO's. And what about memories? No way should a rig with a memory be in the same class as a rig without a memory. And lets not forget about those rigs with the automatic antenna tuners all built in. Of course, there are those fussy individuals who actually tune their antennas so they don't need a tuner. They need to be in a class all by themselves! Some place in here we have to leave room for the one fellow who runs Xtal control!

Wow, even more confusing and we have just started to look into the shack! We will come back to rig later. Lets look at some of the other areas of the shack. After all, this is like the war room. It's where it all happens!

Look at the wall and all those antenna switches! Gee, what about those who can't afford to buy or build antenna switches? OK, I smell another class there! What about all that coax, open wire and hard line? No way can all those different systems be in the same class. Look at those control wires running from the switches to the rigs. Or are they going to the computer? What??? Rigs, as in more than one? Computer? What the heck is the computer doing out there? Special software for contesting? No way can all those programs be equal. We need classes for each brand of software! Look over there in the corner, there is a bathroom! In the other corner is a refrigerator and stove. Even the coffeepot is out here. I can see that we are going to have to classify all the different types of shacks.

We will come back to the equipment in a little bit. Right now I think it's time to do the easy part. After all, the operator is just the operator, right? All the operator does is work other operators, right? Of course we have to realize that some operators can copy CW faster than other operators and that's really not fair, is it? Some operators send their CW with a hand key and call themselves "Pure" while others are just too lazy to do that and let the computer send for them. That sure doesn't sound very fair, does it? What about a keyer? Add some memories and it's almost like using a computer!

Then there are the bugs. Not really "Pure" like a hand key but not as automatic as a computer. Some operators let a computer logging program keep track of the dupes while others do it all by hand. That's sure not fair! But what about those who send with one hand and dupe/log with the other hand? Not really very fair to the less talented operators either, is it? Then there are the operators who are old, young, healthy, sick, skinny, obese (didn't think I could be politically correct, did you?) slow, fast and whatever else you can think of!

This operator category is getting a bit out of hand already. And we still need to revisit some of the other areas! Lets look at what was said over on the Contest email reflector a while ago. This was written by Fred Laun, K3ZO who is one of the top contest operators and has a great station too!

Fred writes:

Hey! This isn't my fight. But since my name has been dragged into it, I feel compelled to make a suggestion.

PROBLEM #1: Judging by persistent comments on this reflector, there is obviously a deep yearning for a Level Playing Field (hereinafter abbreviated LPF) which has obviously not yet been perfected by sponsors of major contests.

PROBLEM #2: Attempts to meet the creation of an LPF by increasing the number of participant categories would make contest rules too complicated and unwieldy.

PROPOSAL: That a simple schedule of bonus points be drawn up in order to create an LPF without expanding the number of participant categories. Below you will find an example of how this might be done. Those who each April must calculate their respective contributions to the IRS may note a similarity in methodology.

Column 1: Situation		Column 2: Bonus
Schedule LPF-L: Location		
Line 1	Right Coast	No bonus points
Line 2	Left Coast	Multiply final score by 1.1
Line 3	Black Hole	Multiply final score by 1.3
Line 4		Subtotal, Schedule LPF-L
Schedule LPF-T: Towers		
Line 5	Two or more towers	No bonus points
Line 6	One tower	Multiply amount on Line 4 by 1.1
Line 7	No tower	Multiply amount on Line 4 by 1.2
Line 8		Subtotal, Schedule LPF-T
Schedule LPF-O: Ownership		
Line 9	Owns station in question	Multiply amount on line 8 by 1.2
Line 10	Does not own station	No bonus points
Line 11		Subtotal, Schedule LPF-O
Schedule LPF-W: Work on towers and antennas		
Line 12	Works on station's towers and antennas	Mult. amt on Line 11 by 1.2
Line 13	Does not work on towers and antennas	No bonus points
Line 14		Subtotal, Schedule LPF-W
Schedule LPF-E: Equipment		
Line 15	Repairs own equipment	Multiply amount on line 14 by 1.2
Line 16	Somebody repairs equipment for him	No bonus points
Line 17		Subtotal, Schedule LPF-E
Schedule LPF-Q: Use of "QRL?"		
Line 18	Never sends "QRL?"	No bonus points
Line 19	Sends "QRL?" once before running	Multiply amt on line 17 by 1.1
Line 20	Sends "QRL?" twice or more B4 run	Multiply amt on line 17 by 1.2
Line 2		Subtotal, Schedule LPF-Q
Schedule LPF-C: Complaints		
Line 22	Complains to reflector at least twice a year	Multiply amt on line 21 by 1.2
Line 23	Complains to reflector once a year	Multiply amt on line 21 by 1.1
Line 24	Never complains to reflector	No bonus points.
Line 25:		**FINAL SCORE**

The above are sample LPF items only. Certainly, other LPF items could easily be added to the list as the need arises. Point multiplier values are suggested values only. Note one advantage of this procedure: No one is penalized for anything. Every participant gets to keep at least his basic score. Scores can only be increased as a result of this exercise. **73, Fred Laun, K3ZO**

Thanks Fred, but I think I can see some weak points in your approach to the "Perfect Contest". Lets look at it from another position. Who really knows what needs to be done to make a contest fair? It's the people that don't win anything! How do we cut down on the number of complaints? Make more winners! How do you get more winners? You have to make more classes. How many more classes? No set number, just how ever many it takes!To make up for all the work keeping track of the classes lets get rid of some of the other things. Trust me!

Lets start with the post contest report form. This form needs to contain all the important and interesting information. This form will be called the "LOSERS" form for its content, Logs, Observations, Score, Excuses, Rules and the Salutation. *I had first used a form for Second Hand Information Tabulation but dropped that for obvious reasons!*

You must fill this form out prior to the contest. Or after the contest. Or instead of the contest! I'll get back to that last one later.

The name of the contest is, Wining Here Is Never Easy, Rewarding or Satisfying, or WHINERS for short. To win the WHINERS contest, simply complete the LOSERS form. The object of the LOSERS form is to create enough classes to be sure that you will win your class!

As you look over the form, rate each category on a scale from 1 to 100 with the highest valve given to the biggest handicap needed.

For example, in the line for your rig if you have something like a FT 1000MP you would put down only a small number but if you don't even have a rig you would put down the whole 100 thus claiming the highest handicap in that category.

Here is a sample of the LOSERS form. You can either copy this one or make one of your own. You can add other category's as you see fit. All LOSERS forms will be checked and no ties will be allowed. The form checker, me, will adjust scores to break any ties. Each total will be a class of it's own and you will win!

W.H.I.N.E.R.S. Contest

		Points
Date of Contest	______	___
Mode of Contest	______	___
Rules	______	___
Operator	______	___
Do you have a radio license?	______	___
Do any of your friends have a radio license?	______	___
Do you know the code?	______	___
What is your code speed?	______	___
Do you use a code reader?	______	___
Do you use a mind reader?	______	___
Do you have a mind to read?	______	___
Radio #1	______	___
Radio #2	______	___
Antenna Farm	______	___
Did you work any stations?	______	___
If yes to the above, why?	______	___
	Total Handicap Points	___
	Total Score	___

LOG: (not required)
OBSERVATIONS AND EXCUSES: Limit to 25 words or less. Long soap box style comments are not fair to those who don't have good writing skills.

Sincerely, [your name] [your call if you have one]

Special Notice:
Stations may not be worked on any band for contest credit. That would not be fair to those without radios.

Winners certificate's are available from the author for only $10. Each Winning WHINERS certificate will be numbered and signed by the author. Have your contest soon to get a low WHINERS number. Impress your friends. Be proud to be an official WHINER, complete with a number! The judge is ready.

Ron, KU7Y, ku7y@dri.edu
3320 Nye Drive
New Washoe City, NV 89704

Power Altiods: "A Curiously Strong Amplifier"

Steven Weber, KD1JV *PO Box 140, Gorham, NH 03581* *email: kd1jv@nica.net*

If you frequent the QRP-L email reflector, then you are no doubt familiar with Steve "Melt Solder" Weber's projects, many of which he has made available as "limited edition" kits. Here's one of his designs that you put together from scratch. Even if you don't need a "QRP Afterburner" at the moment, take a look at his unique amplifier biasing scheme for future reference. –W1HUE

Looking for a way to give your peanut whistle of a QRP rig a little boost? Here's a cute little linear amp that's easy to build and will turn one Watt into a powerful 10-Watt signal. If you're unfortunate and have to use an inefficient antenna system, or when conditions are rotten, a little more power can give your QSO rate quite a boost.

The linear can work on the HF ham bands, 80 through 10 meters. However, because of the lack of room in the tin, it is set up to operate on just one band, as there is room for only one low pass filter. It would be possible to build in a filter for the highest frequency band of interest and use external filters for other bands. In this case the low pass filter capacitor that connects to the amplifier side should have its value reduced by the value of the output capacitor built into the amplifier. This way the total capacitance seen by the input of the external filter will be the proper value. Another possibility is to build several filters into another tin and use slide switches to select them.

Theory

As one can see from the schematic, the linear is a classic push-pull Class AB amplifier. The power transistors are 2SC2078's, inexpensive CB finals that work well up to and including 10 meters. Using broad band balun transformers, the amplifier can be used on 80 through 10 meters. An RC network from the collector to base of each transistor provides negative feedback, ensuring stability and fairly even gain over a wide frequency range.

The amplifier has a gain of about 10 dB, so a 500 mW input results in 5 Watts out. One Watt in produces 10 Watts out and so on. With sufficient drive and adequate power supply current, the amplifier saturates at about 20 Watts out. I've rated the output at 10 Watts to be conservative and to allow some "headroom" for modulation peaks when using SSB. I would not recommend running the amp at 20 Watts unless a good sized heat sink is used, your SWR is low and you are using a low duty cycle modulation like SSB. Even then it might be risky, as at 20 Watts, the transistors are working hard. Best to stay down at 10 Watts or less to be safe.

Since the amplifier is linear, it can be used with CW or SSB. You might think that if all you use is CW, the amplifier doesn't have to be linear, but it does produce a better sounding signal, as it preserves the wave shape of the keying produced in earlier stages. In addition, the class A biasing reduces the input drive requirements.

Biasing circuit

In order to have a linear amplifier, we need to provide bias current for the transistors. We also need to ensure we don't encounter a "thermal runaway" condition. If the base bias current isn't regulated in some way, as the transistors get hot they can pull more base current, resulting in more collector current and heat, leading to more base current and more collector current, and so on, until it reaches a melt down condition.

In most power amplifier designs, regulating the base current is done with a temperature compensating diode. This diode is thermally coupled to the heat sink, and if it's working right, will shunt some of the base current to ground as the base-emitter junction voltage goes down due to the transistor getting hot. Usually, a lot of current is sent to the compensating diode to ensure the voltage across it is a little greater than the base-emitter voltage it's suppose to regulate. If the diode is well coupled to the heat sink, the voltage across the diode will vary pretty much the same as the transistors, thus keeping the base current constant.

I decided to take a different approach that has worked out well. One way to ensure a constant current into a load that has an apparent resistance that varies is to use a constant current source. This is easily constructed using a LM317L variable voltage regulator and a resistor to set the current. As can be seen from the schematic, the resistor (R7) is connected between the output and adjust terminal of the regulator, with the output taken from the R7-ADJ terminal junction, and not the output terminal, as would normally be the case. The regulator wants to keep a constant 1.2 Volts across the load resistor R7. As the load resistance from the adjust terminal to ground varies, the voltage across the regulator will change to keep a constant current flowing through R7. Since this is a series circuit, this same constant current will flow through the load.

Despite the fact that we keep the current into the base of the transistors constant, the collector current will still go up as the transistors get hot. This is because the "beta" or DC gain of a transistor tends to go up as the transistor gets hot. However, this effect is minimal and the constant base current prevents the thermal runaway problem. If the base current isn't held constant, the increase in beta can enhance a thermal runway condition.

T/R relay circuit

When built as an external amplifier, there must be some way of switching the amplifier in and out of the antenna to transceiver circuit. This is done with a simple two-transistor circuit, Q3 and Q4. The input signal is sampled by D1 and is applied to the base of Q3 through R8. C8 filters the AC signal. It takes about 10 mW to turn Q3 on, which in turn turns Q4 on by pulling base current through R9. When Q4 turns on, it energizes the T/R relay and sends power to the PA transistor bias circuit, IC-1. C9 is used to slow down the turn off time, so the relay doesn't chatter between short pauses in speech and syllables.

If you build the amplifier into an existing rig, it is possible to eliminate the T/R relay and control circuits. However, if the rig uses diode T/R switching, make sure that circuit can handle 10 Watts.

Construction

The amplifier is built on a 2-in. x 3.5-in. piece of double-sided copper clad board. The photo will give you a good idea how it goes together and the mechanical drawing shows the specific detail.

Start by making a copy of the mechanical drawing showing the layout of the "Islands" to be cut on the copper board. Use some double sided tape to hold the layout to the board. First, mark the location of the drill holes, using a sharp pointed center punch like tool. Then, using a metal straight edge and a sharp hobby knife, cut along the lines marking the outline of the component pad "islands". Don't try to cut all the way through the copper at this time, just score a line that you can see in the copper.

Once all the cuts are marked in the copper, remove the paper template. At this time it is best to drill the required holes. On the bottom of the board, be sure to remember to counter sink the holes for the transistor connections to remove the copper around the holes. Now, go over the cut lines you marked in the copper foil to isolate the pad islands from the surrounding copper foil. This is best done by making a "V" cut, angling the knife to one side, then to the other, making a 1/32-in. to 1/16-in. gap around the island.

Once the island pads have been cut, check with an Ohmmeter to make sure they are indeed isolated from the surrounding copper foil. Shear off the end of the board where the T/R circuit parts will go, using tin snips or by scoring a deep cut on both sides of the board and snapping off the end. It the board is to be mounted in an ALTIODS® tin, also snip off the corners of the board.

Making the transformers

The input transformer, T1 is easy enough to make. The secondary that connects to the PA transistor base is a single turn, center tapped. Scrape away the enamel insulation at the center of a 1-in. piece of #24 magnet wire. Attach a short "pig tail" at that point. Bend the wire into a hairpin and insert the wire into the balun core.

