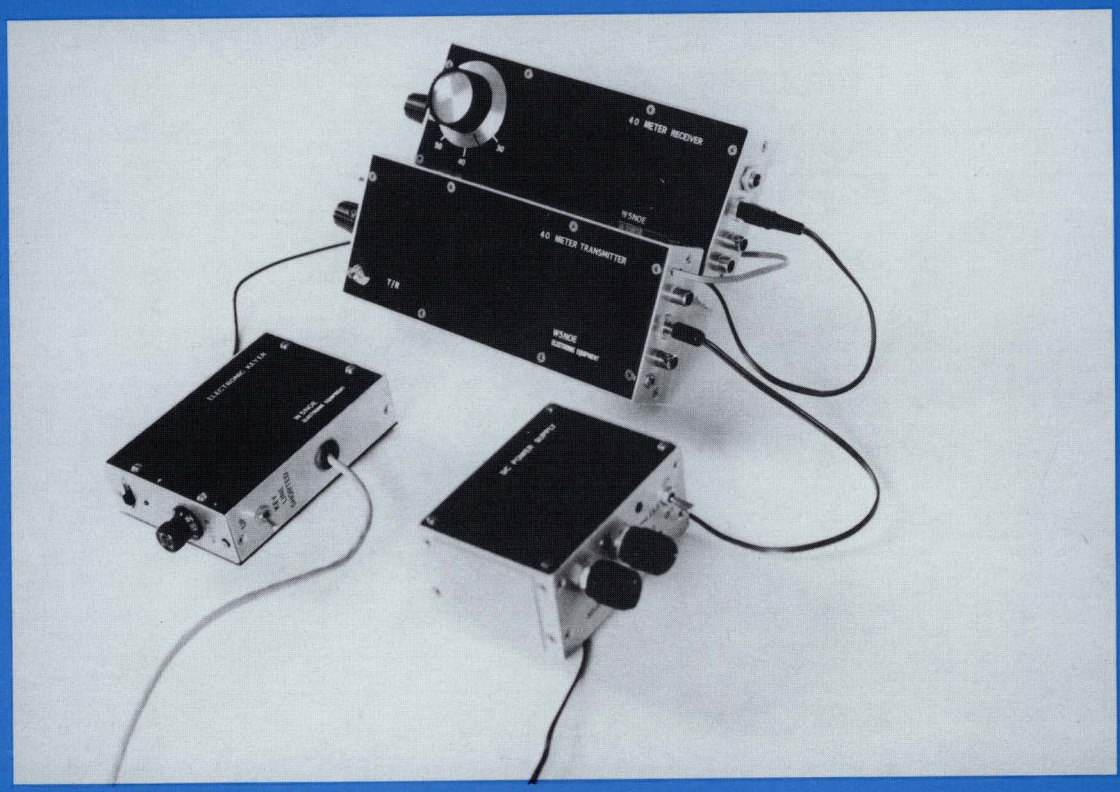
$4.95

QRP Quarterly

Journal of the QRP Amateur Radio Club, International

July 1998 Volume XXXVI Number 3



The cover photo contest winner this issue is Dave Anthony, W5NOE. This photo shows a complete station Dave designed and built. From the lower left clockwise there is the Curtis keyer, 40m Transmitter, 40m Receiver and the DC power supply. The rig has break-in keying with adjustable delay. The receiver has a 650 Hz passive band pass filter.The power supply will supply 6 to 17 volts DC. The cases are surplus. It is the itch to see all those neat little boxes filled with rigs that motivates Dave to build more and more rigs! Keep up the good work Dave.

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

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

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NOTES FROM THE PRESIDENT

Mike Czuhajewski, WA8MCQ

QRP DAYTON 1998: BEST EVER!

This is being written a week after returning from QRP Dayton 1998, and it was a blast! I've been there several years in a row and think I enjoyed this one the most of all. I hate to use cliches like "best ever" but I think it was! A lot of people put a huge amount of work into making it happen and it showed. There were the usual problems with the hotel, of course, just like every other year, but still it was a most enjoyable 4 days. (And reports are that several other hotels had plenty of problems of their own!)

This year the QRP ARCI took over some of the functions that had been done independently in the past but were widely assumed to be formal QRP ARCI functions. Since the club gets the blame for any and all problems anyhow, we might as well make them official functions so we can at least share in the warm fuzzies! Vice President **W4QO** agreed to be the overall coordinator for the club's Dayton efforts. **W4DU** oversaw the Four Days in May (FDIM) QRP symposium, with **KT3A** handling the advance tickets. Several excellent speakers provided us with a day full of technical talks, and **N2APB** did a great job on the printed proceedings. (The concept of the QRP technical forum the day before the Hamvention officially starts was the brainchild of **W6TOY** and **N0EB** a few years ago. This year the QRP ARCI assumed responsibility for running it; during the last two years it was handled by an independent FDIM committee.)

A limited number of copies of the printed proceedings may still be available by the time you read this. Contact **K3TKS**, whose addresses appear on the rear page. (Sorry, that's the book only. FDIM attendees also received a set of PCBs, courtesy of G3RJV and the GQRP Club, but that was a special deal for FDIM only.)

Management of the room reservations at the QRP Hotel, the Days Inn South in Miamisburg (near the Dayton Mall) was taken over by the QRP ARCI a few months before Dayton. It had been handled for years by Myron Koyle, **N8DHT**, and we owe him a lot of gratitude for all the work he put into it. (Although he wasn't there to receive it, we presented a plaque of appreciation for him at the QRP banquet a year or two ago.) Keeping most of the people under the same roof has been a big factor in the success of QRP Dayton over the years. This year, **K8DD** and **N8CQA** took it over as an official QRP ARCI function and put the list online on a web page. Although it takes a lot of work for those maintaining the list, it does give faster response and makes it easier to check on your status instantly at any time.

Our thanks to **Pete Meier, WK8S**, for handling the annual QRP banquet for the last 3 years. This year the Maryland Milliwatts further increased their grip on the QRP ARCI (just kidding!) by having one of our members, **Scott Rosenfeld (NF3I)** take over responsibility for the banquet. He did a great job and will be back next year. He also did a super job of soliciting door prizes; in fact, he ended up with over 100!

Adrian Weiss, W0RSP, one of the legends of the QRP world and member of the QRP Hall of Fame, was the featured speaker. Although the Rev. George Dobbs referred to it as a "Nordic saga" due to the length, it was a very interesting look into the history of QRP and the QRP ARCI and it's transition from a 100 watt "QRP" club to a "true QRP" club at the 5 watt level. And for those who haven't already seen my disclaimer on QRP-L, I'll say it again: I had no idea what he was going to speak on, and I most certainly had no idea that he was going to drag me into it in a supporting role! Just before he got up to speak he handed me a script of about 9 pages which contained the text of some letters we exchanged in the old days, and I had to read my parts when cued. His idea was to add a little bit of drama to it by having the actual writers read their letters. (Just as it is today, you have to be careful about what you put on paper! I never dreamed that he'd be a pack rat and keep all those old letters, and that they'd come back to haunt me almost 30 years later!)

Ade has a PhD in English and is a college professor. Thus it seemed entirely appropriate that when my part was finally over and I got to sit down while he kept talking, I graded his paper! Sorry, but the temptation was irresistible. Ade and I go back to 1969, before the days of the Milliwatt (subtitled National Journal of QRPp) which we started together. And as I've said a thousand times already, I ran off to join the Air Force after 4 issues and he did the vast majority of the work for it's 5 year run. And the drive and vision were all his. He looked at the small QRP ARCI regional newsletter for the 8th call district that I was publishing back when the club had the 100 watt focus--it contained a regular section called the QRP Corner dedicated to "real QRP"--and he saw something bigger and better, a national level journal dedicated exclusively to operation and building at the 5 watt and under level. The results are legendary among the old timers in the QRP world.

A comment that I've heard many times over quite a few years, from a number of people, is that they get the feeling that the only people who count in the club (or in the QRP world) are those who go to Dayton, since it gets so much coverage in the QRP journals. Unfortunately there's nothing that can be done about that and it's certainly not restricted to QRP or even to ham radio. All of life works that way; whenever there are large gatherings of any group, many of those who do not attend can feel like "outsiders." There are only two cures—stop reading about it or join in the fun! As for me, I cannot attend any of the NorCal or New England QRP meetings, or other QRP gatherings around the country, but I still enjoy reading about them.

For those who have never attended Dayton, you should plan on going at least once. It's a big hamfest, sure, but lots of us get plenty of hamfests in our own regions. That part is a bonus. The main attraction is the camaraderie and fun of all the QRP events and meeting QRPers from all over, and putting faces on a lot of those call signs you hear on the air and see on QRP-L and in the pages of all the QRP journals.

QRP HALL OF FAME

The 1998 inductees were announced at the QRP banquet, joining the 14 existing members. The new kids on the block are **Chuck Adams, K5FO**; **Wayne Burdick, N6KR**; **Jim Cates, WA6GER**, and **Gus Taylor, G8PG**. This year we allowed each person to choose someone to announce their names and introduce them. 1997 inductee **Doug Hendricks, KI6DS**, announced the names of the three Yanks, all of whom chose him. **George Dobbs** (inducted in 1992) accepted on behalf of G8PG, who, like K5FO, was not able to attend. KI6DS later presented the plaque to K5FO at a NorCal function shortly after Dayton. Details on the newest inductees are found elsewhere in this issue.

PRESIDENT'S AWARDS

I announced three President's Awards at Dayton after the judging of the NorCal 2N2222 and K5FO Unlimited Building Contests; plaques of appreciation to people for their long work on behalf of QRP. One was for **Paula Franke, WB9TBU**, who served two terms as

president of the QRP ARCI while simultaneously editing the QRP Quarterly for several years. Operating in the days before e-mail had become almost universal and working with computer hardware and software that were a few generations older than what we have now, she really did quite a job with the tools that were available at the time.

Mike Bryce (WB8VGE) and **Rich Arland (K7SZ, formerly K7YHA)** have both been involved in QRP writing for quite some time and have over 50 years of QRP experience between them. Mike has been writing a QRP column in 73 magazine since 1986. Not just "preaching to the converted" in a QRP journal, he's out there in the main stream ham press for all the world to see, keeping QRP in front of them and showing everyone that QRP is a segment of our hobby that is enjoyable and fun and has a sizable following. The fact that a main stream ham magazine devotes space to a regular QRP column sends a message to all the readers.

Years ago he also took over as editor of the Hotwater Handbook, later renamed the HW8 Handbook. Created by **Fred Bonavita, W5QJM**, it was a collection of articles and tips on the Heath QRP rigs. Mike built on Fred's work, enlarging it in subsequent editions and keeping it going.

Rich wrote the QRP column in Worldradio for several years, taking it over from W5QJM. Like Mike, his regular writing in the main stream ham press publicized QRP to the rest of the ham community, showing them that it's a vital and popular side of ham radio. He also had several articles on QRP in QST, the latest in the June 1998 issue, and he published three books on "Low Power Communication." One of his lesser known achievements is recording a six part audio series on QRP that is aired annually on short-wave station HCJB as part of their weekly amateur radio program. Both he and Mike have done a lot to keep QRP in the eye of the rest of the ham world.

NEW NORCAL RIG

Elsewhere in this issue is the announcement of the latest kit project from the Northern California QRP Club, spearheaded by **Doug Hendricks and Jim Cates**. I saw a prototype at Dayton, and it's a neat little rig. Designed by **Dave Fifield, AD6AY**, this one is for 20 meters and has lots of neat features. An interesting twist to this particular project is that for each one sold, another one will be given free of charge to a ham in a third world country, with the GQRP club handling the distribution. They will be producing a limited run of 500 kits (plus 500 to give away). But don't send any money just yet, since they won't be accepting orders until the first of August.