T2 is a little more complicated. The ideal way to make the primary turn is with some small diameter (1/8-in. OD) brass tubing (which can be found at Hobby stores). End caps are made from small scraps of single sided copper clad board. Drill two 1/8-in. diameter holes on 7/32-in. centers. Pass the tubing through the core, then the holes in the pieces of PC board (one at each end of the core) and solder it to the copper foil. Start with pieces of board much larger then needed, then trim them down to size. The center tap end will be the connection between the two brass tubes made by one of the PC boards. Cut a gap cut in the copper foil between the tubes on the side going to the transistor collectors. The secondary is wound through the brass tubing.

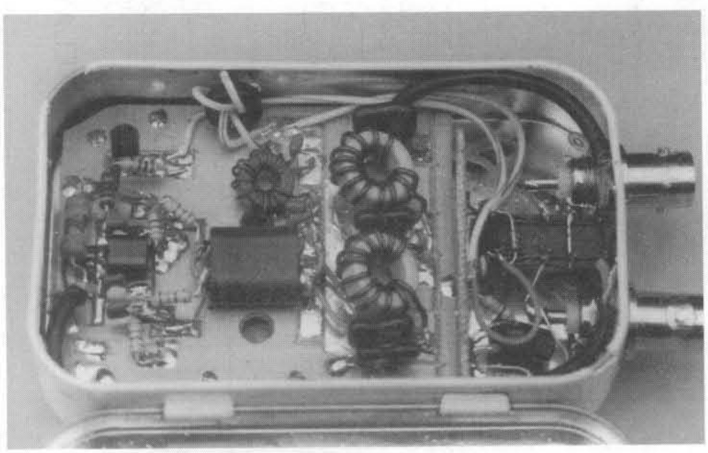
A second method to fabricate T2 is to use the shield from some RG-6 coax. If you're lazy, you can just compress the braid and loop it through the holes in the core. A better way is to insert the braid without collapsing it so you can wind the secondary through the center of the braid. Use a small round tool to push the braid up against the inside walls of the core. Flair the ends sticking out of the core slightly and tin, then trim back so there's just a little sticking out of the ends of the core. Use short pieces of bus wire to jumper over to the PA collector pads.

Once the transformers are made, you can start soldering the parts onto the board, using the parts placement layout for a guide. Don't solder the PA transistors onto the main board yet. I don't show the mounting of the parts in the T/R section because it was too hard to draw clearly. The circuit is simple enough you should be able to figure it out on your own.

Mounting the board in an ALTIODS® tin

Two BNC connectors are mounted on one end of the tin. These are on 1-in. centers, 1/4-in. from the bottom of the tin. Be sure to space the connectors from the centerline of the tin, or they will end up too close to the corner curves.

The tin by itself doesn't have enough mass to be a good heat sink for the transistors, so some extra metal needs to be added. I cut a piece of 0.062 aluminum to the outline of the tin and bolted it to the bottom of the tin on the outside.



View of the amplifier mounted in an ALTOIDS tin.

I "punched" a hole in the bottom of the tin, using a flat blade screwdriver as a chisel, so that the transistors would mount directly to the aluminum heat sink. In retrospect, this was a pain. It would be simpler to remove the paint from the bottom of the tin in the area of the transistors and use heat sink compound between the bottom of the tin and the heat sink.

Locate the transistor mounting holes by placing the board into the tin, push it up against the end of the tin, opposite the RF connectors and use the transistor mounting screw access holes to mark the screw hole locations in the bottom of the tin.

The PA transistors mount between the bottom of the board and heat sink. The holes in the board allow access to the mounting screws so they can be tightened. However, they are not large enough to pass the head of the screw. It's best to mount the transistors to the heat sink first, bend the leads up and then place the board over them and solder the leads.

The transistors MUST be insulated from the tin and heat sink. Use a suitable TO-220 insulator and either a nylon screw or a nylon shoulder washer and metal screw to secure the transistors. Also, don't forget the heat sink compound.

Mounting T/R relay and T/R board

The T/R relay mounts between the two BNC jacks and is simply wired into place, using solid #24 wire. The coil ground is simply soldered to the bottom of the tin, using a short jumper wire.

The T/R board is mounted at right angels to the main amplifier board. The back side of the board is tack soldered to the end of the main board for support and tack soldered to the bottom of the tin for additional support and the ground connection. It's a tight fit and the all the components and connecting wires should already be mounted before permanently installing the board.

RF input and output connections from the T/R relay to the amplifier in and out should be made with RG-174 coax.

Power-up and test

First, use an Ohmmeter to ensure there aren't any shorts from the plus supply to ground. Since there is no reverse polarity protection, ensure proper connection to your power supply. The supply ideally should be a current limited supply, capable of 2 Amps at 13.8 Volts. If a current limited supply isn't available, put a fuse in-line.

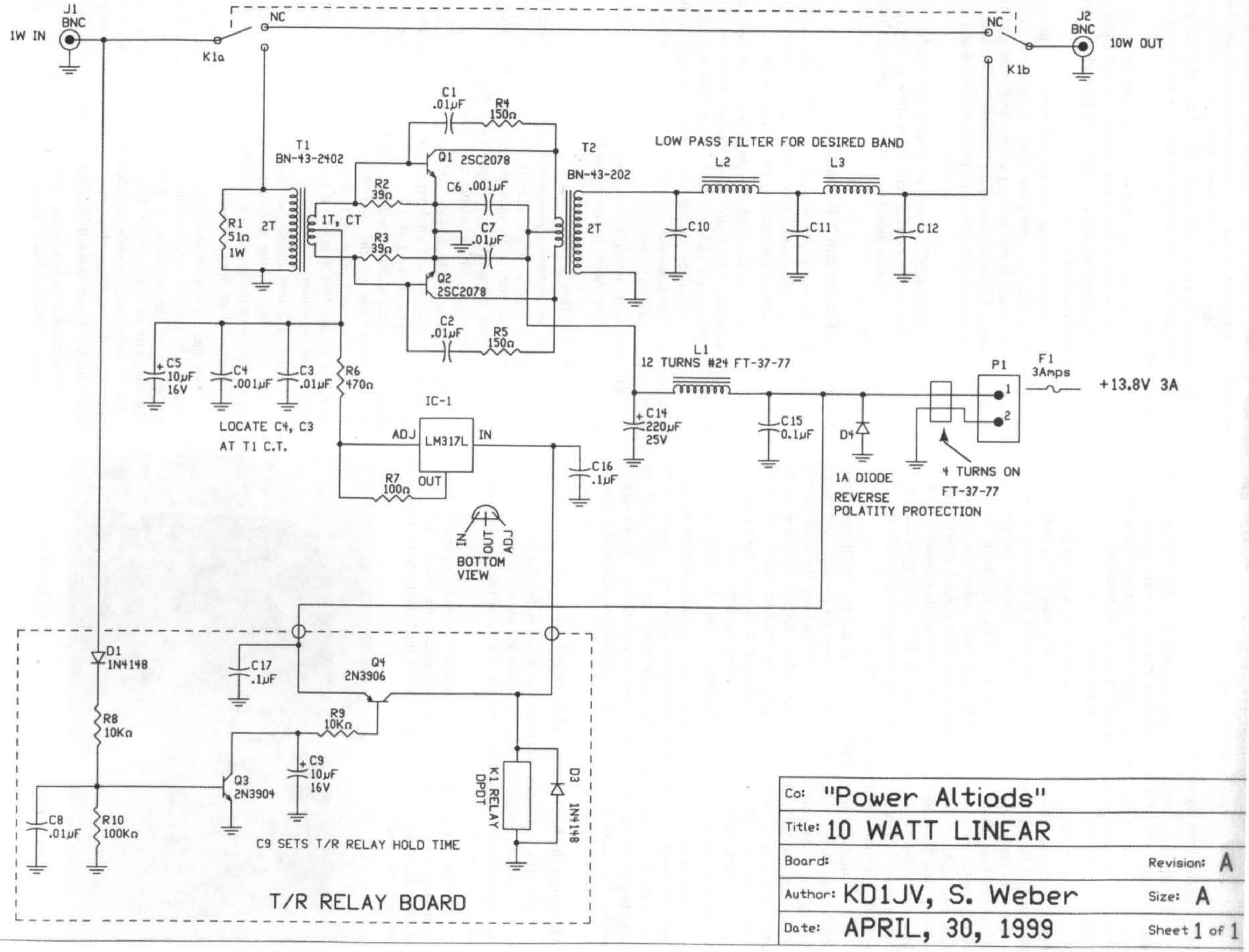
The first thing to check is the DC bias current. Put an Ammeter in series with the supply and amplifier. Disconnect the wire from the T/R relay to the input of the LM317L. Apply power. At this point, there should be no current drawn, although the T/R relay will click on for a second. Jumper power to the LM317L and you should see about 15 mA of current. The exact value isn't too critical, but shouldn't be less than 10 mA or greater than 20 mA. If it greatly exceeds 20 mA, then there is probably an oscillation problem.

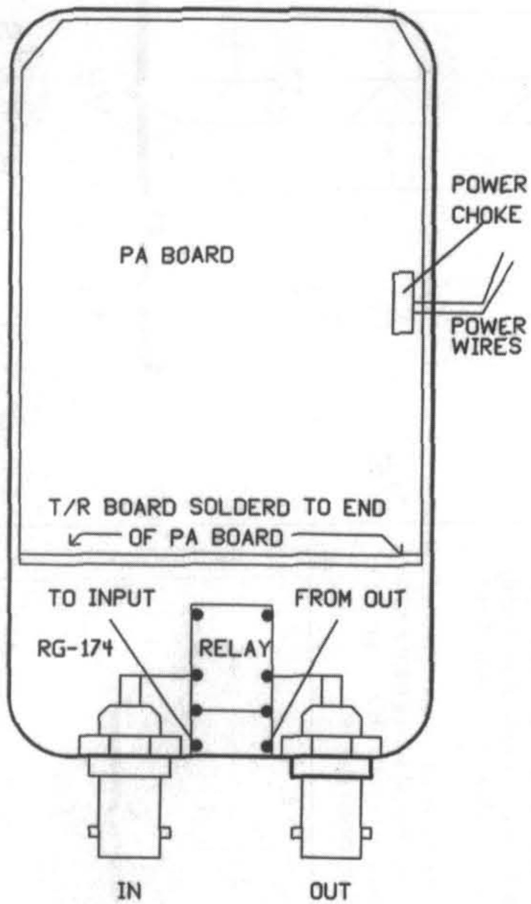
Connect the amplifier to your transmitter, Wattmeter and 50 Ohm dummy load. Ideally, the transmitter should have adjustable power output. Start with the lowest power output available, but in no case put more than one Watt into the amplifier.

Key the transmitter and slowly increase the power out. Almost immediately, the T/R relay should kick in and you should see some power out of the amplifier. If possible monitor the output of the amplifier with an Oscilloscope. The output should be a nice clean sine wave. If the signal becomes distorted at some point when increasing input drive, the amplifier is becoming unstable. Ensure the output power of the amplifier goes to about 10 Watts with one Watt of drive.

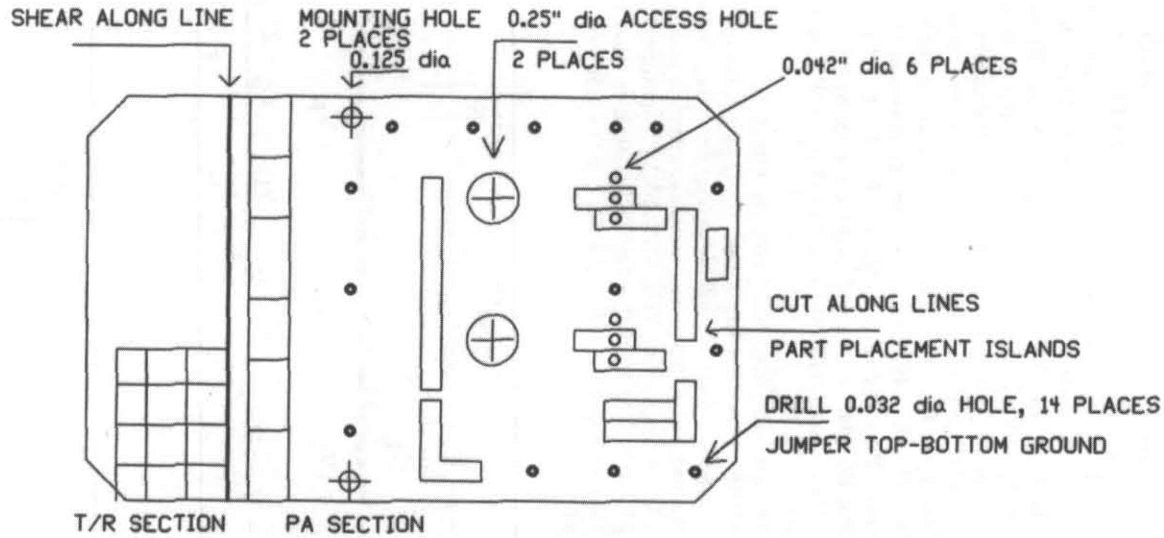
If everything looks good, it's safe to connect up your antenna and try your new "Power Altiods" on the air. Enjoy!

Edited by W1HUE

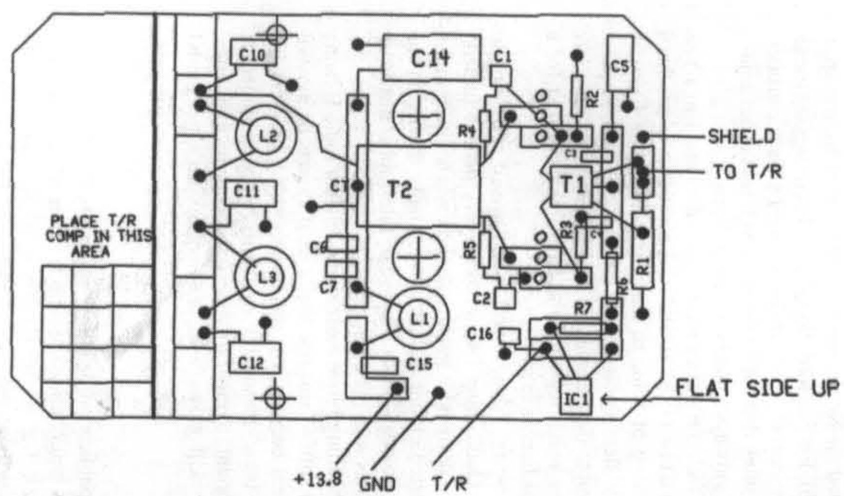

J1
BNC
1W IN
K1a
NC
J2
BNC
10W OUT
K1b
C1
.01µF
R4
150Ω
T1
BN-43-2402
Q1 2SC2078
T2
BN-43-202
LOW PASS FILTER FOR DESIRED BAND
L2
L3
R2
39Ω
C6 .001µF
R1
51Ω
1W
2T
1T, CT
C7
.01µF
R3
39Ω
2T
C10
C11
C12
Q2
2SC2078
C2
.01µF
R5
150Ω
L1
12 TURNS #24 FT-37-77
P1
F1
3Amps
+13.8V 3A
C5
10µF
16V
C4
.001µF
C3
.01µF
R6
470Ω
IC-1
C14
220µF
25V
C15
0.1µF
D4
LOCATE C4, C3
AT T1 C.T.
ADJ
LM317L
IN
OUT
R7
100Ω
C16
.1µF
1A DIODE
REVERSE
POLATITY PROTECTION
4 TURNS ON
FT-37-77
IN
OUT
ADJ
BOTTOM
VIEW
D1
1N4148
C17
.1µF
Q4
2N3906
R8
10KΩ
R9
10KΩ
C9
10µF
16V
K1 RELAY
DPDT
D3
1N4148
Q3
2N3904
C8
.01µF
R10
100KΩ
C9 SETS T/R RELAY HOLD TIME
T/R RELAY BOARD
Co: "Power Altiods"
Title: 10 WATT LINEAR
Board:
Revision: A
Author: KD1JV, S. Weber
Size: A
Date: APRIL, 30, 1999
Sheet 1 of 1



FIANL ASS'Y IN TIN



PAD ISLAND TEMPLATE



PARTS PLACEMENT GUIDE

MECHANICAL DRAWINGS
POWER ALTIODS KD1JV

DRAWN WITH CIRCAD DEMO
HOLOPHASE.COM

QRV?

Michael C Boatright, KO4WX
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email: ko4wx@mindspring.com

Ever since I started the North Georgia QRP Club website (http://www.qsl.net/~nogaqrp), Jim Stafford, W4QO, has been bugging me to write a column for "beginners." Personally, I hope I always consider myself a "beginner." I think that one of the greatest things about amateur radio is that there's always something new to learn.

Now, I might as well start off by letting you know that I'm a Yellow Jacket—GA Tech Class of '82 (BSICS). I must also admit that I learned absolutely *nothing* of value to amateur radio while I was at Tech. In fact, I nearly slept through EM Physics (you know, point charges in space, isotropic dipoles and stuff like that) my sophomore year—something I very much regretted the day I took my first (of a couple) Advanced Class license exam.

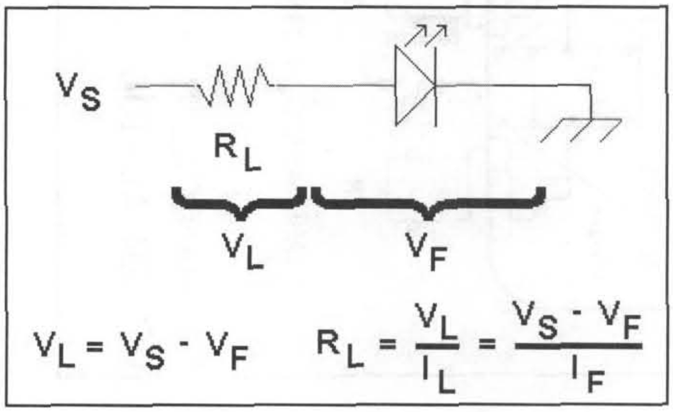
Fast forward 20 years. Man, have I found myself struggling to catch up sometimes! Good thing I have some very patient Elmers! But time and again, I have found it most rewarding when sitting in my shack, partially completed circuit in hand, it suddenly dawns on me about how a particular theory works. I'm one of those folks that learn as much with my hands as with my eyes.

Above all else, the thing I love most about amateur radio is being able to build your own stuff. I imagine that's what attracts us most of us to QRP. QRP's great because it is well within the abilities of the average ham to "home brew" reasonably well performing equipment at QRP levels. It's important, though, to understand your own abilities, and to remember that skill grows with practice. So, let's get ready! Time to QRV!

This Issue's Project

With publication deadlines and such, this issue's column is being written around the time of the Tuna Tin 2 Black Cat event (Halloween). My 11-year old daughter found the mask in this photo for dear old Dad to wear as he escorted her for trick-or-treating in the neighborhood. Not one to leave things well enough alone, I decided it would be fun to put some super-bright LED's inside the mask to make it look really eerie. Sounds like a great application for Ohm's Law!

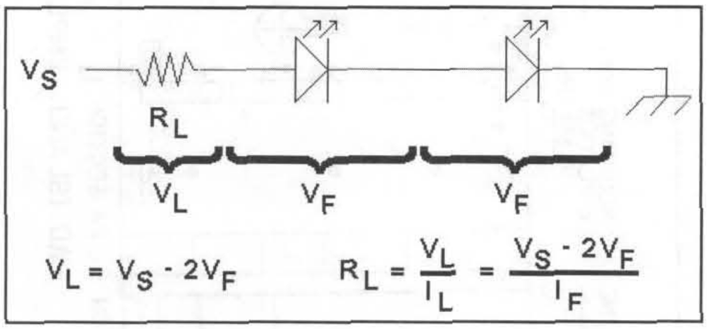
Here's how it goes. The radioshack.com catalog shows a circuit similar to this one and then shows some typical values for the *series limiting resistor*, RL. Problem is, I wanted to use 6 LED's—how do I wire them up and what value of limiting resistor do I use?

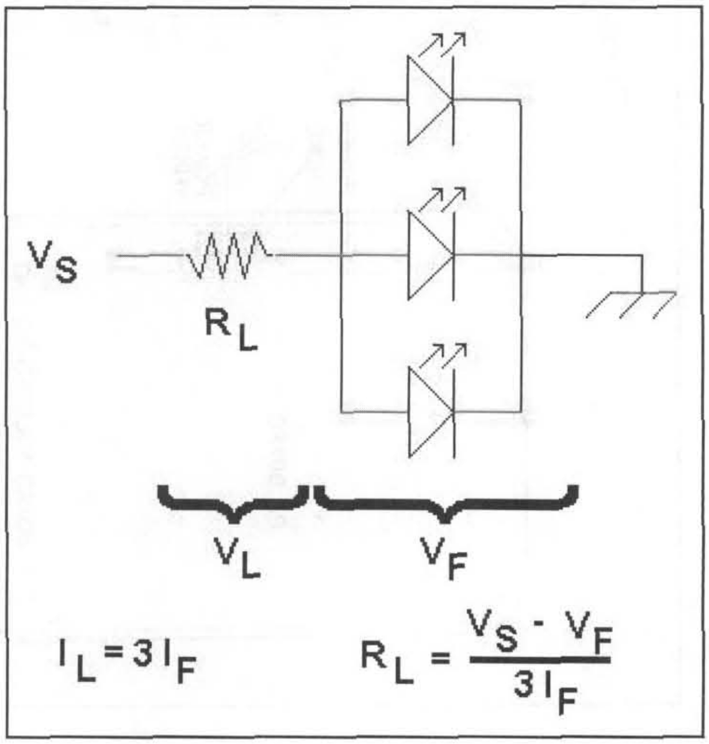


The basic application of Ohm's Law says, **E = I * R**, or put another way, a certain amount of current (**I**) will flow through a resistor (**R**) and the source voltage will drop by a certain amount (**E**).

According to the catalog, the Super-Bright LED (900-6114) that I chose requires 2.1V at 20mA (milliamperes) to operate. Let's say I have a 12V gel cell I want to use to light the LED. What's the value of RL? Well, if the LED drops the voltage by 2.1V, then RL must drop the voltage by 9.9V, since the two devices must drop the source voltage VS to ground. Also, since they are in series, the same current must flow through both devices, that is IL (resistor current) = IF (LED current). Rearranging Ohm's Law, we can easily calculate that RL = VL / IL = (VS – VF) / IF = 495 Ohms. Another application of Ohm's Law is that power (**P**) is dissipated (as heat) by **P = I * E**. 20mA flowing through the 495 Ohm resistor will drop the voltage by 9.9V and dissipate 0.198Watts, so a standard value, 510 Ohm, ¼ Watt resistor will work just fine!

Now, here's the tricky part! You might think that if you put two LED's in series, you'd cut RL in half, right? Well, not quite. Two LED's in series are going to combine to drop the voltage by twice the amount that one will, so the resistor now has to drop the source voltage VS according to the formula VL = VS – 2 * VF. Substituting this for VL and RL = (VS – 2 * VF) / IF = 7.8/.020 = 390 0hms. How big does the 390 Ohm resistor have to be? P = 7.8 * .020 = .156, so a ¼ Watt resistor will do nicely.





OK, time for the big leap! What if we were to replace each of the individual LED's with three LED's in parallel? If we can do this, we get the six LED's we wanted in the first place.

In this circuit, w find that since each LED must carry 20mA, three combined in parallel must carry three times the current as just a single LED. But, just as when there were only two LED's in series, the same amount of current that passes through the first set of LED's, passes through the second set of LED's. Therefore, the total current that passes through RL is three times the current passing through just one LED. Think this through and you will see that RL = (VS – 2 * VF) / 3 * IF = 7.8/.060 = 130 Ohms. The power dissipated is .468 Watts, so use a ½ Watt resistor.

This is similar to the circuit I used for my Halloween mask. I made a slight adjustment to account for the fact that when fully charged, my gel cell is at 13.5V (I used a 160 Ohm ½ Watt resistor which provides a safe current limit for up to 13.8V—the standard supply in my shack).

What good is this to QRP you might ask? Well, first of all, you'll find that no matter what you do, you can't get away from Ohm's Law. Secondly, go ahead and build this circuit—if nothing else, it's great practice hooking up components and soldering--practice builds your confidence for tougher circuits. Try different LED's (Radio Shack stores carry a good selection) and calculate the new value for the limiting resistor.

Also, this little circuit will put out quite a bit of light, for only 60 mA of current—quite useful for operating at night in the field. Construct it in a box with a small battery (gel cell, NiCad's, dry cells, etc.) along with a NoGaPiG (see the NOGA QRP website) and you are QRV!

72 de Mike, KO4WX

(Editors note: Mike Boatright, KO4WX is the District Emergency Coordinator to the Georgia EMA (GA Section ARES). He is an active member of the North Georgia QRP Club, and is webmaster of the NOGA QRP Club website (http://www.qsl.net/nogaqrp). He is an Extra Class operator and was first licensed as KD4BDE in 1991. His passion is QRP and in particular, homebrew construction. He can be reached at ko4wx@mindspring.com.)

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Direct Solar Powered Radio Operating
Part Two: Switching Regulators

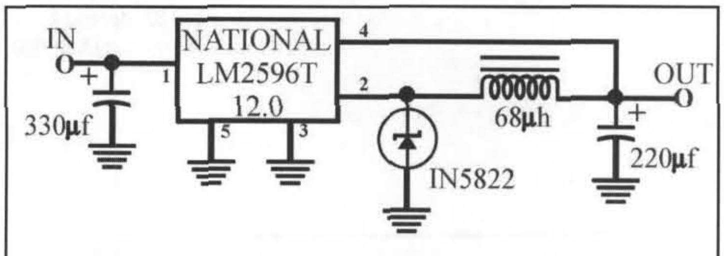
Wes Spence, AC5K   email: AC5K@ih2000.net

My first article on direct solar power appeared in the October '99 issue of *QRP Quarterly*. In that article, I stated that I was working on a better (i.e. more efficient) regulator. This article reports the results of that effort. Let me say up front that this regulator works well, but please consider it work in progress. It is not perfect, but it should serve as a starting point for further improvements and modifications.

Zack, W1VT, first put me on to the line of switching regulators that are produced by National Semiconductor. Their main advantage over the simple regulator from part one of this article is efficiency. The regulator featured here is 90 percent efficient! This project is based on work done by National Semiconductor and available to all via their great web site at: www.national.com/apnotes/SimpleSwitcher.html. The PDF file from National on the chip I used in this regulator is 29 pages long and even has a suggested layout for the printed circuit board. There's tons of information on their web site, even design software for switching regulators that can be downloaded for free.

The Regulator:

As you can see by the schematic, National had a good reason to



SWITCHING REGULATOR

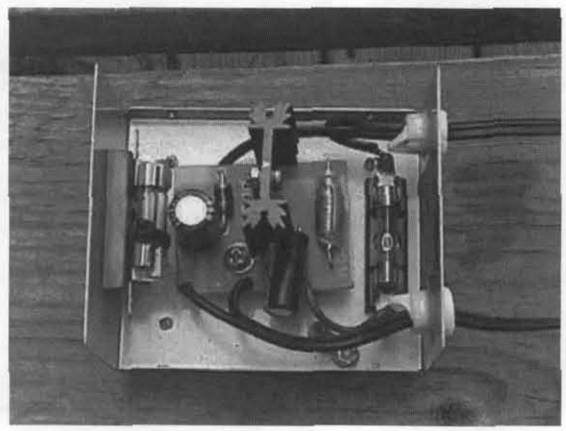
call these "Simple Switchers". Just the chip plus four discrete components and you are in business! There are ICs available for 3.3, 5, 12 Volts, and one that is adjustable. I choose the 12 Volt version as that is the voltage most of my ham gear runs off of. These ICs are good for up to three Amps and contain current limit and thermal shutdown circuits internally. If you follow through the instructions in the application notes that National publishes, they go into detail on choosing correct components to go with the regulators. I followed their advice only up to a point and then bought the closest values I could find from Mouser. (I did not want to special order anything.) The two electrolytic capacitors are supposed to be low ESR (equivalent series resistance) type, which I did. They also specify the coils be from one of their suggested vendors which I did not do. I have no problem following a good design; I just wanted to try this type regulator out before investing extra money in special order components. My concerns were how these regulator ICs would behave while operating in an RF environment and whether they would generate excessive noise (since they operate at 150 kHz). It is to the credit of National Semiconductor that no major problems were found at QRP levels of power. The photo is my regulator built on a printed circuit board made to National's design. They stated that the layout was somewhat critical for isolation purposes. My heat sink (liberated from a junked TV) was overkill. That makes sense, as efficient regulators should not make excessive heat.