THE MFJ-90'S NEWSLETTER

This one is for those who have MFJ QRP rigs, of course, and it's been around for a few years. It's changed hands a couple of times, and now **Paul Harden, NA5N** is taking it over. I haven't seen one yet, but considering the source it should be quite good. Here's some info on it from Paul—

"The new MFJ-90's Newsletter is now being edited by Paul Harden, NA5N and will be published quarterly: spring, summer, fall and winter issues. Subscriptions are $10/year for U.S. and VE, and $12.50/year DX, to:

Paul Harden, NA5N
MFJ Newsletter
P.O. Box 757
Socorro, New Mexico 87801

"My first issue was the Spring 1998, which focused on aligning the MFJ-9000 series receivers, using the MFJ instructions, followed by commentary on the procedures and some illustrations of what you're doing to align the IF, BFO, etc. If you'd like your subscription to start with the Spring issue to get the receiver alignment procedures, please indicate so (while extra issues remain).

"The goal of future issues is to:

1. Contain technical information on the MFJ's for alignment and basic troubleshooting.
2. Circuit analysis ... learning how they work stage-by-stage
3. Various modifications I and others have performed on the rigs.
4. Member news ... photos and descriptions of members, where and how they've used their MFJ's, etc.
5. QRP news and happenings of a general interest.
6. Whatever else may be requested!

"If you have an MFJ, hopefully you'll find the newsletter interesting, particularly with the shift in interest to the technical side of things."

UPDATE ON NEW SPECTRAL PURITY RULES

In April I mentioned that there will be some new technical requirements coming down the pike in a few years, which will significantly tighten the spectral purity requirements of transmitters, even at the QRP level. I exchanged e-mail with several very knowledgeable people, and was allowed to see copies of e-mail from others, and I think everyone is pretty much in agreement that the sky isn't falling. While it could complicate things for some of the extremely simple designs, in general it will be achievable with reasonable ease.

Of course, as is already the case, actually measuring the harmonic content of a transmitter or transceiver will be quite a different story! Even used spectrum analyzers cost a hefty chunk of change, but many of us do have access to them. And if you're building something from an article and follow the instructions carefully you should have no problems (assuming that the author did his homework in the design stage).

For those who want to read more, there's a letter starting on page 61 of the June 1998 QST ("Technical Correspondence" section) by Rick Campbell, KK7B, titled "Unwanted Emissions Comments."

THE NEW, IMPROVED QRP QUARTERLY

We've slowly grown over the years, with **KU7Y** doing a super job as editor and building on the work done by Paula Franke before him. Of course, he couldn't put out a magazine of anywhere near this size without a large supporting cast, with many people feeding him camera ready copy and computer files, taking a huge load off him. We've had good articles in recent years, and lots of them. At one time we were content to sit back and let the articles come to us, but for some time now we've been following the lead of KI6DS and QRPp, and going out and actively hustling material and recruiting authors--and the Quarterly has slowly grown as a result. But if you have an article in you that you think would be of interest to everyone, don't wait for us to contact you--go ahead and send it to us, then sit back and enjoy the infinite fame and glory of being published in the QRP Quarterly!

--qrp--

FROM THE EDITOR

Monte "Ron" Stark, KU7Y

Here it is, time for another issue already and I'm just not ready. First thing I want to do is let everyone know that the late delivery of this issue of the Quarterly is all my fault. All the contributors got their work done and to me in plenty of time. I just wound up with too many projects both at home and at work. Send any nasty letters about not hitting the schedule to me and not the crew. I know just where my trash can is and don't mind using it!

Dayton was a blast again this year. I even carried a little HP 200LX palm top computer with me and did some writing while on the plane, both on the way to Dayton and on the way home.

———— On the Plane ————

Here I am, about 35,000 feet over the Sierra Nevada mountains, on my way to Dayton. We were about 15 minutes late taking off because the plane was covered with ice and snow. Yes, I know it's the middle of May and that the weather in Dayton is nice! *(It turned out that it was HOT and HUMID, not what I call nice!)*

I will be bouncing along for about 3 hours getting to St. Louis. There I change planes and head for Dayton. This is being written on a new HP 200LX palmtop computer. Small and slow to type on but it is much easier than I thought it would be.

Made a mad dash at St. Louis to make the connection to Dayton. *(Why do they always have the connections so far apart?)* We were soon in the air and then into Dayton. I was met by Rob Brown, WB2DVX. As we neared the baggage area we ran into Dick Pascoe, G0BPS. He was waiting for Grahm and Tony. We three had been chatting for about five minutes when they arrived. To save Rob from having to make the drive all the way to DIS in Miamisburg I rode with the Brits. *(Rob had left a meeting just to be sure I didn't get stranded at the airport!)*

Soon we arrived at DIS. Dick didn't go the wrong way once. He might make a good colonist yet!

Days Inn, Dayton South, the Mecca of QRP. What a place. All my QRP heroes were either already there or were on their way. It was hot, I was tired, hungry and most of all excited. Out of the front door came Mike Czuhajewski, WA3MCQ & Danny Gingell, K3TKS. As I came in the door I was introduced to Les Shattick, K4NK & and his lovely wife.

Soon Mike, Danny & I were settled into our room. At this point we even had HOT water! What fun it is to see friends again after a full year. Then it was down to the lobby to see more friends. About this time things start getting fuzzy.

(Dayton has a history of doing this to me. This is my third trip there and I still go into overload soon after arrival.)

There was just so much that went on & so many people to see. I can not find the words to really describe it. We visited with Dick & Kathy of S&S Eng. They always have a little "open room", complete with chips, sodas and friendship. We even got a peek at their new all band rig. It was after midnight before we went to bed. This was just Wed night. Nothing was going on yet, just visiting. FDIM minus 1, relax light still on. I should point out that all this relaxing and visiting was taking place while we seting up the room for the Symposium in the morning. The organizers sure wield a mean whip!

It sure didn't take long to get to sleep but all too soon the alarm went off. Clean up, eat a bite and it was time for the FDIM to officially get under way. And what better way to start off than to have a first class Symposium. I heard that there was 170 people there! For those of you that couldn't make it, be sure to order the book that contains the papers that were presented.

And so each day went. Start early and end late! And every minute was filled with fun. So many nice people. I often think about how lucky I am to be able to meet and have as friends so many nice people.

I am now at 31,000 feet over some place on my way back to Reno. Still using the little HP 200LX and the batteries that came with it. The little battery indicator still shows full power. Either there is something wrong with that gauge or this little palm top is really QRP! *(This things runs on two AA batteries. I used it for a few days after getting back on those same two batteries. It truly is QRP!)* The good news is that I got lucky and got an earlier flight out of St. Louis to Reno. That will save me a good two & a half hours. Carol will get to hear an extra hour or two of Dayton stories!

———— Off the Plane ————

At the Banquet I was very happy to see Jim Cates, WA6GER inducted into the QRP Hall of Fame. Congratulations Jim! And Congratulations to Chuck Adams, K5FO, Wayne Burdick, N6KR and Gus Taylor, G8PG on their inductions into the QRP Hall of Fame. Four top notch people that all deserve to be there!

Speaking of the Banquet, it was SUPER! There was about 240 people there! Some without tickets were turned away because the room was filled. Scott did a super job.

The speaker was Ade Weiss, W0RSP and speak he did! He even had Mike Czuhajewski, WA8MCQ come help him. It was a long speech but well worth every minute of it. I feel the history he presented is important enough that it is printed in this issue in it's entirety. After reading it, let us know how you feel about the idea Ade has about making a change in the QRP ARCI logo. I remember when there was a club that claimed that QRP was 100 watts and I would have nothing to do with it because to me QRP was 5 watts! So it's easy for me to agree with the change Ade wants!

The NorCal building contest was another big winner. If there is anyone who still thinks people don't build any more, get them out to a hamfest that has a NorCal building contest. You will see so many examples of "real" ham radio you will start hunting for your soldering iron!

I did make it back home in time to get ready for the CQ WPX CW contest the last weekend of May. And I think I did OK with my 40 meter single band entry. At least I beat my last score and set a new personal record to try and beat next year.

Having a computer do the logging and duping and having that yagi at 85 feet sure helped! The conditions to Europe were not very good but I had many of the JA's stop to remark how loud the 5 watts was. Most of those said I was over S9 which made me feel very good!

Don't forget that the ARRL SS contest isn't too far away. Time now to get in touch with Billy Lunt at the ARRL and sponsor a plaque for QRP again this year. I would love to see all the QRP plaques sponsored this year.

Speaking of the ARRL I want to mention that they did a great job of covering the FDIM. Rick Lindquist, N1RL was there with a camera and we are all looking forward to some coverage in QST. The League has really been giving QRP a lot of exposure over the past few years.

Still no QRP/DXCC. And that may never change. Maybe what we need to do is get an agreement with the league to let the QRP ARCI give out QRP endorsement stickers for the ARRL's DXCC award.

That's it for this time. I have to hurry up and get this all pasted up while I have a chance. Starting in about 12 hours I'll be busy again! Sorry for the long delay with this issue. I plan to do better with the October issue.

de Ron, KU7Y

THE QRP HALL OF FAME, 1998

Mike Czuhajewski, WA8MCQ

The **QRP Hall of Fame** is an honor bestowed by the QRP ARCI on those who have made outstanding contributions to the QRP community. (Membership in the QRP ARCI is not required to be inducted.) We are pleased to present the latest inductees; announced at the QRP banquet at Dayton in May, they are:

Chuck Adams, K5FO
Wayne Burdick, N6KR
Jim Cates, WA6GER
Gus Taylor, G8PG

CHUCK ADAMS, K5FO

Chuck Adams certainly needs no introduction to QRP-L subscribers, nor is he a stranger to readers of the QRP Quarterly and hamfest/convention attendees around the country. In addition to his articles in various QRP journals and work with the NorTex QRP group, he is the founder of QRP-L itself (the Internet QRP discussion forum, a mail reflector), as well as the nominal overseer and de facto "president" (if such a term can be applied to a mail reflector). Started in 1993 and growing in popularity and size over the years, QRP-L has become one of the dominant forces in QRP today. As I've said many times, QRP-L, which I like to call "the QRP Daily," is one of the two best things to happen to QRP in years.

Chuck also created the Fox Hunt, an interesting on-the-air event which is coordinated and reported on via QRP-L. Unlike the traditional Fox Hunts we know, where people run around an area of several square miles hunting for a hidden VHF transmitter in a single day, the QRP-L Fox Hunts are an ongoing, months long operating event. Appointed stations, from all over the country, appear on the air on a preannounced 40M frequency on scheduled nights, call CQ, and have QSOs with as many QRP stations as can hear them. This goes on month after month until the Fox Hunt season is over for the year, and the person who contacts the most foxes is the winner. (Chuck also created several other operating events via QRP-L.)

Doug Hendricks, KI6DS, had this to say about Chuck on QRP-L after his induction was announced:

"Chuck Adams, K5FO, may be one of the most influential QRPers in the world today. His accomplishments are legion, and include conceiving and starting QRP-L, which today is the straw that stirs the QRP drink in my opinion. If you want to know what is going on in QRP today, you go to one source, QRP-L. It has replaced the various clubs as the primary driving force behind QRP. Chuck not only started QRP-L, he manages it. Many, many hams have said that it is the only civilized list dealing with ham radio on the Internet.

"Chuck also undertook at his own expense the superhuman effort of getting the QRP ARCI awards archives in order. He spent over 500 hours working on that project alone. He started the Fox Hunt on 40 meters, and last year alone they were responsible for thousands of QRP QSOs. Chuck also has been a huge supporter of NorCal, quietly doing countless things to help out, many, many times refusing to be recognized. I have called him for advice many times, and he is always there to help. He has flown to Pacificon at his own expense just to be part of the fun and to help get it going. Chuck Adams is also my friend, and highly deserves to be in the QRP ARCI Hall of Fame."

WAYNE BURDICK, N6KR

Wayne Burdick, N6KR, is well known as the designer of many excellent NorCal rigs and accessories. I first heard of him in the pages of QEX many years ago, when he published his Safari 4 QRP transceiver in a series of articles. The name was quite unknown to all of us at the time, but since then has become very familiar indeed. This was not the first time Wayne had been nominated for the HoF. In prior years when we discussed the nominees before voting, some expressed concern that he was a relative newcomer and had not "paid his dues" and might be a "flash in the pan". But as time went on it became obvious that he was a very talented designer and is definitely in QRP for the long haul.

Here are excerpts from some of the nomination letters from 1997 and 1998--

"Wayne is a top notch QRP idea man, and has provided QRPers with an ever-growing list of projects tailored for those who like to build, and those who like to learn. Who hasn't built the NorCal 40, or worked someone who has? The NorCal 40 also formed the basis for a Cal-Tech college textbook on electronic design, which was also made available to QRPers. The multiband Sierra transceiver, adorned with the widely used and imitated KC-1 (frequency counter with Morse readout and memory keyer), or KC-2 (LCD frequency counter, power meter, S meter, and memory keyer in one accessory), is a model of compact, efficient design. The NorCal 49er transceiver was a wonderful learning experience for many QRPers. It spawned a construction contest and an on-the-air contest, as well as many design discussions and modifications. Wayne has also given us the SST [transceiver], and now the NorCal 2N2222 design competition. He has written articles detailing these projects for the QRP Quarterly, QRPp, QST and the ARRL Handbook.

"It is not easy to find an issue of a QRP periodical which does not contain an article or letter by someone about modifications to a Burdick design, or a photograph of some proud QRPer's N6KR rig, or the announcement of a contest or club project Wayne conceived. Wayne's minimalist design concepts (finding ways to reduce parts counts without sacrificing performance, reducing current draw, avoiding transformers and chassis wiring) have had a great influence on individual QRP builders."

—Ralph Irons, N7RI

"Wayne Burdick has made a huge contribution to QRP. His design skills make him a member of a very elite class. He has broken new ground in the simplicity and reproducibility of his designs, yet there is no degradation of performance.

"All of his designs are now household words in QRP circles. I doubt that there is anyone in QRP who has not heard of Wayne Burdick, N6KR. He has spoken at several QRP forums, and is a true genius in my opinion. He has given confidence to literally thousands of beginning builders who are successful because all of his designs are basically fool proof. They work as advertised. Burdick has also been a leader in setting the standards for construction manuals, which in themselves are a work of art."

--Doug Hendricks, KI6DS

JIM CATES, WA6GER

Jim is the co-founder of NorCal along with Doug Hendricks, who was inducted last year. He is the second half of the team that created the Northern California QRP Club, which I consider to be one of the two best things to happen in QRP in years (QRP-L is the other). While Doug is the more visible and outspoken of the two, with Jim preferring to keep a low profile, WA6GER is nonetheless a very integral part of NorCal and it's continuing success. And in case anyone thinks that Jim is a newcomer to QRP, I invite you to dig back into the pages of the Milliwatt (National Journal of QRPp) published in the early 70's--you'll find his name there, too! He's also a collector of QRP rigs; the cover of NorCal had a picture of his collection a few years back, and it's one of the most awesome displays of QRP rigs I've ever seen.

Doug Hendricks, KI6DS, nominated Jim more than once, and has this to say about him (a distillation of his nomination letters for the last two years)--

"Jim has been licensed for over 35 years, and has operated QRP the entire time. He was an early subscriber and contributor to The Milliwatt [QRP journal published by W0RSP, 1970-75], and has been building and modifying QRP gear his entire ham career.

"Jim cofounded the NorCal QRP Club in 1993 and has been a major force in its growth to over 2500 members. Jim writes a welcome letter to every new member in the club, not because he has to, but because he wants to and feels it is the proper thing to do. He has mailed over 5000 kits produced by the NorCal QRP Club, and has handled all of the correspondence for the club since its inception. Jim routinely gets 40 to 50 letters per day, all requiring an answer, and he does it without complaint. Some of the ideas that Jim has done for NorCal include the first idea for a kit, the NorCal 40; meeting monthly at the California Burger after the Livermore Swap; a West Coast QRP Forum at Pacificon; bringing in speakers from outside the local area and paying expenses; the St. Louis Tuner project; the NorCal Keyer; NorCal providing inexpensive crystals for ham frequencies.

"Jim has the most extensive collection of QRP gear that I know of in the world. He has almost every QRP rig and kit produced in the last 25 years. Jim collects the gear to preserve it, and it is one of the finest collections that I have ever seen.

"Because of his efforts, NorCal has been able to help promote and support QRP and QRPers throughout the world. Jim has always done everything possible to help newcomers get started in QRP. I know, because he helped me. Jim Cates aligned the first kit I ever built, then he showed me how to do it myself, and he was a wonderful teacher.

"Jim is a quiet, gentle man, who is a gentleman at all times. NorCal would never have been the success that it is without his leadership and untiring work on behalf of all QRPers. He does not stand out in a crowd because of his choice to remain in the background. But no one has done more to support QRP than Jim Cates. He has been my mentor and friend, and I am extremely fortunate to count him as my best friend."

And after his induction was announced, Doug had this to say about Jim on QRP-L--

"Jim Cates deserved to go into the Hall of Fame last year with me, and I have felt guilty about being in the HoF without him since my induction. In fact, I will hang my plaque on the wall now, as I refused to hang it until Jim was in with me. Several years ago I remembered Roy Lewallen (W7EL) saying that he did not feel right being in the HoF until Wes Hayward (W7ZOI) was inducted. I did not understand how he felt until last year. I also now know his relief. Jim is my very best friend, mentor, father figure, and brother. I love him and would do anything that he asked because I trust him implicitly. He has worked tirelessly for QRP and is and always has been a gentleman. NorCal business takes up at least 4 hours of his time every day, and many, many times it has taken 16 hours a day. He never complains, and he does what he says he will. NorCal would not have happened without Jim. He is my friend, and I am far, far better for it. I thank the QRP Hall of Fame voting committee for honoring a great QRPer."

GUS TAYLOR, G8PG

Gus Taylor, G8PG, is not quite as well known on this side of the pond as he is in the UK, but he is quite prominent in the GQRP club, and graces the pages of SPRAT on a regular basis. He currently writes a column for it titled "Antennas -- Anecdotes -- Awards." When nominations are made for the QRP HoF there are some names to which my reply is to smile and say "but of course." Gus is one of those, and I'm sure all of the folks on his side of the pond will agree.

From the nomination submitted by **C. F. Rockey, W9SCH:**

"If you please, I'd recommend Gus Taylor, G8PG for the QRP Hall of Fame. I have been a subscriber to SPRAT, the GQRP Quarterly for about 20 years now, and in very few issues have I failed to see notes and articles on how much he is doing for British and world QRP as described in that publication. He does a great, regular column on antennas in SPRAT. He sponsors contests, writes technical articles, builds gear and "elmers" beginners into QRP. GQRP has recently honored him for it's Worldwide Service Award also.

"In my opinion he is the perfect example of a fine British gentleman, and is into QRP with both hands and both feet! If anyone has earned a true place in the QRP Hall of Fame, Gus certainly has!"

Here's a tribute passed on by a neighbor when he read of Gus' induction on GQRP-L--

"Glad to see the list for this years Hall of Fame includes Gus G8PG. He happens to live a few miles from me on this side of the pond. He has been a great source of help and inspiration to me for a number of years. A little while ago I had the pleasure of visiting his shack - quite modest in many respects. But to hear him on the key is wonderful. He is a mine of information on many aspects of radio and, as you are aware, particularly on matters relating to aerials." -- **Niall (G0JNP)**

THE MEMBERS OF THE QRP HALL OF FAME

The 4 people inducted this year join 14 others; the current members are:

1992	1996
Doug DeMaw, W1FB (silent key)	Brice Anderson, W9PNE
George Dobbs, G3RJV	George Burt, GM3OXX
Roy Lewallen, W7EL	Tom Davis, K8IF
Randy Rand, AA2U	Wes Hayward, W7ZOI
	Rick Littlefield, K1BQT
	C. F. Rockey, W9SCH
	Adrian Weiss, W0RSP
1997	**1998**
Doug Hendricks, KI6DS	Chuck Adams, K5FO
Dick Pascoe, G0BPS	Wayne Burdick, N6KR
Mike Czuhajewski, WA8MCQ *	Jim Cates, WA6GER
	Gus Taylor, G8PG

* I think a disclaimer about my own induction is in order, since I assumed responsibility for the QRP Hall of Fame starting with the 1996 cycle and was inducted the following year. It was done behind my back and almost completely without my knowledge or involvement. I received a couple of letters nominating me, and told them I would not accept the nominations into the system due to the appearance of conflict of interest--after all, I was the one running the program! I instructed them to send them to a third party if they really wanted the nominations to be put in place, and it would then be up to that other person to forward them to the voting body if he saw fit, and handle it without my knowledge or involvement.

SOME ADMINISTRATIVE COMMENTS

The QRP Hall of Fame is an honor bestowed by the QRP ARCI on people who have contributed greatly to the QRP community. Not only is it not necessary to be a member of the QRP ARCI to be inducted, we've even had some people who did not particularly consider themselves to be QRPers! However, their contributions to the QRP community were still quite noteworthy.

Nominations are solicited from the general club membership each year and passed on to the voting body. The QRP Hall of Fame is not a competition, and we have no limits or quotas. Each person is judged separately on their own merits, and must get at least a 2/3 majority FOR vote to be inducted. If the voters feel that all of the nominees in a given year are deserving of the honor, then all will be inducted. On the other hand, if no nominees in a given year receive a large enough FOR vote to be inducted, none will be added to the list. We will not "lower the bar" and accept a slightly lower score just for the sake of having names to announce every year.

The QRP HoF program got off the ground in 1992 due to the efforts of past president Paula Franke, WB9TBU. She noted that while the QRP Hall of Fame program had existed on paper for a while, the criteria for induction was a rather unrealistic 100% FOR vote, which virtually guaranteed that no one would ever get in! She reduced it to a more reasonable 2/3 majority and got things rolling with the induction of W1FB, G3RJV, W7EL and AA2U. The program went into "idle mode" for a few years until responsibility for it was given to me, WA8MCQ, and has been going strong since. The next inductions were made in 1996, 1997 and 1998, bringing us to a total of 18 people thus far.

In the years since we've gotten the program back on track, the voters have been holding the nominees to a fairly high standard. While there is no formal list of qualifications to meet to be inducted, the voters do discuss the nominees and the induction process by e-mail each year before the voting begins, and it seems to be working out well so far. And considering the number of nominations vs. inductions, there appears to be no danger of it turning into a rubber-stamp operation. The number of inductees vs. nominees was 7/17 in 1996, 3/15 in 1997 and 4/8 this year. By the way, of those 17 nominated in 1996, 11 are now in the Hall of Fame. A number of people have been nominated in more than one year, and some were eventually inducted.

Once again, as we did last year, we gave the existing Hall of Fame members the option of voting if they wanted to, and several did so. The regular voting body is the QRP ARCI Board of Directors, plus President and Vice President.

If anyone has a favorite QRP hero that they think is worthy of being in the QRP Hall of Fame, you'll have a chance to nominate them later in the year. The call for nominations usually goes out with the October issue of the QRP Quarterly, and will also be posted to QRP-L. (Nominations are not accepted before that.)

—qrp—

Still QRP Really!

QRP WISDOM FROM UNCLE BRUCE

Bruce Muscolino, W6TOY
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Silver Spring, MD 20916
w6toy@erols.com

Dayton

Dayton is going on right now, even as I type this! In fact the swap meet has been open for about 2 hours now. Long live Dayton. This is the first year that I didn't make it out there in the last five. Health problems eliminated the trip for two reasons – first I would have had to ask the crew to stop the car every hour or so I could get out and ease the cramping in my legs, and second, because I would have been mostly confined to my hotel room. And fine as the rooms are at the Days Inn - Dayton South, what's to do there when the action is 20 miles away! I mean really, could you imagine being stuck in a room 20 miles from the greatest Ham Radio Swap Meet in the free world and not being able to attend? But, I digress.; by the time you read this I may actually be on the road to recovery. Say a prayer for me!

The big buzz around Dayton this year seems the introduction of several brand new multi-band, multi-mode QRP Transceivers. S&S Engineering, Elecraft, and OHR all apparently have radios in the works. I will be cornering my friends who were there for first hand, eye-witness impressions next Monday, or Tuesday. That, the Technical Conference, and the NORCAL 2N2222 Design contest were high on my list of things to see while there. Oh yes, and let's not forget the new and improved banquet! Hmmm, maybe I could have just stayed around the hotel and been happy.