The price I paid for using more common components and not finding the exact values the design called for is that this regulator has an output of ~11.5 Volts instead of 12. This was my fault, and I expected some degradation due to the components used. The regulator is very steady at 11.5 Volts though. It is tough to regulate a CW signal that is using direct solar power, and this circuit does a great job. My test set-up was to use the regulator with my 55-Watt panel in full sun. I used my mobile antenna mounted on the car and operated beside the car to purposely place the regulator in an RF environment to see how it acted. I tried the 20, 15 and 10-meter bands. On 10-meters the regulated voltage went up a little when the radio was keyed, but that was the only band I noticed any change at all on during transmit. As far as noise generated by the regulator on receive, I did notice that the 'noise floor' came up some on both rigs I tried. The noise was not enough to cover any usable signals except in a few spots on the band where the noise seemed to peak. Shielding the regulator in a metal box and adding capacitors did not seem to help. The noise seems to increase with the load placed on the regulator, but never to a point that I felt it was a problem. I used a SWL DSW-20 and a Ten-Tec Argosy 1 as test rigs. I made many contacts with this set-up, and worked the CA QSO party with it. I also asked for reports of any impurity on my transmit tone, and no one reported any problem there. I also tried the regulator with a hand-cranked generator taken from a ship lifeboat emergency radio. It again worked great.

The Future:

I really feel that these regulators are going to be useful tools for many applications within our hobby since an amazing percentage of QRPers seem to also be interested in alternative energy. I am anxious to hear from others who build this regulator and do use the proper components. If I had it to do again, I would build the variable regulator and set it for about 13 Volts. My Argosy would only put out four Watts at 11.5 Volts. Look at National's web site—the regulator in this article is a "buck" type regulator because it regulates down. National also makes "boost" type regulators that *increase* output voltage (at decreased Amperage of course). Boost regulators could be used to make those 6-Volt bicycle type generators work to power 12-Volt rigs! The opportunities are endless. My hope is for others to carry this work forward. There is opportunity for someone to conduct a group buy of components or sell kits once the ultimate design is found. Please keep us all informed of your results with these great new regulators! Homebrew Power Rules!

72, Wes Spence, AC5K



Wire / Rope Antennas

Joel Denison, KE1LA *PO Box 542, Strong, ME 04983* *email: hamjoel@juno.com*

Hello to the QRP community – my name is Joel and I was licensed in 1962 and currently hold an advanced license. I was born and raised in Louisiana and moved to Maine in 1993. My hobby is playing with antennas. I am using wire/rope construction and so far I have fared better than the trees.

The last few years I have been playing with two and three element wire Yagies. For the antennas, I use the formula

Driven Element Length = 468 / F

where the element length is in feet and F is in MHz. For the Reflector and director I use the good old 6% formulas:

Director Element Length = (468 / F) x 0.94

Reflector Element Length = (468 / F) x 1.06

The spacing formula is

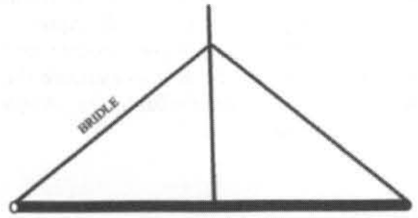
Spacing in feet = 984 / F x desired spacing (0.1, 0.15 or 0.2 wavelength spacing)

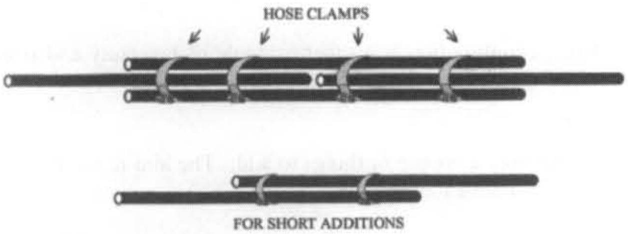
I use wooden dowel rods that are 14ft or longer and 1-1/8in. to 1-1/4in. in diameter and light, made from fir. The prices up here in Maine are about ninety cents per foot—the larger the dowel the more the cost. I have also used the wood dowels that are used for handrails ($1.90 per foot); they are heavier and stronger.

I use braided nylon rope rated from 70 working lb. load to 120 working lb. load. Let's hear it for Wal-Mart… I haven't had any rope breaks but have had a tree or two lose a branch or fall on the house—that's another story I call "When Snap Crackle and Pop Come to Visit".

If I'm going to use more than one dowel I cut some short pieces of dowel (about two feet long) and place them along side the two pieces I'm going to use (I butt the two pieces I plan to use together and lay the short ones overlapping the connection) Then I hose clamp it all together using four hose clamps, one on either side of the connection and one at each end of the short pieces.

To hang the dowel I use a bridle made of rope. I attach one piece of rope to the center of the dowel or dowels and measure off about five feet. I then attach a rope to the ends of the dowels and while holding the 5ft. piece of rope in the center tight, I attach the other two ropes to the center rope securely while the dowel is straight and all ropes taut. Like this, it'll hang like a felon! Add more rope where you add elements or obviously need support. The whole arrangement is shown below.





Hanging your rope in the trees can be a community activity—the community comes by and watches. I use a rod and reel and it works fine for me. I am also using a pulley tied to the end of one rope and pulled up into the tree—less wear and tear on the rope as I raise and lower my antenna.

Let's start simple; two elements, one driven, the other a director at 0.1 wavelength spacing will get you about 5 dB of gain and is simple, simple. On forty meters 14ft will be 0.1 wavelength and on twenty about seven feet will be 0.1 wavelength; a small price for 5 dB of gain. With three elements you will need to put the director about 0.15 wavelength from the driven and the reflector about 0.2 wavelength in back of the driven element.

My particular favorite is the three element Yagi at 0.2 wavelength spacing for both the director and the reflector, giving somewhere around 7 to 9 dB gain. That's a dowel with only a total length of 28ft on twenty meters. Two fourteen-foot dowels butted together works fine.

I guess I should note that the two element Yagi will give you a good match to 52 Ohm coax but with the three element Yagi I use my trusty MFJ tuner; of course one could always try a different matching system, I just use the tuner— it's there and it works.

Now let me tell you about my most favorite antenna project in recent memory. I decided on a three-element Yagi for forty meters with 0.2 wavelength spacing. That's a total length of 56 ft. for each side. No problem, ha. I got two fifteen-foot dowels that are used for handrails, diameter is about 1.5 inches, and cut flat on the bottom. I also bought a small four-foot piece of this large dowel and laid the flat part of the dowels together and hosed clamped the sucker, along with some Elmer's carpenter glue...

With these two 15 ft. dowels butted together and overlapped by two feet on either side of the butt, I had a total of thirty feet. A bit short of 56ft. to be sure. I bought two fourteen foot dowels and overlapped them a foot at each end of the large dowels. Let's see, that's 30ft. plus 13ft. plus 13ft., or 56ft., the magic number. I made a rope bridle and tied the rope in the center and at both ends and at each joint. I also made the center rope about eight feet long; that seemed to work better.

I tied the reflector (70ft. 5in.) directly to one end of the dowel with rope and then tied the driven element to the center of the dowel, leaving the end of the element 2 ft. away from the dowel, so the center of the elements would be in the same line. And then I tied the director to the other end of the dowel leaving four feet of spacing to center it with the other elements...

As I was short on money I only used two 14 ft. 1-1/8 in. dowels on the other side and tied a rope from the end of the dowel to a nearby tree. Rope doesn't hold the elements as good as dowels but it is affordable and works somewhere in the "good enough" category. As my trees would have it, I had the thing pointed towards Louisiana, the desired direction.

On the way up to the top of the tree the heavy dowel met Murphy and they decided to open a box of Rice Krispies—I heard snap-crackle-pop as the dowel dropped about ten feet. Murphy flew out of the tree in the form of a branch. The dog howled and ran into the open barn door and an angry moose stood looking at me and wearing a tree limb across his antlers.

After I negotiated a truce with the moose, I finished pulling the dowel up the tree and ran the coax to the shack. With one Watt I was working stations giving me 57 reports on SSB. I went down to 0.5 Watts and still got 55 reports on SSB ... even got my thousand miles per Watt award for forty SSB.

If you have the trees, try the wire/rope approach and see how easy and helpful a few extra dB can be.

Edited by W1HUE

Test Topics ... and More

Joe Everhart, N2CX email: n2cx@voicenet.com

When I agreed (with strong urging from the old editor, KU7Y) to do this column it was with some trepidation that no one would notice. But response has been overwhelming! It seems that there is a great interest in testing among QRP'ers and they look to this column to help them learn more about the subject. As you may have noted, testing is a subject near and dear to my heart and has been since my earliest exposure to electronics and amateur radio. In fact even in my occupation as an electronics engineer I always seem to end up building special purpose test gear tailored to whatever job I happen to be assigned. So writing TTAM is fun for me and made even more so by all the positive feedback received!

The e- and snail-mail has contained lots of ideas for both questions to answer and test projects that you'd like to see. You guys have some seriously cool ideas! Please keep them coming. I will answer all mail received (though it may not be immediate due to the volume received!) and seriously consider the gadgets you propose.

Designed for Test

One of the most gratifying letters received was from someone who has been sharing his ideas in ham circles since I first got started - I won't tell you how long ago...

He graciously sent in the following test circuit and description. It is so good that I am reproducing it verbatim. - Thanks, Rock!

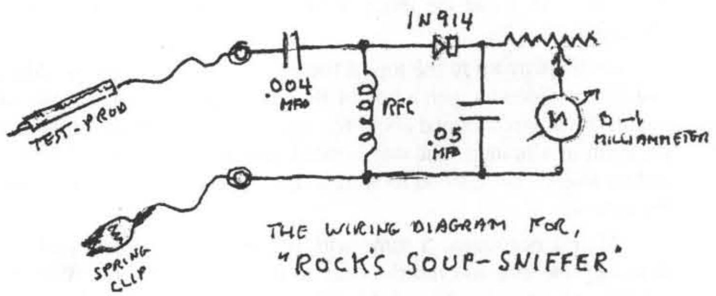
Rock's "Soup-Sniffer"

"It is seldom that most QRP'ers can build a multi-stage, transistorized transmitter (say an oscillator, frequency-doubler, driver, final-amp lineup) and find that it puts-out its desired final output on its first test.

We all, nearly always, have to do some "tweaking" of the various stages before the final-amplifier puts-out the "Soup" we have a right to expect from it.

To simplify this "tweaking" operation, it is very handy to have a device with which you can check the performance of each stage in the rig's lineup. Your "Sniffer" will enable you to roughly estimate the relative RF output of each stage. If one or more stages are not doing their job, the "soup sniffer" will soon tell you so. And if you make-changes in the circuitry, the "sniffer" will also tell you whether your work upon it has made any changes...

With it, you can examine conditions right-up-the-line, and locate



THE WIRING DIAGRAM FOR, "ROCK'S SOUP-SNIFFER"

any difficulty, often almost immediately. Just clip the "ground" lead of the "sniffer" onto any RF-grounded portion of the circuitry, then hold the test-prod onto the circuit-point whose RF voltage value you want to examine. (Use it this way, --very much as you would any other voltmeter.)

Adjust the potentiometer knob until the "Sniffer's" meter reads, say, at about half scale. The go up to the next stage's output and test the "soup" there also. The meter should usually read a substantially-higher value of voltage. If it does not, it indicates that the stage being tested had no RF gain and the problem lies between the first and last tested-points of the circuit. If the meter reads "up scale", ---or the potentiometer's resistance must be increased the keep the meter-pointer on-scale, ---you KNOW that the stage involved is delivering some real output gain, ---or conversely, some loss. (There's no "bunk" here, --- "Sniffer" tells the truth!)

Your writer has built his share of QRP transmitters, ---some which contained problems which this cheap and simple device has been invaluable in locating, ---it has been so helpful in this respect that he can now barely "keep shop" without it! Build one and try it for yourself!

Nothing in the "Sniffer's" circuitry is critical, any part within fifty percent of the specified value will serve! For instance, almost any old "RF choke" coil will work in it (or make your own by winding two hundred turns of almost any "coil-wire" around any two-watt carbon resistor larger than 50K ohms.) If you use a "zero-to-one-ma." meter, a potentiometer resistance of 10K will be best. (If a more-sensitive meter is used, make the "pot" larger, say 25K.) Use some kind of calibrated scale in conjunction with the "pot's" knob. This will help you to make more-careful voltage estimates with the device.

The mechanical arrangement of this device, like everything else about it, is not critical. Use your imaginative taste here. (Got an old cigar-box around? If so, you can use that... "Pretty is as pretty does!")

Sadly, "zero-to-one" DC milliameters are becoming more difficult to find. Visit ham-flea-markets, or see if any of the numerous part-dealers stock these. Maybe some "old timer" you know will have something similar to spare. (If worst comes to worst, and you feel "tough", buy one of these cheap "multimeters" from any auto-supply store and "cadge" the meter out of it! --- If you plan to "home brew" many QRP transmitters, you will soon pay-off the cost involved because as your writer has, you'll find your "Sniffer" invaluable!)

The "Soup Sniffer" is not a precision RF voltmeter and is not intended to be one, ---only the fastidious will require such for the jobs we plan to use it for! However, as you become more-familiar with your instrument, you will soon be able to estimate the voltage-values and "gains" being examined within useful limits. And it will vastly aid you practical understanding of radio."

72/73, Rock
C.F. Rockey, Box 171
Albany, WI 53502

Rock's contribution is a super example of ingenuity and intelligent use of simple, practical ideas that I enjoy seeing. I hope you do, too!

I have only a couple of things to add. The aim is not to detract from his ideas but to augment them.