Back to the Future

Can there be any of you who still haven't heard about the great "Back to the Future" project? This revival of a design series started by Doug DeMaw's Tuna Tin 2 transmitter back in 1976 is moving along at full speed. The concept behind the Back to the Future is to revive and update a series of classic designs in honor of Doug DeMaw. The QRP ARCI and the NorCal QRP Club agreed to jointly sponsor the project and to publish the construction articles in their magazines. The April issues of QRP Quarterly and QRPp presented the Tuna Tin 2, the original 400 mW transmitter, and the Herring Aid 5, and the 5 transistor Direct Conversion receiver. In this issue, July, we're presenting the CB Slider, the VFO, and Codzilla, a 5 watt linear amplifier.

Now, for the really big news; the American Radio Relay League is joining the group and will co-sponsor an operating event especially for these radios. The event details are still being worked out, but we're hoping to put the original Tuna Tin 2 on the air from W1AW. There will be special QSL cards and probably some certificates. Tentatively we're looking at October/.November as a target for the event, so you'll want to get moving on building the rigs NOW! Circuit boards are/will be available from FAR Circuits and all the parts can be bought from Mouser.

I got in the revival part by doing the design update of the CB Slider. I have to tell you it was a heck of a lot of fun! But, I am also going to restore the ORIGINAL Tuna Tin 2 Transmitter. There's an interesting little story behind this radio, parts of which I've told you before. Now here's the "rest of the story"! In 1985 I made a trip to ARRL Headquarters to visit with my old friend (and former boss) Bruce Williams. As you entered the League's office building you walked through a small museum area filled with historical treasures from ham radio's past. Among the exhibits are the original "Wouff Hong" and many others I grew up with as a kid. There, prominently displayed in a glass case was the original Tuna Tin 2, looking just like it had looked on the cover of QST in 1976.

It seems that sometime after that visit, during remodeling, the Tuna Tin 2 went AWOL. Later on, Ed Hare, W1RFI, found it in a box, under a table at a hamfest up in New England. He paid a buck or two for it, and put it in his pocket. He thought he'd bought a good copy of the original until he got it back to Headquarters. There, something about it prompted him to dig out the photographs that had been taken for the article. Guess what? It was the original article! Ed went to his bosses and offered it back to the museum but after hearing his story they decided that someone had stolen it and Ed came by it legitimately. It's been in his possession ever since.

Wanting to add his part to the Doug DeMaw tributes going on this year Ed has decided to restore the rig to it's original glory, use it in the operating event from W1AW, and then re-present it to the League's museum. I'm the one fortune smile on to do the restoration. I'm checking my post box every hour on the hour, waiting for it to show up!

I'm gonna tell you, if you don't participate in this project and the operating event I won't speak to you any more. When you open your copy of the Quarterly the pages with my column will forever be blank for you! Just Do It!

Electronic Magic

The NorCal 2N2222 Design Contest got a lot of us to try out some of the latest crop of electronic design software. I downloaded MicroCap, an electronic design program. MicroCap and I have recently become great friends. While there are large holes in my knowledge of how to use MicroCap, but I've been merrily modeling band-pass filter networks for the last couple of weeks. It sure is neat to draw up your circuit and run the analysis program to see how it works. The result of changes can be evaluated almost instantly!

But, my own experiments aside, let me encourage you to download the sample software (you can get it from <sales@spectrumsoft.com>) and do your own experiments. It's amazing what you can do and what you can learn this way. It is not a substitute for burning your fingers on a hot soldering iron; but it can make your sessions using real solder more productive!

Old Radios

Many of you know I use a Kenwood TS130V as my main station radio. A couple of months I bought it a friend -- a Yaesu FT301SD. Then just last week I bought a Heathkit SB104Q for more noise in the shack. The Yaesu FT301SD was a contemporary of the TS120/130, and it too was the low power version of a QRO radio.. I'd been looking for one of these for a long time, and even though this one is hardly mint, I think I got a great deal. It covers 160 through 10 (minus the WARC bands), CW, SSB, and AM! By the way, the first three QSOs with the rig were DX stations, on 20 and 40!

The SB104Q. What's that you say? You didn't know Heathkit made a "Q" model of this radio? Neither did Heath! It seems this radio experienced terminal failure in the power amplifier module and the owner removed converted it to QRP. I got a pretty great deal on it too, and though I haven't had it on the air yet, I'm looking forward to it. It should produce about 3 watts out. I'll try to have pictures and some results for you to ponder next time.

Me.

If you read my last column you know I've been having problems with my back/hips. Well it's gotten bad enough that I'm even considering surgery. In fact I pretty much expect to have a hip replacement sometime in early June. The final verdict is not yet in from the surgeon, but he's pretty much excluded my back and put the blame on my hips. I'll see him again in a few days. 'Till next time, your prayers will be gratefully appreciated. 73

QRP CLUBHOUSE

Bob Gobrick, N0EB, (VO1DRB & UN7N0EB)

Welcome to the QRP Clubhouse. What's the secret password? Why "QRP" of course! Summer has arrived at the QRP Clubhouse and it is summer that makes those QRP Club outdoor activities all that more enjoyable. It's a great time of year for club members to get together and play with those new transceiver kits built during the winter or to try out some new exotic "to-the-field" antennas. It's also a great time to just move the monthly club meeting "out-of-doors" and set up some simple operating stations and a BBQ. Whatever the excuse, get the club members out in the sunshine for some QRP operating fun.

This July column will be reaching many of you just as the grand daddy of outdoor field operating events takes place - the ARRL Field Day exercise. If your club participated in the event then you know how much fun it can be. A QRP club can have just as much fun putting on a small impromptu event. Recently the **Minnesota QRP Club** made one of their monthly Saturday meetings a "Minnesota QRP Gopher Operating Test". Folks brought their QRP rigs and some portable antennas and proceeded to throw up some nice little operating stations. Even though it rained that day and the bands were completely shut down by a solar flare (gophers don't worry about those sort of things) a good time was had by all. So just do it! And if you get a chance, drop the QRP Clubhouse some JPEG photos of your clubs operating events to be shared with others.

The QRP Clubhouse in-basket has lots of QRP club news for this issue. So let's see what is happening on the QRP Club scene.

Iowa QRP Club Sprouts after Early Spring Planting

It only took a few months for a new QRP Club to establish its roots in the State of Iowa. **John Burnley NU0V** sowed the seeds early in the year by posting on the QRP-L list for any interest in forming an Iowa QRP club. By April 1998, they had their inaugural meeting with many of the 19 new members bringing their show-and-tell QRP toys to that meeting. Since that "Field of Dreams" meeting much has developed for the Iowa gang. First a web site and list serve was established by **Adam N2BRT** and **Dan KB0JUL** with a URL of http://wwwl.iastate.edu/-drcase/iowaqrp.html Next, **Jerry WB0T** established a weekly CW QRP net on Sundays at 16:30 (CDT) at 3.710 MHz. Then **Jerry KI0IH** volunteered to put out an electronic newsletter for the members and **Mark KQ0I** took on the task of keeping the gang informed of up-and-coming QRP operating events and contests.

New sprouts began to bud as **Larry WB0RMT** helped set up a QRP information table at the April Des Moines hamfest and a follow-up presence at the ARRL Midwest/Dakota Division Convention in Sioux City in late May. **John NU0V** deserves a pat on the back for getting this club up and going in such a short period. I think you can see from above some of the reasons why - these are one heck of dedicated bunch of QRPers. For more club information drop **John NU0V** an email at burnley-ia@worldnet.att.net. Good luck gang.

EA-QRP Club - Hablo Espanol?

When we think of International QRP Clubs, names like the **G-QRP**, **CW Operators' QRP** (Australia) and **QRP ARCI** pop into our minds since we associate these clubs with their English language publications. But as many of you know, there are other popular QRP Clubs that we hear about via the QRP-L Internet list that do not publish their newsletters in English. One such club is the **EA-QRP Club** or the QRP club of Spain. The club was founded in October 1993 and has grown to over 350 members. A quarterly newsletter, the QU-R-PE, which is published in Spanish, is one of the clubs' wonderful contributions to the QRP world. The club sponsors an annual QRP contest and additionally they produce printed circuit boards from circuits in the QU-R-PE, which are then distributed to members once a year. Checking the EA-QRP-C club homepage you even come across a club project - the EA-40 which looks like a "European RFI ready" 40 meter cw transceiver designed by **Enrique EA5GRG**.

For subscription information check out their Web site at http://www.eaqrp-c.arrakis.es or write to **Miguel Molina EA3FHC**, Av-Rio de Janeiro 123 2-1, 08016 Barcelona, Spain.

AR QRP Club Still Growing

As **Bob N9ZZ** (QRP AR #1) states in the latest issue of the **Arkansas QRP Club** newsletter - 300 MEMBERS BY END OF 1998. The June 1998 AR QRP Newsletter arrived at the QRP Clubhouse via email and this is one of the reasons for their stellar growth. Membership is open to all QRPers but you must have Internet capability to receive the free newsletters. The club also runs a Monday night (local) CW Net at 0130Z (Tues.) at 3.560 MHz - give it a try. The newsletter had a nice report by **Bob N9ZZ** on the AR presence at FDIM 98 at Dayton. In addition, **Bob W0LK** reviews the **Oak Hills Research** OHR 100-A for 30 meters and **Sandy W5TVW** gives some thoughts on QRP portable antennas. Finally the newsletter ends with some Member Profiles - these profiles are solicited on a random basis from the membership roster and you'll never know what surprises are in store - hi. The June issue profiled AR QRP members **Frank N5SAN**, **Hank K8DD**, and **Bob K2LGJ**. For information on joining the AR QRP Club drop an email to **Jim Hale KJ5TF** at kj5tf@madisoncounty.net

The CW Operators' QRP Club Gets Pretty

The QRP Clubhouse just received a posting from **Kevin Zietz VK5AKZ**, the Secretary of the Australian **CW Operators' QRP Club** that the club now has a new Web Homepage for all to see. The Homepage can be reached at http://www.users.on.net/zietz/qrp/club.htm

Don Callow VK5AIL, the editor of the clubs' super newsletter, the Lo-Key, and President **Barry Samuals VK5BLS** structured the Web page with an Introduction, Contests, Inside the Latest "Lo-Key" and Membership. If you get a chance check out the Homepage - there is a neat posting on "Ten Steps to QRP Success". It should be noted that the "Lo-Key" is a gem of a newsletter. The March 98 issue has an article on a Simple Transistor Tester by **Paul Anderson VK2GPT**; a Club Mini-ceiver Receiver Competition to celebrate 15th Anniversary of the first issue of the "Lo-Key"; Making Your Portable QRP Station Smaller by **Peter Parker VK1PK** and the Spontaflex Rx by **K.P.S. Kang VU2OWF**. For membership information drop **Don Callow VK5AIL** an email at kevin.zietz@adelaide.on.net

St. Louis QRP Society - 10th Anniversary

The **QRP Clubhouse** just recently started to receive The Peanut Whistle, the newsletter of the **St. Louis QRP Society** (SLQS). What is unique about the St. Louis QRP Society, which by the way is one of the oldest QRP clubs in the United States, is that it strives to keep it's membership local and not expand beyond its QRP reach. Over these

past ten years the club has been publishing this wonderful newsletter and it is always filled with good technical articles. Unfortunately, the QRP community does not usually get to see these great writings unless the QRP Quarterly or the NorCal QRPp republish a particular article.

Well that may change! The **QRP Clubhouse** was fortunate enough to receive from **Dave Gauding NF0R, Keith Arns KC0PP** and **Matt Kastigar N0XEU** a special **10th Anniversary Issue of the Peanut Whistle**. This 34 page double sided Anniversary issue is just choke full of some of the best technical articles around. Lots of Heathkit HW-8 tidbits from the Notorious SLQS HW-8 Sub-Group, **Paul Harden NA5N** with his original articles on Regenerative Radio Receivers, the famous SLQS LM380N Audio Amplifier, the St. Louis Tuner, the St. Louis Vertical, St. Louis Radials, the St. Louis Loop and much, much more. This is a "must have" publication for any QRPers library.

There is a catch though! The 10th Anniversary addition was put out in limited circulation and I'm not sure if the Club has any copies left. But with enough of a cry from the QRP masses maybe SLQS will make a second run. The **QRP Clubhouse** suggests you contact **Dave Gauding NF0R** at nf0r@slacc.com or drop Dave a note at 880 Judson Manor, St. Louis, MO 63141 for more information.

The Low Down on the Low Down

Congratulations are in order to the new slate of **Colorado QRP Club** Officers - **Marshall Emm N1FN** is now President, **Rich High W0HEP** - VP, **Jan Medley N0QT** Secretary and **Dick Schneider AB0CD** Treasurer. And a BIG congratulations to the four plus year effort that **Rich W0HEP** put into making the **Colorado QRP Club** the premier Club that it is. **Rich** continues as Editor of the Low Down, the CQC bi-monthly newsletter and as always the Low Down is packed with some great articles. The May 1998 issue has featured columnist **L. B. Cebik W4RNL** talking about Up, Up and Away or Harmonic Operation of Off-Center-Fed Dipoles. This is Part 10 of the Antennas From the Ground Up column and I hope, someday, Rich will catalog all of L.B.'s articles into a separate book - I bet it would be a high flying seller. **Marshall Emm N1FN** talks about Adjusting Straight Keys and Paddles, **Duane Sanderson W0TID** looks at The Search for a Better Portable HF Antenna and **Steve Galchutt N0TU** looks at Converting the "Hamstick" to a "Bugcatcher" or the BC/Lite. The March 1998 issue of the Low Down also has a wonderful Part 2 article on Troubleshooting & Alignment **by Paul Harden NA5N**. All good stuff. If you are interested in joining CQC then drop **Rich High W0HEP** an email at W0HEP@aol.com or write CQC, PO Box 371883, Denver, CO 80237-1883

Give a Call to the QRP Society of Central Pennsylvania

By the time this issue of the QRP Quarterly hits the streets the **QRP Society of Central Pennsylvania** will have hosted its first annual QRP contest - the TAContest or the Telephone Area Code Contest on June 6, 1998. Good luck to the gang and remember, it only takes a couple of one ringy-dingies to have fun in QRP Contesting. For more information on the QRP Society of Central Pennsylvania drop an email to **Cam Bailey KT3A** at KT3A@juno.com

MN QRP Club Chills Out

Congratulations go to the top team entry of **WQ0RP**, the official call of the **Minnesota QRP Club**, for their winning ways at the annual 1998 "Freeze Your Bxxx Off" Contest. Led by the cold blooded team of **Jim N0UR**, **Larry KB0R,** and lots of logging, cooking and "moral" support by the MN QRP members, the gang held on until 9 PM when the temperature dipped to 18 degrees F. Good time had by all and I'm sure this is going to stir up other "polar bear" QRP Clubs for next years event. For more information on the MN QRP Club check in with **KA0GKC Claton Cadmus** at http://www.qsl.net/mnqrp

Columbus QRP Club Reports on New Multiband QRP Rigs

The Columbus (Ohio) QRP Club newsletter was one of the first to report on a flock of new multiband QRP rigs coming out this year. In addition to the **ELECraft** K2 All band SSB/CW Transceiver Kit news, **Steve Bornstein K8IDN**, the editor of the monthly **CQrp Club** newsletter, reports in the May 1998 issue of a new **Oak Hills Research** OHR-500 five band cw transceiver replacement for the discontinued OHR-400 and a new **S&S Engineering** All band SSB/CW transceiver called the M1. Rumors have it that **Small Wonder Labs** also has a multiband in the works. This is going to be an exciting year for builders of some high performance multiband QRP transceivers kits. To get the latest news breaks from the CQrp Club contact **Steve K8IDN** at 475 East North Broadway, Columbus, Ohio 43214.

Michigan QRP Club Misses Out on the Winter of 97/98

Michigan QRP Club President **Tim Pepper K8NWD** reports that the mild 1998 winter season seems to have led to a lot more QRP activity for the Michigan QRP club contests. The mild winter also brought in some nice articles for the March quarterly publication of The Five-Watter. **Chuck Adams K5FO** has a review on the **Oak Hills Research** OHR-100A, **Craig La Barge WB3GCK** reports on The Duck Vertical, a take-off of the St. Louis Vertical suitable for operation in the town of Duck, on the Outer Banks of North Carolina and **Ron Stark KU7Y** talks about Contesting for Fun, an article that originally appeared in the **ARRL National Contest Journal**. For more information on joining the Michigan QRP club contact the Membership Chairperson, Michigan QRP Club, 654 Georgia, Marysville, MI 48040.

NorCal QRP Gone Fishing

The Spring issue of the **Northern California QRP Club** quarterly newsletter QRPp arrived here at the **QRP Clubhouse** with a wonderful front cover of a QRP lad fishing. Well the NorCal QRP gang probably wishes they had some time for fishing with all the ambitious projects on the docket for 1998. At the **QRP ARCI Four Days in May** weekend in Dayton, the NorCal QRP Club hosted the annual building contest with some great prizes for NorCal K8FF Paddles, 2N2222 Design Contest and the K5FO Unlimited Class. What a super event this turned out to be. Also at FDIM, NorCal announced their new club kit - the NorCal 20, a easy to build 20 meter cw transceiver modeled after the NorCal 40 except it is designed for international (high RFI environments) use. This will be a very special Project for NorCal since it will help spread ham radio and the NC-20 to many third world countries. The third world distribution will be a joint venture with the **G-QRP Club**. And finally NorCal announced their sponsoring of a full day of QRP talks at the October 1998 PacifiCon hamfest in Concord, CA. If it is anything like last year this will be one great QRP event. And finally, yet another NorCal accomplishment - congratulations to NorCal co-founder **Jim Cates WA6GER** and his induction into the **QRP ARCI Hall of Fame**. What a great HOF duo of Doug and Jim from NorCal.

With all this activity it's amazing they find time for yet another super QRPp newsletter. Although I will not cover all 72 pages of the **Spring 98 QRPp** I would like to mention one article that will help make your summer operating events a lot more fun. **Joe Everhart N2CX** writes a nice tutorial on End-Fed Half-Wave Antennas. This is

a must read article since the EFHWA is probably one of the easiest antennas to get up at a field location and is a super performer for such a simple design. Forget all those radials that you need to attach to that fishing pole vertical. Just throw up a half wave wire, add a 1/4 wave counterpoise and attach all to your rig and bingo - you are on the air. Give it a try.

For more information on NorCal QRP Club drop a line to **Doug Hendricks KI6DS** at 862 Frank St. Dos Palos, CA 93620.

New Jersey QRP Club Finds Another Pot of Gold at the End of a Rainbow

At the recent 1998 FDIM QRP Symposium **George Heron N2APB**, **Joe Everhart N2CX** and **Clark Fishman WA2UNN** presented a paper on the next **New Jersey QRP Club** project - the Rainbow Antenna Analyzer. The analyzer will be a low-cost, microprocessor-based measurement instrument for automated SWR analysis, with remote PC control and graphical display. This should be popular Club project and will allow the builder a nice piece of test gear to compete with the commercial units by MFJ and Autek.

Also over on the NJ QRP Club Web page work continues on the MicroBeacon project which we should be hearing more about during the next few months. To check out the NJ QRP Club happenings log on to their web site at http://www.njqrp.org

G-QRP Club Exports Six-Packs to the Colonies

In a move to bring quality "taste" back into the lives of QRPers, the **Rev. George Dobbs G3RJV** presented a wonderful paper at the **1998 FDIM QRP Symposium** on the G3RJV Six-Pack. Actually George's talk had nothing to do with the national drink of the UK or North America, but instead it was about six simple circuits to entice hams back into building. Many of these circuits have appeared in **SPRAT**, the G-QRP newsletter, over the years - A Plug and Play Transmitter, The Quick Receiver, An Instant SWR Meter, A Diode Probe, An LED Voltage Monitor and Crystal Checker. A Six-Pack Printed Circuit Board and parts kit is being made available by Kanga UK and Kanga US for those interested. For those who really want to homebrew it themselves, **Dick Pascoe G0BPS** also presented a companion paper at the **1998 FDIM QRP Symposium** called "Alternatives to the "ever so umble" PCB".

The circuits presented in these papers are the makings for some neat QRP Club projects. In particular, the simple LED Voltage Monitor has caused a stir among the veteran QRP builders since this one chip and 10 LED circuit answers the need of knowing when your rig's battery is about to go QRT. This is the making of a great club project. For those interested in securing a copy of the **1998 FDIM QRP Symposium Proceedings** (a wonderful publication by **George Heron N2APB**) please drop **Hank Kohl K8DD** an email at the **QRP ARCI Toy Store**.

NorthWest QRP Club Turns Six Years Old

Congratulations to **Bill Todd N7MFB**, NWQ Editor and the **NorthWest QRP Club** on their Sixth Birthday. Many may not know this, but back in June 1992 there were only two US national-like QRP Clubs - namely **QRP ARCI**, which at that time had an "East Coast" slant, and the **Michigan QRP Club** which catered to the Midwest QRP gang. Additionally some regional clubs existed, like the **St. Louis QRP Society** and the **OK QRP Club**, but they didn't publish national newsletters. That all changed in the summer of 1992 when two new QRP Clubs came on to the scene and started what many consider to be the meteoric growth of Regional QRP Clubs with national newsletters. Those two new QRP Clubs were the **New England QRP Club** and the **NorthWest QRP Club**.

And how have things changed since 1992. The NWQ, the official bi-monthly newsletter of the **NorthWest QRP Club** now arrives electronically at the QRP Clubhouse as a "real zine" magazine complete with color illustrations. In the June 1998 issue there are some super articles - **Bill Jones KD7S** on "Maximizing Small Loop Antenna Performance (original article appeared in QST), **Duffey KK6MC/5** on "how to Understand and Work Sporadic E Skip on 10 Meters", **Paul Harden NA5N** on "Why I Am A QRPer", **and John Porzelt N9UKX** on "Spring Lightning Protection". Those feature articles, along with the regular DX and activity columns, make the NWQ one heck of a magazine. For more information on joining the NorthWest QRP Club drop **Bill Todd N7MFB** an email at bill@willapabay.org

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

What's the secret password? - "QRP"

Link-Coupled Antenna Tuners
Part 2: The Input Story

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

This is the second installment of a multiple part series on Link-Coupled Antenna Tuners. The first installment appeared in the April 1998 issue of ***The QRP Quarterly*** *beginning on page 13.*

Having digested the fundamentals of inductive coupling presented in Part 1, we can next turn to a step-by-step investigation of inductively coupled antenna tuning units (ATUs). We already know that the tuner will consist of an input inductor (L_P) plus any other refinements we eventually choose to add. It will also consist of an inductor (L_S) and capacitor (C_S) in the secondary, forming a parallel resonant or near-resonant (tank) circuit, with the load (R_L) connected in parallel to the tank. Figure 1 shows the most basic schematic once more.

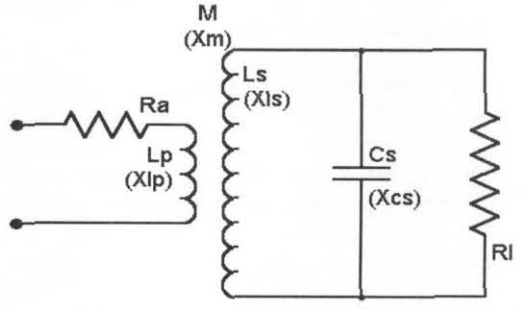

Fig. 1 The most basic link-coupled ATU.

The input resistance in series with Lp is designated R_A and is the resistive impedance coupled back to the primary. As we have noted, the secondary tuned circuit at resonance has no series-equivalent reactance and therefore does not couple a reactance back to the primary or input side of the circuit. To couple a compensating capacitive reactance back to the primary, one must resonate the secondary at a frequency somewhat higher than the operating frequency. In this case, there are both resistive and reactive components to the secondary impedance, and hence, resistive and reactive components to the impedance coupled back to the primary.