1. You can increase sensitivity slightly for low-level signals by replacing the 1N914 diode with either a 1N34 germanium diode or a 1N5711 hot carrier device.

2. For the RFC you can use one of the Radio Shack 273-102 100 uH chokes if you can't locate one of the getting-harder-to-find-these-days 2 watt carbon composition resistors.

3. Another source for analog meters is defunct CB radios that are a goldmine of RF parts. I often find junkers for $2 or less at flea markets.

Stimulus and Response

Man, there were too many good questions to deal with this time around to get to them all. I will eventually get to them but here's one that gives a good opportunity to don my professor's cap...

Bill, K5ZTY queries: "*I have an audio signal generator that has a calibrated output measured in dBm. The three dials will give me from -42 to +10 dBm. When I put the signal into a circuit and measure the output on my oscilloscope the scope reads to me in volts per division. How do I transpose dBm to volts or vise versa*?"

Good question! I'll give a direct answer to the question now and save some of the finer points for a future segment. Of course you *can* read up on it now in the ARRL "Radio Amateur's Handbook".

Audio circuits and generators use standardized impedance of 600 ohms (and RF applications use 50 ohms - just why is one of the future finer points.) As with RF, audio power is expressed relative to 0 dBm (zero dB milliwatts), or 1 milliwatt. A little math gives the equivalent rms voltage (dang - more deferred explanation). Power is expressed by the formula P = V*V/R, or power equals voltage squared divided by resistance. This can be rearranged to give voltage knowing power and resistance or V = SQR(P*R) or voltage equals the square root of power multiplied by resistance. Plugging in a power of 1 milliwatt and 600 ohms, we get an RMS voltage of .775 volts. And a little more math (see the Handbook) gives us a peak-to-peak voltage of 2.19 V. This is actually what you would see on the 'scope!

Now check the table and you can see that 0 dBm is 1 mw of power which corresponds to the RMS and peak-to-peak voltages just described. The table lists how dBm values of 0 to -20 are related to power and both RMS and p-p voltages. For dBm numbers above or below those in the table, just remember that +10 dB multiplies power by 10 (also multiplies voltage by 3.16) and -10 dB divides power by 10 (and divides voltage by 3.16). Similarly a +20 dB change multiplies voltage by 10 (or power by 100) and -20 dB divides voltage by 10 (and, of course divides power by 100). To handle powers larger or smaller than those in the table, apply the above factors.

On the other hand you just *may* find it easier to avoid math every time you make a measurement. Examine the entries above to get the hang of the pattern and you can make up your own table that extends up to, say +30 dBm and down to -40 dBm. Then you can simply look up whatever value you want without resorting to a calculator.

Phil, VE3AXL asks: "*Where can I look for stranded small gauge insulated wire? Must not have insulation that melts easily.*"

Phil, most common hookup wire has PVC insulation. Its rather low melting point makes it sometimes creep back or even peel off when the wire is soldered. I prefer either of two types of insulation with much better results in soldering. One solution is so-called "irradiated PVC" insulation. It has been treated to increase cross-linking so that it stands up to the heat of soldering much better. The ultimate wire insulation is Teflon (tm). Teflon is what those expensive military projects use!

Both types of insulated wire are available from commercial suppliers such as Mouser. However, they are several times the cost of ordinary PVC! My usual source of Teflon-insulated wire is the mail-order electronics surplus dealers. The "good" stuff from them is still more expensive than ordinary PVC but much more reasonable than from the "new" distributors. Still another option is to keep your eye out on the QRP-L email reflector. One fellow who periodically sells Teflon wire quite inexpensively is Jim N2GO. Contact him at ***jskalski@localnet.com*** for details.

Coming to Terms

Sorry but I have been so loquacious (look it up) this time around there is no room for CTT. Stay tuned because next time the topic is an important one - calibration vs accuracy.

Well I guess that's enough for now. Please keep those questions and comments coming in. It's like Radio Sha__ says - you got questions, I got errr... you know the rest!

72/73, Joe E., N2CX
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Table I
Audio Power vs dBm and Volts

dBm	PWR	Vrms	Vpp
0	1 mw	.775v	2.19v
-1	.794	.690	1.95
-2	.631	.615	1.74
-3	.501	.548	1.55
-4	.398	.489	1.38
-5	.316	.436	1.23
-6	.251	.388	1.10
-7	.200	.346	.979
-8	.158	.308	.872
-9	.126	.275	.777
-10	.100	.245	.693
-11	.0794	.218	.617
-12	.0631	.195	.550
-13	.0501	.173	.490
-14	.0398	.155	.437
-15	.0316	.138	.390
-16	.0251	.123	.347
-17	.0200	.109	.309
-18	.0158	.0975	.276
-19	.0126	.0869	.246
-20	.0100	.0775	.219

PICking It Up

Bruce Muscolino, W6TOY/3 *email: w6toy@erols.com*

Do you remember the 70s? Do you remember the first microprocessors, the 4040, and the 8080? Do you remember the articles in Popular Electronics and other magazines on building your own computer? Do you remember Kilobaud, and Byte? Did you wish you had built your own computer…

The PIC microcontroller is a lot like those early microprocessors, a lot like them and even more! The PIC is a complete microcontroller on a chip. A microcomputer, but with a useable internal memory, and a machine with an instruction set tailored for controlling other devices. Simple, to be sure, but a microprocessor capable of working right away it is! Contained in one chip are all the support chips, the memory, and the processor, ready for you to apply! Now, for some like me, who were too afraid or confused by the 70s, it is available to learn and use.

But, where do you go for the lessons? You could take a night class, or even a day class at some universities, but they require you follow a pretty rigid schedule. You could buy one of the many development kits on the market, but that requires an investment of several hundred dollars for most, and you don't have an instructor right at your elbow to help out.

Try PICTutor! PICTutor is a CD-ROM tutorial with an optional printed circuit development board.

The CD-ROM teaches you about the PIC and how to program it in a down to earth way, and the Printed Circuit board can be used as a learning tool and a development tool. The PIC Tutor system aims to provide a "comprehensive hardware and software bundle" that helps users understand the PIC from the very basics of the PIC and start development projects without any previous experience with microcontrollers.

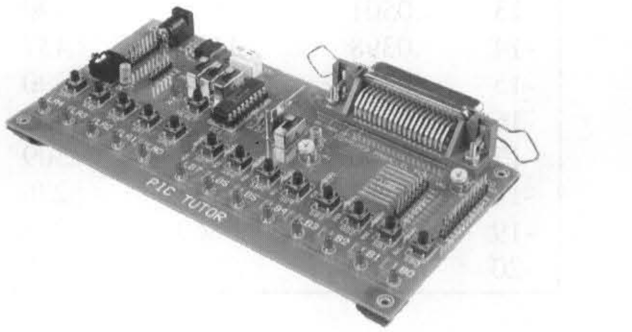
What is a PIC?

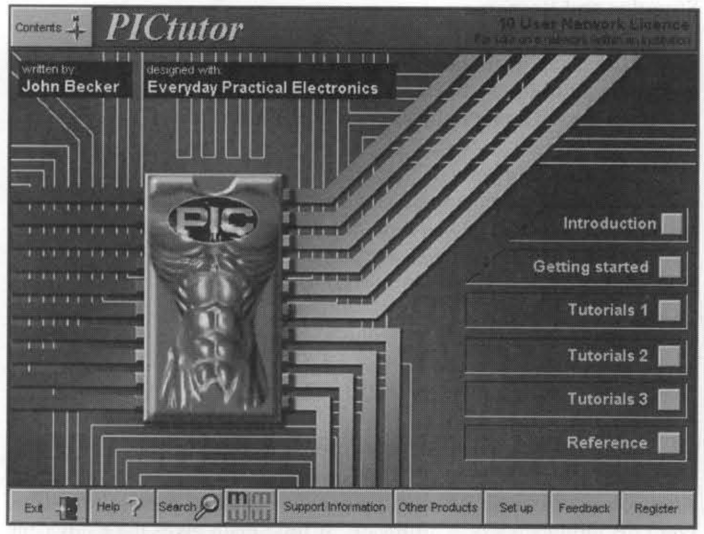
A PIC microcontroller. A microcontroller is very similar to what we know as a microprocessor, but it does not require a support chip set. It already contains it's own memories for program commands and data storage, bi-directional (input/output) ports and clock oscillator. In short, it only needs a battery and an application!

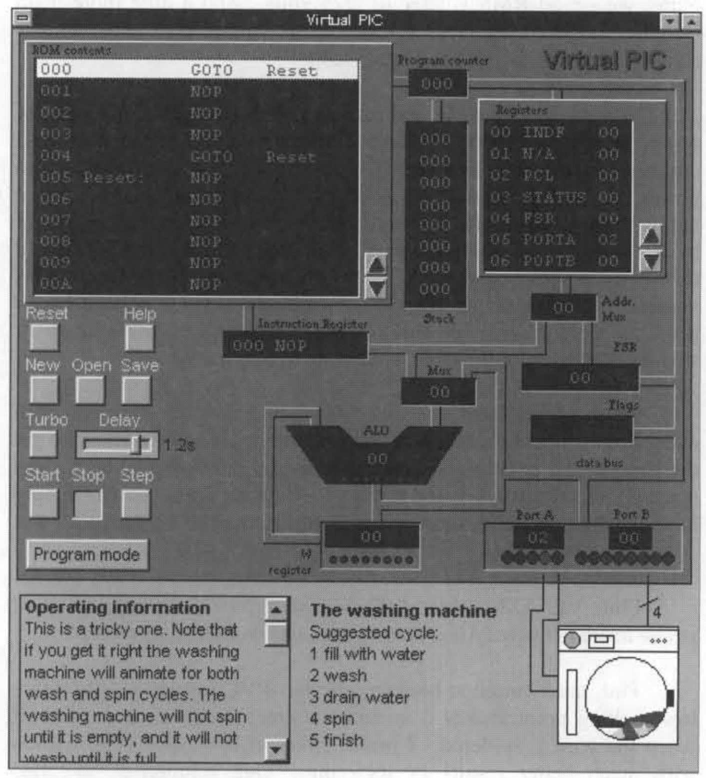
PIC microcontrollers can be programmed to perform many functions that would require a microprocessor and peripheral chips. But, PICs cost quite a bit less, and they are small and easy to use. This simplifies electronic circuit designs and allows functions to be performed in a single chip that would have required a microprocessor and peripheral chips.

PICs are available in two major types, those that can only be programmed once and those that can be re-programmed. There are two types of programmable PICs, those that can be programmed only using ultraviolet light and those that can be electrically reprogrammed.

The PIC Tutor course is organized around the 16C84 (or 16F81) types. Once you have mastered programming and applying this chip, you should have little difficulty with other types. The printed circuit breadboard can use either type.







The PIC Tutor Course

The course consists of 5 (five) sections. Each section includes a number of lessons.

Section 1 - The Introduction, (Getting Started). What a PIC is, what it does, and how to use it.

Section 2 - Tutorials 1 through 14, The basics, using the Virtual PIC and the development board. Familiarizes you with the TASM and Assembler programs, downloading programs to the PIC, binary expressions, basic PIC commands, input/output ports, flags, loops, and control structures. In other words, the basic elements of programming. These tutorials can be used with either the Virtual PIC or the development board.

Section 3 - Tutorials 15 through 29. More advanced PIC commands. Audio tone generation, subroutines, tables, indirect addressing, timers, using 7-segment displays, and simple clocks. Again, these may be run with both the Virtual PIC and the development board. The deluxe board is used for display operation or the Virtual PIC may be used.

Section 4 - Tutorials 30 through 39. Really advanced Pick programming! LCD displays, 24-hour clock program, burglar alarm, watchdog timer, interrupts, and the sleep mode. The Advanced development board is required to run these tutorials.

Section 5 - Reference materials. PIC specifications, useful addresses, and a summary of op-codes.

Learning is an iterative process. By reading and rereading the material, and applying it, understanding occurs. If a point is not well understood, try reading it and maybe the preceding sections. If you still find it difficult, move on and come back. Often reading the next section will clarify the material.

Virtual PIC

While it is necessary to have the assembler and 'send' programs, and the printed circuit development board to program and use an actual PIC, much of the learning can be done with the on-screen PIC emulation program Virtual PIC. Virtual PIC allows you to explore programming and look at the program and its actions on the CPU screen before you actually program the real PIC.

PIC Programming

There are several items needed to successfully program a PIC:

- A PC compatible computer
- A standard Centronics type parallel printer port
- A PC board into which the PIC may be plugged
- A power supply of between +12 and +14 VDC
- The PIC program and a "send" program

The PIC Tutor CD-ROM supplies the last three items. It is presumed you already have a printer, and example source software data to be loaded into the PIC is provided on the CD-ROM. The PC that you use for the course will be more than adequate for programming the PIC; neither speed not memory size is a requirement.

The SOURCE code must be written in PURE ASCII. This point is very important, for illegal characters appearing in the code will cause errors. The only requirement for the PC is it must either have the MS DOS EDIT program or use WORDPAD to produce plain ASCII text for the assembler

PIC Software

PIC software is written in four stages. A few words about how to determine which you are looking at and their function are in order.

The first stage, or step, is to write the SOURCE, or ASSEMBLY code. This text file is written using the various PIC commands which instruct the PIC to perform specific actions. This file is named using the .ASM extension.

The ASSEMBLY code is translated into a BINARY file which the PIC will read. The Translation is done by an ASSEMBLY program. The resulting code is known as OBJECT code, and carries the extension .OBJ.

The assembled, or OBJECT code is sent to the PIC by a special SEND program. The SEND program inserts the assembly file into the PIC in the proper order and in the proper place to run.

Once downloaded into the PIC, the code is now ready to be tested. Testing can be accomplished in many ways. This is where the printed circuit board supplied with this course can assist you. Of course, if the PIC does not perform as expected you must rewrite the assembly code and start over.

Rules for good PIC programming

Since about 99% of learning to apply the PIC is learning how to prepare good software, the course tends to dwell on the topic. It tries to teach good programming. Good programming includes:

- A complete understanding of the function of each command.
- Taking proper care when writing code - microcontrollers are very fussy about syntax, order, grammar, and spelling.
- Starting with a detailed flow chart of what you want the PIC to do.
- Organization, breaking your project down into easily manageable tasks
- Writing good comments in your source code and last but not least, protecting yourself by making frequent backups!

Programming is really a combination of following a few rules about spelling and grammar, and a lot of experience. Experience is gained by writing code and making mistakes!

The course examines the commands the writers think you will find most useful for PIC programming in great detail. They hope you will find these commands useful in developing your own applications.

Bruce, W6TOY/3

CQ QRP Correspondance

by Mary, NA6E
na6e@arrl.net

A QRP Expedition to Australia

When my company told me I'd have to attend a business meeting on Australia's Gold Coast, I immediately started thinking about some QRP operation on the side. The Gold Coast is in the extreme southern part of Queensland, on their Pacific Coast about 50 miles south of Brisbane. A search on the web led me to the very helpful site of the Australian Communications Authority (ACA). The site explained that I could either request a temporary "ticket" by mail, or go in-person to an ACA office. As payment in Australian dollars was required, I decided to apply in person at the ACA's Brisbane office. As I still had some questions, I sent an e-mail to the ACA and promptly received a detailed, friendly reply, packed with helpful information (FCC take note!). After presenting myself at the ACA office the morning following my arrival in Brisbane, I found myself with the temporary callsign VK4CSI after a few minutes time.

Prior to the trip, an inquiry on qrp-l netted a humorous, friendly reply from Ian, VK2TIP, the most useful tidbit being a caution against getting into a game of "two-up". Regarding bands to operate, two folks had recommendations. I decided to have a shot at 30M and 40M with my OHR Sprint and NorCal 40A, respectively. I cut a 30M dipole and matched it to 300 ohm twinlead, which is inexpensive and lightweight. A 4:1 balun interfaced the antenna to the Sprint. For 40M I cut a folded monopole and one radial. I took along a spindle of nylon line for supporting the antennas. For power, I intended to use eight alkaline D-cells to be bought on arrival in Australia. I limited myself to eight because OHR cautions against applying more than 14 volts, and new alkaline cells produce 1.65 volts each. And I didn't want to take the batteries aboard the plane.

To make sure that I could show airport security staff what was inside those metal boxes, I took the screws out of the OHR Sprint's cover and held that in place with rubber bands. The NorCa40A of course is easy to open up. Remember that amateur QRP rigs are a lot less common than laptop computers and cell phones. It turned out that at only one stop during the 26 hours of traveling each way did anyone exhibit any curiosity and they didn't feel they needed to see the insides. But once before I'd had to leave a shortwave portable behind because I hadn't put batteries in it and I didn't have the power cord. Luckily, that time there was a friend seeing me off. So I figured it would be better to be safe than sorry.

Besides picking up the D-cells when I arrived in Australia, I also bought an inexpensive spin fishing rod and reel, and some sinkers, to get the antennas up. My first try was on 30M, from a park near the hotel. Got the dipole up and worked an Aussie west of Sydney. I heard a T31 calling, but didn't raise him and then he was snowed under by a horde of JAs. Also, there was a high ambient noise level from traffic on a main road which bordered the park, and the audio from the Sprint isn't too robust. I then went back to my hotel room, fired up on 40M using the monopole upside down, and spaced a bit from the hotel wall using the fishing pole. But there was a good deal of QRN and I was on the south side of the hotel, so I ended up working a few more VKs. I did draw a QRZ from a 9M2.

My Australian counterpart at the meeting was Jules, VK2EXT, and he's a member of the G-QRP club. An inquiry to Danny, K3TKS, netted a few issues of QRP Quarterly that I took along for Jules, asking him to use them to promote QRP. I hope there will be some new members of QRP ARCI from the land down under, as a result!

Oh yes, "two-up". An Australian taxi driver sketched out the history and rules of this game for me. Apparently, it was conceived in the WW-1 trenches by Australian troops. One bets on the appearance of either two heads or two tails when two pennies are tossed. After five occurrences of one head and one tail, the house picks up the pot. It's illegal to offer the game in Australian casinos, although I'm told that the police turn a "blind eye" on Anzac Day.

Cal Cotner K4JSI

The "Houston Hounds"

We are all members of the Northwest Amateur Radio Society (NARS), an approximately 200 member club serving the northwest section of the Houston/Harris County area. In 1994, there was no QRP activity in the NARS club. This year there are two foxhunt teams and two foxes out of the NARS group and a number of other hunters that could not commit to a team because of extensive travel requirements of their jobs. The other team calls themselves Team Cramp. The QRP movement within NARS gets bigger every year and the QRP-L Foxhunt is a big part of the motivation.

Bill Stietenroth, K5ZTY

Dan Clark, KK5LD, Terry Myers, KQ5U, Bill Stietenroth, K5ZTY, Bill Denton, W5SB

Resignation of Member News Columnist

I don't remember doing it, but in his very first installment of the Members News column, Rich Fisher, KI6SN, said that I had sent him a postcard offering him the job. That was the April 1992 issue of the QRP Quarterly, and Rich has served us very well and faithfully for the last 7 years, making him one of our longest running columnists. Unfortunately, Rich has decided that it was time to move on and has submitted his resignation. We all owe him a great debt of gratitude for the many years of faithful service. Rich is a professional journalist by trade, and that was evident in every issue of the Quarterly. Rich won't be leaving the world of QRP writing, though. He will begin writing a member news column for QRPp, journal of the Northern California QRP Club. And those of you who also subscribe to Worldradio know that he writes a regular QRP column for them as well. We hope that Rich Fisher will continue to serve the QRP community for years to come.

Mike Czuhajewski, WA8MCQ

Have something you'd like to share? Exciting QSO...new rig...interesting photo? Send your contribution to me at:
Mary Cherry, NA6E
8383 Sierra Sunset Dr.
Sacramento, CA 95828-5304
or
Na6e@arrl.net

Adventures in Milliwatting

Jim Hale, KJ5TF
kj5tf@madisoncounty.net

1999 was a great year for QRP. I was fortunate to get to play in many of the contests, and made many mW QSO's. Plus I discovered the fun of writing about it. Sharing the joy of this hobby is a great multiplier of the fun. Along with this column in ARCI QRP Quarterly, you're invited to visit my new website and keep up with my projects and activities into the new millennium.

Islands of Arkansas QRPp expeditions

Ham radio and QRP becomes even more fun outdoors. I love to take the family hiking, and boating in the Arkansas Ozarks. I'd like to take my radios along every time but manage to control myself and work out a balance between family and hobby. After all the family has been skiing, swimming, picnicking, I feel free to enjoy an hour or two of ham radio. Beaver Lake is about a 1½-hour drive from home, but well worth the effort. In 1998, I "activated" two islands on this lake as part of the US Islands awards program. A total of 25 contacts must be made to do this, and the island is given a number. Thus, Cedar Island became AR-03L and Shaddox Island became AR-04L. I highly recommend this to everyone. I'm currently working on Slate Gap Island, and have about 17 contacts from there. I'll have to pick it up again next spring, as it's too late in the year now.

For my island expeditions, I take along my QRP+, two "C" cell nicad battery packs, home brew paddles, and Tick keyer. The antenna is a 20' Black Widow collapsible fishing pole. I drive a 2' long piece of rebar in the sand and the antenna stands right up. The stinger is attached at the top, and operates on 20M. But it's cut and tied with string 2/3 of the way up for 15M. For radials, I have just two wires, but use some old 2' fiberglass tent poles to keep them elevated. To operate on 15M I just roll up the radials to a pre measured knot.

Operating portable from the beach is wonderful. You are on the air, outside, watching boats sailing by, plus the occasional water-skier. If I can find suitable uninhabited islands in Arkansas, anyone can do the same. If not an island, there may be a national forest, or park. Antennas seem to work very well when set up near the water. . At home, I worked N4SO in AL with 9mW, but from the beach with my simple portable antenna, I worked Ken with 2mW.

Milliwatting in the contests

In 1999, I learned the tricks of operating QRPp in many contests. Number 1 trick is to look up and down the bands for big gun stations CQ'ing with no callers. These stations are likely to be well equipped; they are listening hard, and most likely will hear you and answer. Or they don't have a super antenna, but there is a "path" between your station and theirs. This is the best way to get started in mW QRP. In only a few contests it's possible to earn your QRP/QRPp WAS award.

If it's a DX CW contest, I get on the Internet and look up QSL managers. Many DX stations have stateside managers, and those QSL cards are easy to get with just a SASE and 33c stamp. After one or two DX CW contests you could be half way towards your QRP/QRPp DXCC. As I once read in this column when Bob White wrote it, "It's easier to work DX with mW than stateside stations". It's very true!

Fall ARCI QSO Party

The QSO Party is always a lot of fun. This time I was in the home stretch of my mW WAS effort, only needing NE to make 50. Going into the event my WASTP was 1.3w. Not only was I trying to get all 50 states with mW's, I was also trying to get the WASTP below 1 watt before 12/31/99. In about 14 hours I was able to reduce my power for 14 states, between 4 & 31mW.

Now my 2 element quad beam at 70' is always good to me in contests, if 15/10M is open. Thinking a beam antenna on a tower, even a small beam, is better than a low wire antenna I have always favored 10/15M. But my 20M half square at 25' and 40M dipole at 45' really came through for me. I guess that's another lesson learned.

The quad did very well for me, getting WA with 4mW plus ID & NV 5mW on 15M. The 20M half square got ME with 10mW plus ND & IN with 18mW. My 40M dipole brought me UT with 17mW & MS with 21mW.

But the best was yet to come near the end of the event. I heard a NE station calling CQ on 14.058.2mHz! This is the last state I need for mW WAS! I set my power at 30mW and gave him several calls in the clear, but he didn't hear me at all. Not even a pause. So I ran the power up to 65mW and had another clear shot at him, called his call and my call twice. This time a pause, and he came back with "KJ5?F?". It took a couple more repeats, but he was into it, and I wasn't giving up easy! He finally got the T and my exchange ok. Later in an email, he said my signal was ok, but there was QSB every time I came around to the T and he wasn't getting it. That's one to remember.

I ended up with 24 QSO's, ranging from 21 to 4mW. And the one 65mW to get NE. It would be nice if there were a better multiplier for under 25mW. I had to use the <250mW multi.

Email

Jim: I was absolutely delighted to see the new mW WAS award now being offered. It's nice to see a fresh challenge that results in a pretty special piece of "wallpaper." Back in the mid 80s I completed DXCC QRP SSB with an Argonaut 515. I've always been interested in QRP but choose to mix it with QRO operating. I've worked about all the countries that I'm going to with 100 watts, 270 right now, so I need something new to rekindle my QRP fire! It was a thrill way back when to finish WAS QRP and to receive the stickers as the states were conquered. This mW WAS will be equally as enjoyable I'm sure. I have been dabbling at mW DXCC and have worked 73 countries with 35 confirmed. Why can't a mW DXCC award be offered as well. Seems as though the interest might be here already and would be attacked by many who have already done just plain ol' DXCC QRP. As you know, it's relatively easy to work 40 or 50 countries on a contest weekend with milliwatts. It makes me grin when the Kw stations give my 200 mw signal a 599 report during a contest!!! Enjoyed your article in QST, BTW. Keep up the fine work. You will be getting up-dates from this neck of the woods concerning this new mW WAS challenge!! ***72 Brad W1XV QRP ARCI #4505***

WASTP

October 1999, I got my last state for mW WAS, and my WASTP below 1 watt.. Special thanks to those who volunteered to make schedules with me. In contests, it was fun making 1st contact with 5 and 8 milliwatts. On skeds I was able to take some time and play QRP Limbo. Each time I reduced my power, I would send the power and get a new RST if they copied me ok. Some folks have a code word to exchange when doing this. I find being sure they copy my new power level is just as good. And functional!

Last words

January & February are great months for starting your personal mW WAS & DXCC efforts. In January you start with the ARS Spartan Sprint, there's the NA QSO Party, HA DX contest, REF CW, CQ 160M CW, KS QSO Party, and MI QRP contest. Come February the action continues hot and heavy. Again starting with the ARS Sprint. But this month has a major array of state QSO Parties. Look for NH, VT, DE, MN, and NC QSO Parties. The famous FYBO Winter QRPTTF, followed by the CQC QSO Party. ARRL DX CW contest is the perfect time to work on mW DXCC.

Best of 73's, 72's and sometimes 71's! Jim, KJ5TF

High Pass LC Filter Design

Transformation of a Low Pass LC Filter into a High Pass LC Filter

by Ian C. Purdie, VK2TIP email: ianpurdie@integritynet.com.au

Introduction

Assuming you have mastered the design of low pass LC filters, we will now proceed to the design of a high pass LC filter. A high pass filter is simply the transformation of a low pass filter. For our purposes, we will say we need a five pole Butterworth filter with a cut off frequency Fc at 2000 KHz. That is we want to pass all frequencies above 2000 KHz but attenuate those below 2000 KHz.

Perhaps this might be required for the antenna input to a receiver where AM Radio interference is proving troublesome.

Design Procedure

Let us first review the design procedure for a similar five pole filter but as a low pass LC filter. From our design tables we know that for equal source and loads:

BUTTERWORTH - equal termination filters

n stages	C1	L2	C3	L4	C5	L6	C7
2	1.414	1.414					
3	1.000	2.000	1.000				
4	0.765	1.848	1.848	0.765			
5	0.618	1.618	2.000	1.618	0.618		
6	0.518	1.414	1.932	1.932	1.414	0.518	
7	0.445	1.247	1.802	2.000	1.802	1.247	0.518
n stages	**L1**	**C2**	**L3**	**C4**	**L5**	**C6**	**L7**

The table above applies to the two low pass filters shown below in fig 1. Note the subtle differences.