Since the offset adjustment has little effect on the value of the coupled resistive component, but chiefly provides the capacitive reactance needed to cancel the inductive reactance of the primary inductor, we shall normally not mention (except where necessary) this offset adjustment. However, tuner designers and users should remember that this offset is a normal part of most antenna tuner adjustments. When we use an SWR meter between the ATU and the transmitter, we are making this adjustment automatically in seeking a 1:1 SWR. If we leave the reactance of the primary inductor uncompensated, the SWR will be above 1:1 for the case where R_A is 50 Ohms.

A Little Orientation

In the account of inductive coupling fundamentals, we gave the following equation as the most basic approximation of the input resistance to the remaining conditions in the coupling circuit:

$$R_A = \frac{X_M^2 R_L}{X_{LS}^2} \qquad 1$$

where R_A is the resistive impedance coupled back to the primary, X_M is the reactance of the mutual inductance between coils, and X_{LS} is the reactance of the secondary inductor (or capacitor) at secondary resonance on the operating frequency.

In editions of **The ARRL Antenna Book** since at least 1960, a different equation is given, presenting the initial appearance that the account there may differ from this one. However, let's do a little work on Equation (1) above.

First, we know that the coefficient of coupling (k) and the mutual inductance (M) are related by the square root of the product of the two coupled inductances. Since converting an inductance to its reactance at any given frequency is a matter of multiply the inductance by $2\pi F$, which cancels out in the relationship, we can also express how k relates to M this way:

$$X_M = k\sqrt{X_{LP} X_{LS}} \qquad 2$$

where X_M is the reactance of the mutual inductance, and X_{LP} and X_{LS} are the reactances of the primary and secondary inductances, respectively.

Squaring both sides of Equation (2), we can replace the term X_M^2 in Equation (1), cancel out an X_{LS} above and below the line, and reach this step:

$$R_A = \frac{k^2 X_{LP} R_L}{X_{LS}} \qquad 3$$

where all terms have the definitions given in the equations so far.

For a parallel-loaded circuit where the load resistance is small compared to the resistive impedance of the resonant circuit, the loaded circuit Q is approximately the following:

$$Q = \frac{R_L}{X_{LS}} \qquad 4$$

If we replace R_L over X_{LS} with Q, we obtain the very equation shown in **The ARRL Antenna Book**:

$$R_A = k^2 X_{LP} Q \qquad 5$$

The only differences lie in the choice of subscripts, and I have selected mine to be consistent with those in Part 1.

Equations (3) and (5) give us important information about the design of inductively coupled ATUs. First, the resonant secondary ATU is most efficient when the numerical values of R_A and X_{LP} are the same. (Note that we only approximate this condition when we detune the secondary in order to cancel the reactance in the primary.) Under these conditions, a relationship emerges between k and Q:

$$k = \frac{1}{\sqrt{Q}} = \sqrt{\frac{X_{LS}}{R_L}} \qquad 6$$

The upshot is this: We can optimize our ATU design by varying the relationship between the load resistance and the reactance of the secondary inductor, or we can optimize our design by varying the coefficient of coupling—or we can do both. That gives us a good bit of flexibility in designing the ATU.

We shall look at both sides of the circuit for ways to optimize our design. As we did in Part 1, we shall stick to purely resistive loads and leave the question of reactance on the line for later consideration.

Likewise, we shall retain the parallel configuration of the secondary circuit and devote some attention later on to low impedance loads and the series-counterpart of the circuit. Let's master one thing at a time.

The Big Little *k* and X_{LP}

Let's reset the parameters of our initial ongoing problem that we initiated in Part 1. We wanted a tuner for 7 MHz and chose a secondary inductor of 12 µH (with a reactance of 528 Ohms at that frequency) along with a primary inductor of 1.2 µH (53 Ohms reactance). The resonant capacitance was 43 pF. We chose as our load (R_L) 1500 Ohms (resistive).

With the chosen values and an assumed k of 0.6, the mutual reactance was 100 Ohms. The secondary loaded Q was 2.8 or so (which tells us that everything we are doing here is an approximation, since the equations are truly accurate only for Qs above 10). Whichever equation we use to obtain the coupled resistance to the primary, we obtain about 54 Ohms. However, this value of R_A applies only to a load of 1500 Ohms resistive.

What happens if we have a different load to match with the same components? Table 1 tells us a story.

Table 1. Some values of R_A for various loads (R_L) in the standardized circuit.

R_L (Ohms)	Loaded Q	R_A (Ohms)
500	0.95	18
1000	1.89	36
1500	2.84	54
2000	3.79	72
2500	4.73	90

In order to effect a 50-Ohm match, we might consider altering the value of X_{LP}. This would entail altering the size of the primary inductor, which would inevitably alter the values of M and k. However, assuming we could retain a k of 0.6, Table 2 gives us the trend of value changes needed for the 50-Ohm match.

Table 2. Some values of X_{LP} for various loads (R_L) to achieve a 50-Ohm match.

R_L (Ohms)	Loaded Q	X_{LP} (Ohms)
500	0.95	146
1000	1.89	73
1500	2.84	53
2000	3.79	37
2500	4.73	29

For most inductively coupled tuners, this is not a practical alternative. The primary inductor is normally fixed within or immediately over the secondary inductor. Tapping it precisely would require closely spaced taps. Mechanically, the switch leads or the manual tapping wires would introduce variations in the impedance seen at the input terminals of the tuner. But the exercise does give us a feel for what happens at the primary with changes in antenna feedline loads.

Swinging Links

We mentioned that our changes in the reactance of the primary inductor would occasion changes in the coefficient of coupling. We can use that idea in another way. Suppose that we could change the coefficient of coupling without disturbing (too much) the reactance of the primary inductor. Figure 2 shows how this has been done traditionally.

The swinging or movable link or primary inductor, moving within a space at the center of the secondary coil, effectively changes the coefficient of coupling and hence the mutual impedance of the coupled inductors. The value of k increases as coupling is increased, that is, as the link is moved into the secondary field. Notice that the value of k changes continuously with changes in the primary inductor position, in effect giving us a variable k-control. We cannot say in the abstract what the value of k might be with each possible position. However, we can look at

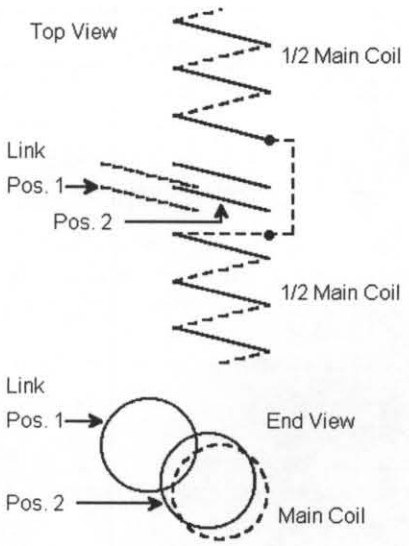

Fig. 2 Swinging-link inductor.

the values of k necessary to effect a 50-Ohm match in our standard circuit in Table 3.

Table 3. Some values of k for various loads (R_L) to achieve a 50-Ohm match.

R_L (Ohms)	Loaded Q	k
500	0.95	0.99
1000	1.89	0.71
1500	2.84	0.57
2000	3.79	0.50
2500	4.73	0.45

Since values of k above about 0.6 are normally not achievable with air-wound inductors, the standardized 7 MHz tuner circuit would not be able to match loads less than about 1500 Ohms. However, we might select a larger primary inductor value, which would reduce the required values of k. Unfortunately, this move would also increase the value of X_{LP} so that it no longer matches the desired value of R_A, thus setting a less than optimum ratio between the two figures.

A second alternative results from Equation (6), which suggests that we might redesign the coupler secondary, tailoring its Q to provide a more usable range of values for k. We shall retain a target values for R_A and X_{LP} of 50 Ohms each. Let's also set a limit: At a load impedance (R_L) of 300 Ohms, the value of the coefficient of coupling (k) will be 0.6. From Table 3, we can see that at lower impedance values, k will need to reach values not likely to be achieved, but at load values above this value, required values of k will be lower. By swinging the link further out from the main inductor, these values of k can be achieved.

Since k, X_{LS}, and R_L are related, we can rewrite Equation (6) as

$$X_{LS} = k^2 R_L \qquad 7$$

Having set the limits as k=0.6 and R_L=300, we can calculate that X_{LS}=108 Ohms. At 7 MHz, this translates into an inductor of 2.45 µH and a capacitor of 210 pF for the tuned secondary. With these values, we obtain the following table (Table 4) of values of k vs. the various load resistances.

Although this redesign achieves the immediate goal of providing values of k within the range of a swinging link for a span of realistic load values, all is not well. When the Q exceeds a value of about 10, the tuning becomes very sharp, requiring one to reset the tuner variables more than once across a single amateur band.

Table 4. Some values of k for various loads (RL) to achieve a 50-Ohm match with the revised swinging link coupler.

R_L (Ohms)	Loaded Q	k
500	4.63	0.46
1000	9.26	0.32
1500	13.89	0.27
2000	18.52	0.23
2500	23.15	0.21

Although the swinging link might be combined with some techniques applied to the tuner secondary that we shall explore a bit further on, they are no longer the input circuit of choice. Swinging links were once popular, but have essentially gone out of style because they are mechanically large and complex. Moreover, there is a much simpler means of achieving the same goal.

The Series Capacitor

The most common way to adjust the input circuit of an inductively coupled ATU is with a series capacitor. See Figure 3 for a revision of our standard circuit to incorporate the unit.

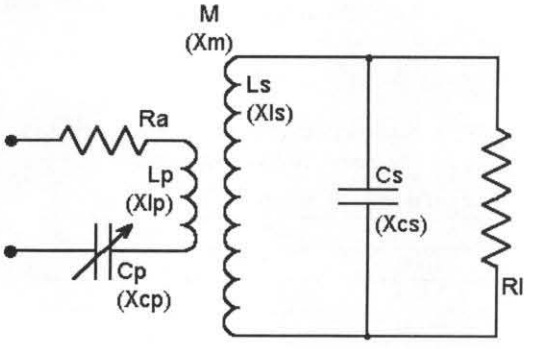

Fig. 3 Link coupler with series primary capacitor.

The first task that the new series capacitor, C_P, can perform is to cancel the reactance of L_P. This frees us from having to retune the secondary circuit to achieve this effect. Essentially, C_P and L_P form a resonant series circuit, leaving only R_A as the input impedance of the overall impedance matching circuit.

We choose the value of C_P to resonate with L_P at the lowest frequency in the band to be covered. In our running example, at 7 MHz the reactance X_{LP} is 53 Ohms; hence, the reactance of the capacitor must be the same at resonance. The corresponding capacitance is 430 pF. However, we show the capacitor as a variable for a set of good reasons.

The values just calculated apply for the case where the overall circuit load is 1500 Ohms resistive. However, not all loads faced by the ATU will be exactly 1500 Ohms. Other load values will not be converted by the circuit constants to the values of R_A and X_A in the example (where X_A has had a value of zero).

In the first episode, we showed how to cancel the value of X_{LP} by tuning the secondary circuit to a higher frequency, so that X_{LP} and X_{CP} did not have the same values at the operating frequency. As we increased the frequency to which X_{LP} and X_{CP} were equal, a value of X_A was coupled back into the primary circuit, and the value was capacitive. At the same time, the value of R_A slowly decreased.

Had we begun with a secondary load, R_L, that was higher than 1500 Ohms, the value of R_A would also have been initially higher. To a limited degree, we may use the same technique of making X_{LP} and X_{CP} equal at a higher frequency to produce something closer to 50 Ohms for R_A. However, when we do this, we also couple a capacitive reactance, X_A, into the primary circuit. Since this coupled reactance provides part of the reactance needed to cancel the reactance of the primary inductor, the new series capacitor, C_P, must now be set at a lower reactance—just enough lower so that the sum of its reactance and the coupled reactance together cancel the coil reactance. A lower reactance in C_P means a higher capacitance. Therefore, the series capacitor used in the primary should have a value sufficiently greater than the target value to handle such cases.

Lower values of R_L would have yielded lower values of R_A. To raise them, within limits, we may set X_{LP} and X_{CP} to be equal at a frequency below the operating frequency. This will simultaneously raise the value of R_A coupled back to the primary and also introduce a value of inductive reactance, X_A. The series capacitor must now be set at a higher value of reactance (and a lower value of capacitance) to cancel the sum of the introduced and the primary inductor reactances.