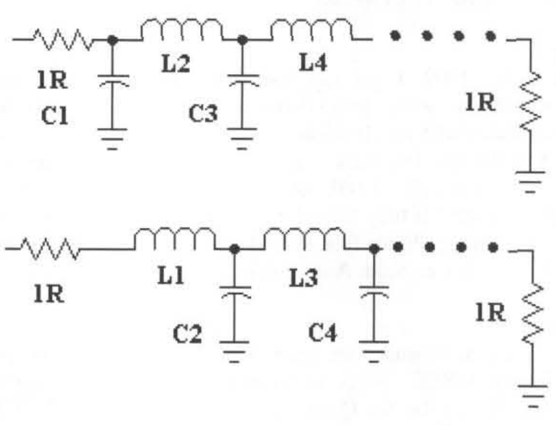


Figure 1

Which type you choose is a matter which may well be influenced by your needs in some applications to have a DC blocking capacitor in the input or output of the final finished high pass LC filter. In this case, use schematic 2. In the two schematics shown in figure 1 the principal difference is the placement of the first capacitor, denoted either C1 or C2. Depending on the circuit configuration chosen, you read the values from the top of the table or the bottom of the table. Is that clear? Also I have only presented one table, there are hundreds of tables and filter types with varying responses but Butterworth is fairly easy to compute. We said earlier we would use a five pole filter and we will opt for the top type of filter so we should have these values.

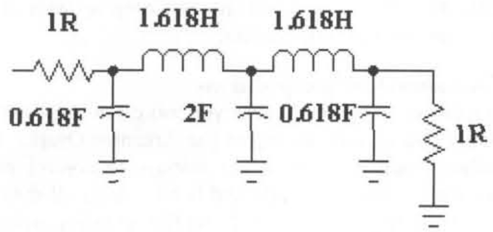


Figure 2

Notice that this low pass filter is normalized to 1 Ohm impedance both in and out, a frequency of 1 Hz and capacitor values are expressed in Farads while Inductor values are in Henries. Transformation to High Pass Filter PrototypeAll right we have a low pass filter prototype, what now? We simply want to do the opposite to a low pass with our high pass filter, so we do the opposite and invert everything. Replace each component with it's opposite. A capacitor becomes an inductor and, an inductor becomes a capacitor and, at the same time the values are also inverted e.g. the first capacitor of 0.618F becomes an inductor of 1 / 0.618H. Cool?

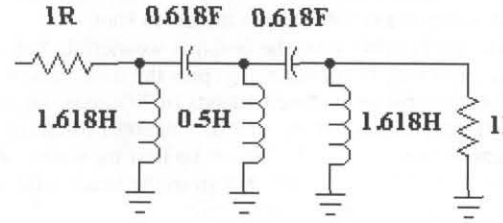


Figure 3

Notice that in the schematic I have already done the reciprocal or the inversion. The first capacitor was 0.618F, converting to an inductor of 1 / 0.618 becomes 1.618H (check it out on the calculator for ALL the components). Now all we have to do is get back to a standard impedance, we'll use 50 Ohms but it could be any value which is suitable to our requirements. Also we need to get back to our cut off frequency of 2000 Khz. Component calculations at Fc and at Zo - Frequency and Impedance scaling. This is the truly simple part if you like doing basic sums on the calculator. If not, then you're in for some bother. The transformation is effected using the following basic, yet simple formulas:

$$C = \frac{C_n}{2\pi f_c R} \quad \text{AND} \quad L = \frac{R L_n}{2\pi f_c}$$

Figure 4

Here C is the final capacitor value, L is the final inductor value, Cn and Ln are the prototype element values in Fig 3, R is your final impedance value and fc is the final cut off frequency. It's as simple as that! So for a cut off of 2000 kHz and a 50 Ohms impedance the calculations for the first capacitor and inductor we encounter become, as a worked example for you.

$$C = \frac{C_n}{2\pi f_c R} = \frac{0.618F}{6.2832 \times 2{,}000{,}000 \times 50} = 9.836^{\times 10^{-10}} = 984 \text{ pF}$$

$$L = \frac{R L_n}{2\pi f_c} = \frac{50 \times 1.618H}{6.2832 \times 2{,}000{,}000} = 6.438^{\times 10^{-6}} = 6.438 \text{ uH}$$

Figure 5

Note that the original prototype is always expressed in terms of 1 Ohm, 1 hertz (Hz), Farads and Henries. When you do your sums you get back to numbers with negative exponents, they are the -10 and the -6 respectively.

To bring capacitance to pF we multiply by exponent 12 (that's number 1 followed by 12 zeroes as in 1,000,000,000,000). Why? Because 1 pF is one 1,000,000,000,000th of a Farad. To bring inductance to uH we multiply by exponent 6 (that's number 1 followed by 6 zeroes as in 1,000,000). Why? Because 1 uH is one 1,000,000th of a Henry. Your final filter comes out as follows:

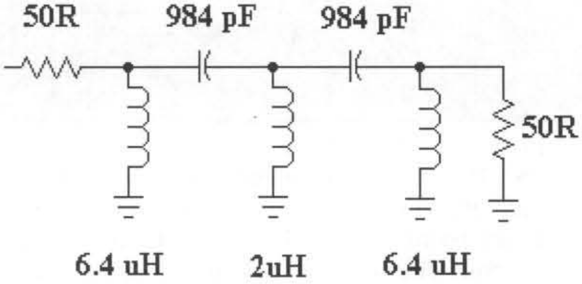


Figure 6

Paranoia to avoid with filter values

Firstly, don't use an unnecessary precision with your values. A capacitance calculated as 983.5752483 pF is totally irrelevant. In the "real world we would use a standard 1000 pF capacitor, remembering it's tolerance is going to be +/- 5% anyway. Consider also, it is doubtful any impedance will be precisely 50 Ohms. Finally, for this type of filter toroids are ideal to use as inductors. If there is sufficient interest, I'll cover designing for unequal impedance terminations.

That's all for the moment. I'm tired and I'll really have to rely upon your email support before going any further, is that fair enough?

Ian VK2TIP *ianpurdie@integritynet.com.au*
http://www.integritynet.com.au/~purdic/ or http://www.qsl.net/vk2tip/

Spectrum Analyzer Kit

Ed Lockhart, K4GEL

Last February I purchased a Spectrum Analyzer kit from Kanga US. The kit arrived promptly via US Mail. It consists of five clearly labeled circuit boards and a clearly labeled bag of parts for each board. Another bag contains capacitors for 2 filters (to be build directly in RF tight boxes) and a bag of wire. All coils are wound by the builder. This is a kit of all the "difficult to obtain in small quantities" parts.

There is a schematic diagram, pictorial, and parts list for each board, plus a reprint of the August and September 1998 QST articles by Wes Hayward, W7ZOI and Terry White, K7TAU.

Board assembly is routine except for T301 and the mounting of the MAV-11's. This information can be found at www. teleort.com/~w7zoi/ or you can request a printout when you order the kit. This is NOT a one or two weekend project. It will take longer.

Some of the parts required that are NOT part of the kit"

- Power Supply: Build the power supply first and then proceed according to the article.
- RF tight boxes: The Kanga US literature has some sources for boxes, or make your own.
- Coax Cable: All signal paths are coax. You will need several feet of RG-174.
- Main Tuning Control: The pot supplied is less than one turn. I recommend a 10-turn pot like in the article.
- 10 Mhz, 30 kHz resolution bandwidth filter is builder supplied. The 300 kHz LC filter and the switching relays are part of the kit.
- Small hardware, knobs and connectors are builder supplied.

This project has now progressed to an unmanageable pile of boxes and cables. This requires considerable thought as to what the analyzer is to be used for and how much you want in one enclosure. A VHF converter and/or a tracking generator (QST Nov 99) may be desired. For QRP rigs the 20 watt, 20 db pad in the article is fine, but you will also need at least 81 db of switchable pad to get 5 watts down to a proper level, with enough pad for calibration. There is a switchable resistor pad in the handbook that, if made with 2 watt resistors, works fine. An input for a reasonably accurate signal generator or crystal oscillator may be useful to identify unknown frequencies.

This is very useful test equipment for the experimenter and builder. The kit cost $195 including postage and seems to be well worth it. The Tracking Generator is $40 including postage. Additional cost will depend on your junk box and ability to scrounge and trade.

73, Ed Lockhart, K4GEL

Board of Directors Nominees

There are three Director positions up for election. Please vote for no more than three candidates. (Ballots with more than three marked will not be counted.) You may cut out the ballot, submit a photocopy or reasonable facsimile, or use the ARCI-QRP web site. You must include your membership number so we may verify eligibility to vote. Only currently active members may vote. Since there are more than three candidates, the 3 with the most votes will take seats on the Board of Directors on the first of April, for terms expiring in 2004. In the event that any seat on the Board becomes vacant before the next elections in 2003, the remaining candidates will be offered the opportunity to fill them.

Jim Larsen, AL7FS Anchorage, Alaska

AL7FS, Jim Larsen (ARCI #6754), was originally licensed as WN0LPK in March 1965 (WA0LPK from 1965-1985). Jim is a member and past board member of the Anchorage Amateur Radio Club (Over 250 members with an annual budget in excess of $50,000). He has twice been a radio operator in Shaktoolik, Alaska for the Iditarod Dog Sled Race and was the Race Communications Director in 1987.

For a while Jim was a Moonbounce (EME) fanatic and earned 2 meter WAS #36. Even then he operated in QRP style, using only about 600 watts output. Jim has participated in HF from 160-10 meters (CW and SSB),packet, satellite, lots of 6 meters from Alaska, UHF, VHF, ATV, DX, QRP-L, QRP and QRPp.

Jim is active in ARCI QRP contests and many others throughout the year. He puts the KL7Y monster station on the air QRP several times per year to help others reach Alaska. He has written articles published in the QRP Quarterly, the Iowa QRP Newsletter and several other newsletters in Alaska and Maryland. Some of these articles may be read on his QRP web site at http://www.qsl.net/al7fs/ Jim has lectured on QRP to Alaska ham clubs and at Alaska flea markets.

Of all his interests, QRP has lasted the longest and the strongest - 1970 to 2000. Jim can be reached at al7fs@qsl.net.

Ken Evans, W4DU Atlanta, Georgia

My name is Ken Evans and my amateur radio call sign is W4DU. I am submitting myself as a candidate for the Board of Directors of QRP ARCI. My amateur radio career began in 1961 as KN8ANW. A move and an upgrade soon followed and I became known under the call of K3RFN. I joined QRP ARCI in 1965 and was assigned the number 696.

I have been an active ham (with the exception of a 4-year stint in the US Army) since I was first licensed. My activities have included building, rag chewing, contesting, dxing on 160 the 1296 (including satellites). I have been thru the linear/yaecomwood commercial experience along the way. About 8 years ago, I was becoming bored with amateur radio and thought the spark was dying. I then rediscovered QRPing and the associated building and operating. This rekindled the spark and (as the QRP ARCI web site says) the thrill was back! My current station is mostly home-brew and kits. I am a cw operator, but do enjoy some ssb as well.

I believe that the QRP experience can help revitalize ham radio. As I said above, it has put the thrill back into amateur radio for me. I have seen it do this for young and old, newcomers and old timers. Many of you have probably had similar experiences. Those of us in QRP today have the unique opportunity to demonstrate the fun and learning experience that is available thru amateur radio.

As a board member, I view my responsibility would be to foster an environment where the club officers and staff could use their talents and abilities to help the club grow. This would involve giving them the latitude to try new things - find out what works and what doesn't. Hopefully, the growth would come not just in numbers, but in focus, activities and resources. This would have to be done within a fiscally sound budget that supports our best resource, the QRP Quarterly magazine.

For those of you interested in personal information/experience, I am 52 years old and am the past Secretary/Treasurer of QRP ARCI. I am currently employed as an engineer in the cellular industry. I have been married for 32 years and have four children and three grandchildren.

Joe Spencer, KK5NA Arlington, Texas

I would like to serve on the Board of Directors of QRP-ARCI.

- I am Enthusiastic about amateur radio in general and QRP operation in particular.
- Earned extra class license in 1994.
- Travel to local, smaller Hamfests with wife Barbara (KK5QA) at least once a month to spread the QRP Gospel, pass out flyers, sell QRP-ARCI goodies, kits and let the qrper's out there know that they are not alone.
- Assisted with QRP-ARCI booth at HAMCOM in Arlington, TX for last 4 years.
- Program director/manager for QRP at HAMCOM in Arlington, TX for last 4 years including a QRP Banquet for HAMCOM 99.
- Organized a QRP special-event station at HAMCOM in 1998.
- Founded the Radio-Active Camping and Contesting Club which meets monthly at our home and set up contest stations at local parks for Field Day, QRPTTF, QRP Afield, FYBO, Flight of the BumbleBee and other operating events.
- Program manager for the FISTS organization.
- Organize location and events and keep NORTEX QRP members up to date on meetings, contests, activities, events.
- Degree in Electronics Engineering.
- I have written articles and given talks to local clubs on QRP and Homebrewing.
- Maintain websites for NORTEX QRP and RACC clubs.
- Have two email accounts.
- Have a wife who supports and participates in my amateur radio activities <grin>.

Member of:QRP-ARCI; QRP-L; ARS; G-QRP; NORTEX QRP Club; NORCAL QRP Club; FISTS; NE QRP; MI QRP; CQC; RACC

Bill Harding, K4AHK Burke, Virgina

I have been a member of QRP ARCI since July of 1980 and served as an officer and/or member of the B.O.D. for eight years from 1981 through December 1989.

As Awards Manager in 1981, I created new artwork for many of the certificates. In March of 1982, I assumed the job of Secretary/ Treasurer. During this time, I was instrumental in creating the job of Membership Chairman and separated this mammoth task from the Secretary/Treasurer's duties. I continued as Membership Chairman until October of 1989 and was elected to one four year term on the B.O.D. in January 1986.

I was NCS of the Southeast 40 meter net (SEN) in 1983 and kitted the "Two-Fer" transmitter for club sales in 1987.

For the past ten years, much of my time has been consumed with buildin a new business and getting two children through college and out into the world. I am approaching retirement in a couple of years and am reall looking forward to having lots of time for ham radio.
At present, Al Wheeler, WB4JJJ, and I are putting together a Northern Virginia QRP group which we hope to pattern after the successful Nor-Cal operation. It is a social group with no officers, dues or formal organization. Our first meeting was great fun.

It has been very satisfying to watch the QRP ARCI membership grow over the past twenty years and to see the QRP Quarterly become a major publication. It is an amazing credit to an all voluntary organization that is spread over the country. With the availability of e-mail and the QRP-L list, communications between members and club officers has greatly improved.