The series capacitor in the ATU primary circuit may be thought of as a "fine tuning" device, capable of allowing a given fixed secondary circuit inductor and its associated variable capacitor to handle a wider range of loads without directly altering the coefficient of coupling. Still, the range of variation that the primary capacitor, C_P, can handle is limited. For wide ranges of R_L, other means of coupling the load to the primary are necessary. The chief function of the series primary capacitor is always to cancel the primary inductor reactance, thus presenting the input source with a resistive load.

A Note on Resonance

To this point, we have referred to resetting the value of the tank capacitor as an offset tuning. Relative to our ordinary understanding of resonance, where the values of X_{LS} and X_{CS} are equal, the retuning of the tank amounts to an offset. However, let's remember that we are dealing with circuits whose operating Q is often well under 10. And here the single definition of resonance breaks down into several definitions, each with a proper context of use.

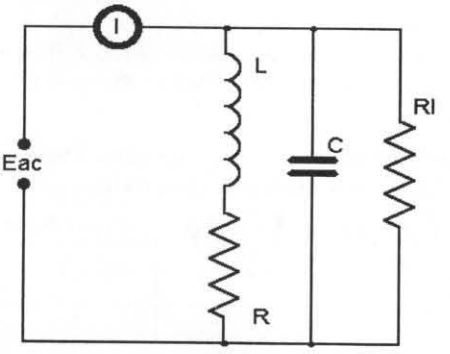

Fig. 4 The parallel resonant circuit.

Figure 4 shows a conventional parallel tuned circuit. Note that the series resistance in the coil leg (R_S) is in addition to the load resistance (R_L), but the two are not in either direct series or parallel with each other. When the operating Q of the circuit is above 10, the presence of R_S makes little or no difference to the notion of resonance. When the operating Q is below 10, differences begin to appear.

When a series or parallel tuned circuit is just off resonance, we expect several differences from performance at resonance. First, X_L is not equal to X_C. Second, the current through the parallel circuit (in contrast to current within the circuit load) is greater than minimum. Third, the current through the circuit is not in phase with the voltage. In a high loaded-Q circuit, X_L and X_C are equal, current though the circuit is minimum, and current is in phase with the voltage all at just about the same frequency. However, in low-Q_L circuits, these three phenomena occur at somewhat different frequencies.

The goal in tuning a parallel resonant circuit in an impedance matching circuit is to achieve minimum current within the parallel circuit and maximum current to the load at the operating frequency. With respect to this goal, successful tuning of the circuit produces resonance. It is not the goal to have the current and voltage in perfect phase within the tank circuit or to have X_L and X_C be equal. These latter phenomena may occur at nearby frequencies, and they become resonant frequencies relative to

each phenomenon. (In 1995, **The ARRL Handbook** expanded the coverage of low-Q parallel resonant circuits to cover these points more thoroughly; see pages 6.37-6.42 of any edition since then.)

Hence, for the aims of the inductively coupled tuner, the definition of resonance that is relevant is to maximize current in the load of the secondary (equivalent to minimizing current through the paralleled inductor and capacitor). Hence, when we retune the secondary to achieve maximum power output from the tuner, we are resonating the circuit, no matter what values of X_L and X_C may be required to do this.

We have also ignored the values of resistance and reactance coupled from the primary into the secondary. Given the disparity of coil sizes, the amounts are quite small in most matching situations and hardly call for any change of control settings to maximize current in the secondary.

However, the effect is real and the control settings are not quite the same as they would be without the mutual coupling. In some cases, these further adjustment requirements add to those just mentioned; in other cases, they may partially cancel each other out. Nonetheless, the overall readjustment of the tank circuit to account for all factors affecting maximum current flow within the tank circuit are part of the effort to achieve resonance.

The most certain way to assure that proper resonance has been achieved is some form of output power measurement.

We have only begun to see the flexibility of the inductively coupled impedance matching circuit by surveying the most common variations we impose on the input side of the circuit. In the next installment, we shall look at some useful variations of the output side of the circuit.

Edited by W1HUE

Members' News

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Basking in Dayton's QRP afterglow

Regardless of the accommodations, the food, the weather, or any number of other variables, QRPers seem to emerge from the annual Dayton Hamvention with an afterglow that just won't quit.

nu6SN
Richard Fisher

Just ask virtually anyone who has been to "Four Days in May," The West Coast QRP Symposium at Pacificon, or any number of other large scale gathering of low power enthusiasts. These events are prime time to renew old friendships; to place faces with the callsigns and personalities you've been reading or hearing about all year.

And even though it has been almost two months since the '98 QRP invasion of the Buckeye State, there's likely still a lot of momentum at work.

Remember that superbly constructed QRP transceiver you saw or read about being entered in the building contest? That's impetus to give a try at that project you've been pondering all these months.

Remember shaking hands with, or hearing about that first rate QRP contest operator? There's incentive to take a serious run at October's QRP ARCI Fall QSO Party. Or ARRL's November Sweepstakes — QRP division, of course.

Remember being impressed with the low power ops who have been giving it their all? Operating. Contributing to journals. Submitting something to Members' News. Becoming involved — *really involved* — in their club, whether it be this organization or any of the growing number of regional groups that have gained such strength over the last several years.

If you were somehow impressed at Dayton, or even if you did not attend but were moved by things you've read or heard about it, now's the opportunity to seize the moment.

Set a goal to do something positive for QRP. You'll be awfully glad you did.

— R.E.F.

Fine QRP work from the bench

Larry East, W1HUE, writes from Idaho Falls, ID, that although he has "been fairly active on the air (particularly chasing DX 'new ones' running QRP), I find that I have been spending more time at the bench than at the operating position.

"The accompanying photo shows some of the kits that I have assembled over the last few years. Starting from the lower left and proceeding clockwise, the items pictured are:

√ **"NorCal '40-9er'** transceiver built in a mint tin. This rig has a DC receiver, produces 1W output, and covers a frequency range of about 5kHZ centered around 7.040 kHz. I have only made some contacts with this little rig and tend to use it more for "show and tell" than operating.

√ **"St. Louis Tuner** obtained as a kit from NorCal. A nice looking tuner with separate meters for forward and reflected power, but unfortunately it suffers from rather poor efficiency. I hope to remedy that one of these days with redesigned inductors.

√ "On top of the St. Louis Tuner is a **NorCal 40A** 40-meter transceiver to which I have made several modifications including vernier tuning, a variable width IF filter, SWR indicator and built-in keyer (using a keyer chip from Radio Adventures Corp. reviewed in the January 1996 QRP Quarterly). The output of this rig can be varied from essentially 0 to 2.5W, but I usually run it at 950mW and have had may nice contacts with it.

√ **"NorCal '38 Special'** 30-meter transceiver kit with all the usual mods — RIT, 5W output, etc. I found this a real bear to get working properly, but I believe I have finally tamed the beast and have made many 30-meter contacts with it.

√ **"CMOS Super Keyer III** built from a board-level kit from Idiom Press. This is an updated version of a microprocessor based keyer described in QST a few years ago and really *is* a super keyer!

√ **"Oak Hills Research WM-2 QRP Wattmeter** with my peak reading mode described in the January 1995 QRP Quarterly.

√ **"EMTEC ZM-2 Z-Match** antenna tuner. This is a nice little tuner, particularly for portable work, and has better efficiency than usually obtained from common "T-match" ATU's. (The ZM-2 was reviewed in the April 1998 QRP Quarterly by AE4IC).

√ **"NorCal paddle kit.** This kit required no soldering (ignoring the connecting lugs and plug for the cable) but a lot of sanding and polishing! (See review in the April 1998 QRP Quarterly).

"Not shown are various other home brew projects and kits nor my highly modified TenTec 509 and Index Labs QRP-Plus.

"For the past eight years I have lived on three sage brush covered acres in the foothills about four miles east of Idaho Falls, ID.

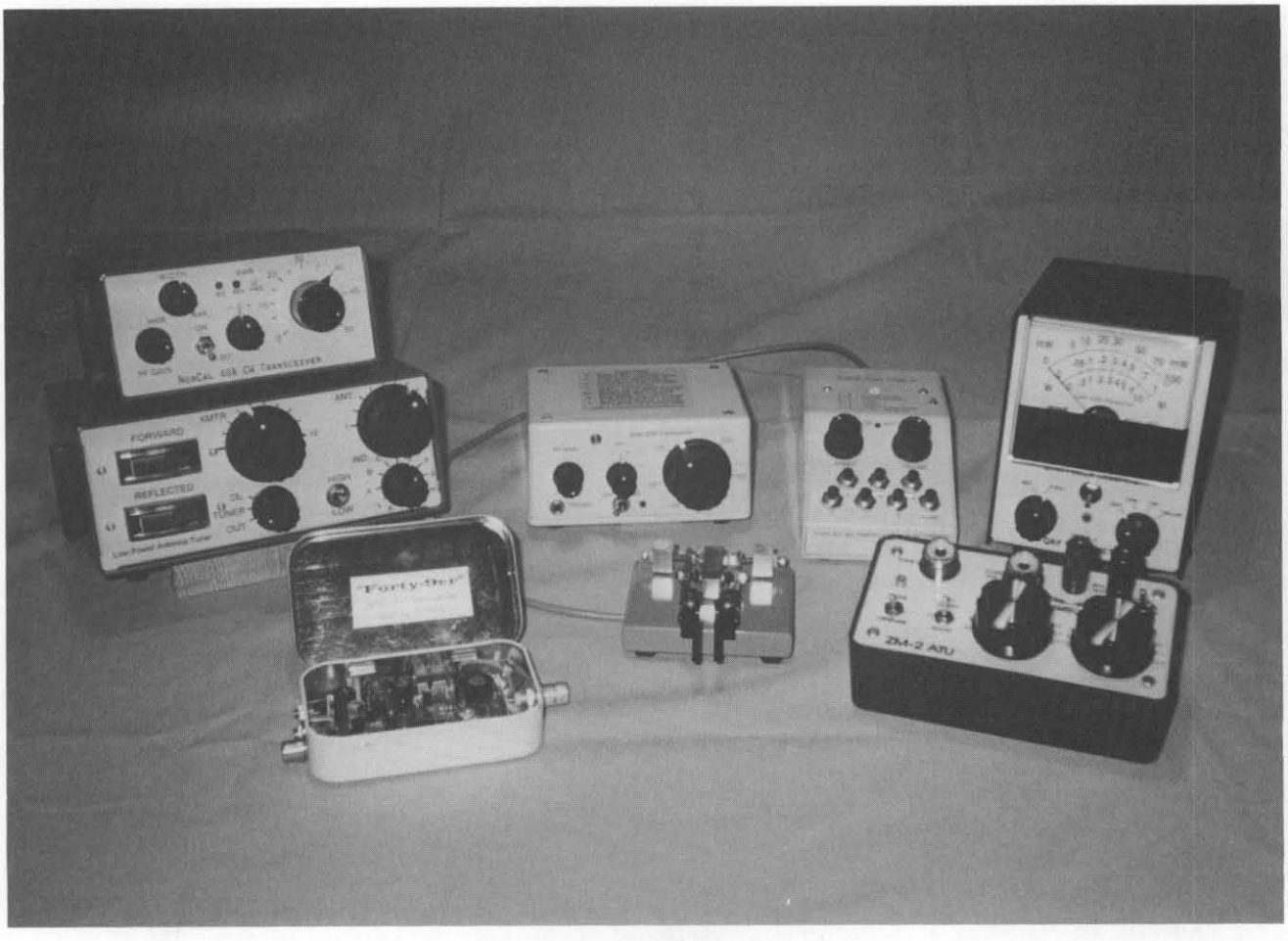
"Although I have a lot of room for antennas, my antenna farm is rather modest, currently consisting of a GAP Voyager vertical for the low bands (including 20M), a trapped inverted Vee for 40, 30 and 15 meters and a 450 foot long wire.

"Although the long-wire is only 20 feet above the ground, it works like gang busters on 20M and above, particularly for stations to the southeast of me."