As a member of the Board of Directors, I would be committed to continuing the growth of QRP ARCI, providing a voice for the membership and participating in the management and support of the best QRP club that I know of.

Dick Pascoe, G0BPS Kent, England

First licensed in 1983 as G1DGO joined G-QRP club in 1984. Gained full license in 1984 as G0BPS.

Started writing about ham radio in same year. NOT QRP! An article on 144MHz moonbounce! (eme)

Several articles appeared over the next few years when in 1989 I was asked to do a monthly QRP column for the UK magazine 'Ham Radio Today'

I first came to Dayton the same year with George Dobbs G3RJV and got to know a few guys. I visited Dayton each year except for 1994 when as the Chairman of the City Council (equivalent of a US city Mayor) I had to greet the President of France and the Queen of England when they opened the Channel Tunnel!

I was elected to the QRP ARCI Hall of Fame (for reasons which still escape me) in 1997.
I have written the QRP column for over 10 years now and still enjoy doing it.

I am an officer of the G-QRP club and count many of the other officers as close friends. I write the SSB column in SPRAT too.

I have actively promoted QRP for many years.

I am aged 55, married to Daphne with two sons aged 27 & 24. Two dogs, a cat and several chickens.

My own interests apart from QRP include VHF DX chasing, wood turning, cameras and Scuba Diving. I am also a broadcaster on the local hospital radio and chairman of the district Sports Council.

My business interests included 23 years with the Fire Department retiring as an officer in 1986.

Kanga Products the UK kit company, now sold on.

I am currently retired and enjoying what very little spare time I have.

Jerry Huldeen, WB0T Sioux City, Iowa

My name is Jerry Huldeen. I have been a member of QRP ARCI, International since November 24, 1984. My membership number is 5641. I am not an award chaser, however, I hold the 1000 Mile per watt certificate, TCN Qni certificate, and others I could not find! I am currently working on the AB7TT worked all band award. (Just kidding, Joe!) I have worked him often.

My main interest is Qrp CW. I was net manager for the 3900 Slow speed net for a number of years, and have been NCS and net manager for the Iowa QRP Club since its inception. I also serve as secretary for the group. I help with the 3900 Club/SARA Hamboree, an annual event with approximately 700 in attendance. My duties are basically to organize the Qrp activities and forums. John NU0V, Paul KB0JIT, and Adrian Weiss W0RSP have been presenters at these meetings, and have drawn large crowds to their forums. John NU0V, Mike N0MF along with others in the club have manned a remarkable QRP display at these events, drawing kind words from many, Ade W0RSP in particular. We also host a QRP building event at the Hamboree, and have hosted QRP during the winter for a day at the American Red Cross, which has drawn approximately 40 - 50 hams interested in Qrp.

I am 64 years of age, and a retired band director in the public schools. I was first licensed as a novice in January of 1981 as KA0JZR, later as N0ETQ, and then WB0T. My first workable rig was an Argonaut 509, which I still have. No one told me that Qrp wasn't supposed to work!

I would like to help the club in anyway that I am capable.

QRP-ARCI Board of Director Nominations 2000

Callsign ____________ ARCI Number ____________

Name ____________

☐ Jim Larsen, AL7FS ☐ Ken Evans, W4DU

☐ Bill Harding, K4AHK ☐ Dick Pascoe, G0BPS

☐ Joe Spencer, KK5NA ☐ Jerry Huldeen, WB0T

Again, please vote for no more than three candidates.

Mail nominations to: Mark Milburn, KQ0I
117 E. Philip St.
Des Moines, IA 50315-4114

Contest Corner

Joe Gervais, AB7TT *Email: vole@dancris.com*

CONTENTS:

UPCOMING CONTESTS:

- Michigan QRP Contest	**January 8 (tentative)**
- AGCW DL QRP Winter Contest	**January 8-9 (tentative)**
- AZ FYBO Winter QRP Field Day	**February 5**
- ARCI Winter Fireside SSB Sprint	**February 13**
- Colorado Winter Contest	**February 27 (tentative)**
- ARCI Spring QSO Party	**April 8-9**

NEWS

Intro:

This is traditionally the quiet issue for the Contest Corner. The logs for the QRP ARCI Fall QSO Party aren't all in yet, and the Summer Daze SSB Sprint is the only other contest to report on. Which provides an excellent opportunity to pass along some news. First off, the Winter Fireside SSB Sprint has been moved to February (see contest announcement).

The later date will allow time for readers to get the announcement in time for the contest (in the January QRP Quarterly), rather than after the fact. It will also make the Winter SSB Sprint exactly 6 months away from the Summer Daze SSB Sprint. Finally, the Winter SSB Sprint is now an exact clone of the Summer Daze SSB Sprint, only colder. :-) The second news item is a bit more detailed.

Hello I Must Be Going

It never seems to fail. You finally get to do something you really enjoy, and Real Life(tm) comes along and changes the game plan. One year ago, Cam N6GA asked me if I'd be interested in taking over as QRP ARCI Contest Critter. Naturally, I jumped at the chance, and was looking forward to many years of serving the QRP community. I was happier than a vole in a haystack, and eager to serve. Then last April my startup business began devouring my time, and by May it was clear that I was in a serious pickle. I was forced to admit to myself that I was no longer able to adequately serve as the Contest Manager for QRP ARCI.

The search began for a replacement and finally, after many months, we found an extremely capable volunteer at Pacificon '99. As coincidence would have it, I've even operated QRP in the snowy mountains of the ID/MT border with him in NorCal's QRPTTF, so I can definitely vouch for him. (He could use a bit more practice on those cross-country skis though! *chuckle*)

He's chased (and bagged) many a QRP-L Fox over the years, is frequently heard exchanging RF in many QRP contests, and being a scientist has great attention to detail. Folks, it is my true honor and pleasure to announce Randy Foltz (K7TQ) as the new QRP ARCI Contest Critter. I think you will all be quite pleased with what Randy has to offer. And if you ever get the chance to operate on a snowy mountain with him, I urge you to accept. :-) Thanks Randy!

I'd really like to thank everyone for letting me have the opportunity to serve the QRP community. I'm extremely disappointed that I was unable to fulfill my duties in the manner (and duration) I intended. It truly has been my pleasure, and I hope to one day have the time to serve my fellow QRPers again. Until then, take care, be well and HAVE FUN! Many thanks to all!

72 es 73 de AB7TT,
-Joe Gervais, Retiring QRP ARCI Contest Critter,
vole@dancris.com

Winter Fireside SSB Sprint 2000, Sponsored by QRP ARCI

Date/Time: Feb 13, 2000-2400Z, SSB HF only. Work stations once per band. Operate all 4 hours.

Exchange: RST, SPC and ARCI number (non-members send power).

Categories: All-band, Single band, High bands, Low bands, Multi-Op, DX.

Suggested Freqs: (KHz): 1830, 3865, 7285, 14285, 21385, 28385

QSO Points: Member = 5 pts, Non-member different continent = 4 pts, Non-member same continent = 2 pts.

Multipliers:

SPC Totals (for each band, count each SPC once per band).

Power: <250mW = X15, 250mW-<1W = X10, 1W-5W = X7, >5W = X1.

Score: QSO points X total SPCs X Power Multi.

Log Submission:

Entries must include copy of log and summary sheet, callsign(s) of op(s), QTH, power out, and station description.

Send entries within 30 days of contest date to Randy Foltz K7TQ (ATTN: SSB Sprint), 809 Leith St, Moscow, ID 83843, or email ASCII-text entries to <rfoltz@turbonet.com>.

All decisions of the Contest Critter are final. Unless you have pizza to offer, in which case I'm always listening!!!!!

Spring QSO Party 2000 Announcement

Date/Time: Apr. 8 1200Z to Apr. 9 2400Z. CW only, 6M thru 160M.. Operate a maximum of 24 hours of the 36-hour period.

Exchange: RST, SPC (State/Province/Country), and ARCI number. Non-members send power out.

Categories: All-Band, Single Band, High Bands, Low Bands, DX, Multi-Op, Portable.

Suggested Frequencies: Near QRP calling freqs.

QSO Points: Member = 5pts, Non-Member Diff. Continent = 4 pts, Non-Member Same Continent = 2 pts.

Multipliers:

SPC Totals (for each band, count each SPC once per band).

Power: <250mW = X15, 250mW-<1W = X10, 1W-5W = X7, >5W = X1.

Score: QSO pts total X SPC total (all bands) X Power Multi.

Team Competition:

Teams may be formed of between 2-5 members, and will compete as a separate category in addition to individual entries of team members. The team captain must submit a team roster to the contest manager prior to the event. Team score will be the sum of individual scores of the team members.

Log Submission:

Entries are due within 30 days after the contest. Include a summary of your results, callsign(s) of op(s), ARCI member number (if applicable), station location and description, power used on each band, and total time spent on the air. Entries exceeding 100 QSOs include a dupe sheet. The highest output power used will determine the power multiplier. Output power is considered half input power.

Entries via email are welcome in ASCII-text format to <rfoltz@turbonet.com>. Mail paper logs to Randy Foltz K7TQ, ATTN: Spring QSO Party, 809 Leith St, Moscow, ID 83843.

All decisions of the Contest Critter are final.

1999 Summer Daze SSB Sprint Results

I have to blame myself for the low turnout for this one. I simply wasn't able to get out and publicize it enough (was traveling on business, wasn't able to even get on the air myself). Hopefully the new wave of SSB-capable Elecraft K2's will help generate some more interest in future events. That's a BIG hint for February's Winter Fireside SSB Sprint!

Congrats to Tim KB9LGJ for 1st Place overall (good luck on the Advanced, Tim!), Ron WB3AAL for 1st Place - Single Band (20M), and Rich W5RXP for 1st Place NM. Certificates will be on the way (along with the rest of the backlog) shortly!

Note that Rich and Ron both worked SSB DX during the event. The bands are almost always open to somewhere in the world, especially as the sunspots kick in now. So get out those mikes, dust 'em off, and try a little QRP SSB! I hereby pledge to get on the air for the Winter Fireside SSB Sprint in February. I'll be doing my best Yoda impersonation, so see if you can find me!

Callsign	QTH	QSO Pts	SPCs	Power	Score	Category
KB9LGJ	MN	31	7	5W	1519	Multi
WB3AAL	PA	28	7	5W	1372	20M
W5RXP	NM	26	5	5W	910	20M

Summer Daze SSB Sprint Soapbox

W5RXP - Unfortunately, the DX was stronger than the stateside signals. Worked EZ7ST at 14.286. It was lots of fun, and it's pretty amazing what 5W SSB will do!

WB3AAL - I was very surprised when I work the 2 DX with 3 watts output for the band conditions.

KB9LGJ - The bands were very poor, but it was nice to make a few contacts.

The Last Word

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

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

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

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

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

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

Material cannot be returned unless accompanied by sufficient postage.

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

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

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

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

Copyright of materials published in the QRP Quarterly remains with the author. Although the author retains the right to reuse the material, the QRP Quarterly requests that reprints of the material in other publications acknowledge first publication in the QRP Quarterly.

(With thanks to **L.B. Cebik** for all his help)

***de* Mary, NA6E**

Change of Address, and membership status questions go to:
Dave Johnson, WA4NID 4312 Cobblestone Place, Durham, NC 27707

RENEW EARLY! Don't wait until your renewal month! Especially don't wait until AFTER your renewal month! You may MISS ISSUES!How do you know your renewal month? Look on the label (the one on the plastic wrapper that you should LOOK AT before you throw away!). Exp after 01/00 means your subscription expires after the January 2000 issue, so ***RENEW NOW***!!!!

If the Membership Chairman does not receive your renewal form by the first of the MONTH PRECEEDING an issue month, your renewal may not be included in the updates for that issue! Forms and funds go to the Secretary then are forwarded to the Mambership Chairman, so SEND YOUR RENEWAL EARLY to avoid missing issues!

Who do I contact about a missing issue? DON'T, unless it's well past the 15th of the MONTH FOLLOWING the issue month. And then only contact the Membership Chairman, NO ONE ELSE!

I'm moving! Where do I send the address change notice? To the Membership Chairman, NO ONE ELSE! Be sure to get your address change notice to me AS SOON AS POSSIBLE! Email notice is fine. ***WA4NID@amsat.org***

If you do NOT include full information with your renewal, your check will be cashed but you will NOT be renewed! Just kidding, but PLEASE do provide all the requested data, if you do not use an official form. I REALLY hate it when you just send a check in an envelope!

Dave Johnson, WA4NID, Membership Chairman

QRP AMATEUR RADIO CLUB, INTERNATIONAL
CASH RECEIPTS AND DISBURSEMENTS

FOR YEARS ENDED JUNE 30,	1998	1999
Beginning Cash:	$14,445.13	$18,388.36
Cash Receipts:		
Memberships	23,795.63	21,952.80
Toy Store, net	1,461.26	633.61
Dayton Banquet, net	174.90	(262.69)
FDIM Seminar, net	(1,451.71)	55.45
Sale of Quarterly magazines	1,621.20	324.54
Interest Income	0.00	395.81
Total	25,601.28	23,099.52
Cash Disbursements:		
Quarterly magazine costs	18,844.43	21,785.68
Prizes and awards given		1,385.19
Contest expenses	299.18	102.73
Dayton booth and hospitality room	1,072.93	1,155.00
Treasurer and legal expenses	627.81	559.75
Membership manager expenses	596.26	445.63
General administration costs	217.44	1,260.18
Total	21,658.05	26,694.16
Net Disbursements Over Receipts	3,943.23	(3,594.64)
Ending Cash:		
Working funds	8,388.36	4,793.72
Reserve funds for unearned subscriptions	10,000.00	10,000.00
Total	$18,388.36	$14,793.72

Become a Famous Author:

Write a Review for the 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 back cover for his 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 as the bad features. Larry prefers to receive articles in machine-readable form as ASCII text files on PC format floppy disks or as email attachments. If you want to send word processor files, Larry can handle MS Word 6/95/97, WordPerfect 5/6 and "Rich Text File" (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 (GIF, TIFF, JPEG, PhotoCD, PCX or bitmap files). If you want your disks, drawings, etc., returned, please enclose an SASE with sufficient postage.

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