QRP success with the ol' Argosy

Jay, W5JAY, writes from Fort Smith, AR, that "a friend of mine, Win (WB5KOM), let me borrow a Ten-Tec Argosy he had in storage. It took awhile to clean off a spot on the desk for it. Hooked up a newly aquired gold VHS paddle from G4ZPY and listened around on 15 meters.

"Worked **WP4LNY (Julio)** who was trying out a new set of paddles for the first time. While not rare DX it was a fun QSO.



Photography by Larry East, W1HUE

Hours at the QRP bench have produced great gear in the shack of Larry East, W1HUE.

"Then I had to do some house work so I didn't get a chance to play radio until 0100 UTC. I fired up the old borrowed Argosy and tuned around 10.123 MHz and heard **LU1ZC** on South Shetland Island.

"He wasn't running many stations fast so I waited until a break and *bang*, I got him with 1 watt. He was a very smooth operator.

"The antenna on 15 meters was a 10-element log periodic up 56 feet and the power then was 1 watt also. The antenna on 30 meters is a 3¼-wave slopper up 50 ft. So much about beams versus wire. I guess both antennas qualify for the miles per watt award?

"It's a shame Ten-Tec doesn't make a rig like this anymore with a price of the Scout! Life is great. I wish I was retired, I would 'ham' myself to death!"

Lessons learned: Antennas count a lot

John Brunley, NU0V, from Urbandale, IA proclaims: "What a difference an antenna makes!

"A friend introduced me to QRP a few years ago. Since then I've been struggling with a ¼-wave vertical on 30 meters and a MFJ-9030. Contacts were scarce and DX was out of the question. Rag-chewing was something I had fond memories about in the QRO days.

"There have been numerous Internet threads about the virtues (or not) of verticals and one posting by **Adrian Weiss, W0RSP,** caught my attention. He made a passing reference to making a vertical multi-band by feeding it with twin lead and going through a tuner.

"I thought, 'Why not? Things couldn't get any worse.'

"About a month ago I lengthened the radiator in hopes to get onto 40 meters (if I'd ever build my OHR Explorer II). I ran down to the local Radio Shack and picked up some of the low loss twin lead.

"After mentally calculating the proper length I picked up the 50-foot bundle. Three hours later I discovered I was eight feet short — of course.

"After the appropriate vocabulary and a splice job, the antenna was ready to test on 30 meters. The results were outstanding. Everyone I called answered!

"After finishing QSOs, stations called *me*. I've even picked up an **XE2** (559), **CM6** (569), and a **VP5** (599).

"Now I'm not proclaiming that a vertical antenna is the answer to all problems. What I am suggusting is that if you are having marginal results with your QRP operating, check your antenna system first!

"You may find your problem there. Now I'm having a blast operating and hope to see you on 30 meters! My success rate is not 100 percent, but I'm not afraid to give any station a call."

QRP revisited — and appreciated

Larry Boellhoff, W3MGL, writes from Toano, VA that he has "at the age of 71 'discovered' QRP! And after more

than 20 years, CW!

"I have been licensed for (more than) 51 years. Like most old timers I started on QRP but we didn't call it that. We called it a couple of tubes on a breadboard, a couple of 40-meter crystals running about 10 watts.

"I haven't been on CW for about 25 years and this paddle 'thing' is a learning experience. I started on my NorCal Forty-9er. I couldn't believe I could work stations with ½-watt. But I did and it was too late to turn back!

"So I now have a Ten-Tec Argo 556, the little brother of the 50-watt Scout. I have been having the time of my life working both CW and SSB at 5-watts. I love this little radio.

"I guess now the only time I will need to fire up the Omni VI and the Kenwood 922 linear is to get those last 15 (countries) I need for Honor Roll. I now have 302 confirmed.

"My antenna farm consists of a 2-element five band quad, 160-80 meter vertical, 80-40 meter vertical, G5RV, and a 40-meter dipole. I plan to put up a 30-meter dipole also.

"I also plan to operate 5-watt QRP in the ARRL November Sweepstakes.

"The antennas I used for (the Fall QRP ARCI QSO Party) were the 40-meter dipole, the 80-40 meter vertical and the G5RV. The score I made is not in any way important to me. (It was) the fact that I was on CW and QRP and I had as much fun as if I had made a thousand contacts.

"Now if I could only learn to send my call on that 'thing.' "

QRP tales from the Sierra

Steve Gallchutt, N0TU, writes from Colorado about his experience in building a NorCal Sierra transceiver he had been lucky enough to find.

". . . at 9:45 p.m. I had one more toroid on the 40 meter band module to go.

"The main board was loaded and ready to go. Ten o'clock is my usual bedtime since I get up around 5 a.m.! But I was near the 'turn on' stage, so I decided to go for it!

"The toroid went faster than I expected. After 15 of those guys you've just got to get a little faster!

It was a little after 10 p.m., and I did another 30 minute check over of components. No mistakes! Yes!

At 11 p.m. I fed it power and watched the current: 35 milliamperes. A good sign!

At 11:30 p.m. there are 2 watts into the dummy load. Alright!

"At 11:45 p.m. the receiver comes alive. But I'm just hearing a lot of QRN. Not many signals. I compare the Sierra's reception to my Argosy. Yes, the band is pretty much gone.

"Man, is the crystal filter razor sharp!

"At midnight I'm having trouble brushing my teeth because of the *huge* smile that stretches across my face.

"At 12:15 a.m., I unclip the gelcell from the Sierra and drift off to sleep, dreaming about keyers, readouts, ABX modifications, SWR indicators, etc.

"At 6 a.m., with a cup of hot coffee in hand, I fire up the wood stove (it's 45-degrees in the barn) and the Sierra. The band was booming. I heard the F and C beacons about S-4! There were big signals all over the place — 7.040 MHz was clobbered.

"I listened for a while until I just couldn't stand it anymore. I hammered a few feeble CQs under all the QR0. *BANG!* **K5JD** slams back his QRO sig (50w) and I had my very first Sierra QSO!

"Let me confirm once again: It doesn't get any better than this. Like some (QRPers like to say): 'I know the guy who built my radio! I'm him!' "

"I'm not finished yet. I've got the chassis to assemble and label. Also, I need to do a proper alignment on it — only 6 more modules.

"*Hmmmmm.* That's 50 some toroids! *YIKES!* I'll be a 'pro' at toroids by the time I finish this project!

"Last night I just tweaked until I heard my 49er 100Mw sig coming through the receiver. What a thrill!"

Keeping in QRP contact

Part of the fun and fascination of QRP comes in hearing of the experiences, challenges and success of others. And telling your story is part of that natural process.

Why not drop a card, letter, photograph or e-mail to Members' News? Sending off a few lines takes only a few minutes. Putting it in the mail or on the wire is painless, and the camaraderie it invokes in the QRP community is a substantial payback.

Here are the only mailing addresses you need:

Richard Fisher, nu6SN
Quarterly Members' News
1940 Wetherly Way
Riverside, CA 92506

(e-mail: nu6SN@aol.com)

A QRP contact to remember

Gary Hanson, KJ5VW, writes from Texas that he "had a terrible time making contacts during the Colorado QRP Club Winter QSO Party in February, but made one contact that made the whole effort worth while.

"I tried to make contacts on 40 meters in the early evening with very limited success. I tried my full wave delta loop . . . called, but got nothing. Made a couple of contacts with the 135-foot center fed dipole and a couple with the 132-foot off center fed dipole.

"The day before, during some horrendous Texas thunder boomers, I had grounded all my antennas, but wanted to listen in on the 'other' contest (ARRL DX) so I went out to the garage and found my old DCTL (distributed capacitance twisted loop) antenna. Remember the Internet QRP-L thread on that one from 1996?

"Well, I had mounted it on a PVC 'T' so that the base of the antenna was about 5 feet off the ground. I took this thing up to my second story ham shack and leaned it against the wall. Heard lots of stuff on Saturday night.

"Then, about 8:30 p.m. Sunday I hooked it up to my two watt MXM-40 transceiver. I heard **Harvey, N6MM,** calling CQ in the CQC contest so I thought, 'What the heck, it won't hurt to throw one in there.'

"Imagine my surprise when Harvey came back and gave me a 559. I was so excited I forgot to give him my name during the exchange and he asked for a fill, but otherwise he got it all.

"It's about 1,200 miles from Texas to California. So, is 1,200 miles with 2 watts on 40 meters using a DCTL antenna a world record? Doesn't matter. That one contact made the whole CQC contest worthwhile. Thanks to the Colorado

crew for putting it on.

"Probably wouldn't have tried the DCTL antenna without it."

Overcoming the fear of (QRP) success

Mike Gipe, K1MG, writes from El Nino-plagued California in mid-February that "it was raining again this morning when the alarm clock went off. The prospect of facing another dark, dreary day kept me under the covers for another 15 minutes, but eventually I pulled myself out of bed and into the shower.

"It was still dark when I sat down to read the newspaper. I thought, 'Dark, raining, nothing but bad news in the paper . . . think I'll go turn on the radio and listen a bit.' So I went in and warmed up the rig.

"Everything was still tuned up from the previous foxhunt. I spun the dial down to 7.000 MHz and started tuning up. 'Lots of JAs,' I mumbled to myself, realizing at the same time that the QRN was nonexistent. 'Must be the rain on the power poles.'

"I came upon a QSO nearing an end, with several rounds of 73s being exchanged. Both stations were perfect copy; one was in Japan, and the other in Korea. I put out a short call at 5 watts to the Korean, and he came back and gave me a 549 report. The QSO with Rim in Seoul was short, but cordial.

"He had a very nice fist. After we exchanged 73s and 'ditdits,' I continued tuning, and came across a pileup at 7.027 MHz. This must be for **9M0C,** I thought, and wondered how well he was coming on this morning.

"I tuned down below the pileup to find him, but couldn't hear a thing.

"Odd, I thought. I should be able to detect something, after all, Spratly with a kilowatt is much easier to hear than a cross-country 'fox' at 1 watt.

"I figured I better tune around the pileup again to get a better feel for it. I found a few stations calling, but none of them sounded like disciplined DXers, so I thought to myself, '9M0C must have QSYed, leaving a few stragglers behind.'

"Sure enough, tuning back down the band, I encountered the pileup again, and exactly 1 kHz below the bottom of the pile was 9M0C, clear as the BBC.

" 'This is too easy,' I thought. I listened for a bit and found the stations he was working. The pattern was clear and simple — he was tuning slowly through the pileup, working one at a time. All I would have to do was drop my call in 100 Hz above the last QSO. I already worked him earlier this week, but the temptation was too great, so I slipped in one call.

"*Bamm!* Got him. I returned his report and slipped '/QRP' after my call, and was surprised when he replied, 'Nice job with QRP, name hr is Bill. TU.' When was the last time you exchanged more than callsigns with a high-profile DXpedition?

"Signing '/QRP' in a pileup is like bringing a baby to a Mary Kay convention. You must try to work this station. They have good equipment and operators who can copy a whisper from a bumblebee. Also, since they often move above 7.025 MHz, you don't need an Extra class license to participate.

"Besides, it's good practice for the foxhunts! Let's keep our perspective — it may be one of the rarer countries in DXCC, but it's no fox pelt.

"You will need to work with transmit offset. RIT is usable. And (the suggestion) of setting up your Sierra or other QRP rig to have an asymmetric RIT range is a good one.

"So, move down off of 7.040 MHz. Jump into the pileup. Let the big guns know that a QRP station beat them out in the pile. Don't let fear of success keep you away. We're having fun now!"

30 meter QRP: Try it, you'll like it

Steve Yates, AA5TB, writes from Forth Worth, TX that "30 meters has me all fired up.

"I just want to encourage others not to give up on it in the evening when 10.1 MHz seems dead. It has has been one of my favorite bands ever since it became available, but it never stops amazing me.

"Even though the MUF for stateside contacts here in Texas has been dropping below 10 MHz when the sun goes down, the DX still rolls in.

"(On a recent evening) I worked **ZS6AWK** in Pretoria, South Africa at 0426 UTC and **ZK1DI** in the S. Cook Islands at 0451 UTC using my 38 Special.

"Being able to work two opposite sides of the world at the same time is great.

"My power output was 4 watts using a solar charged battery and my antenna is an inverted V dipole with the apex 6 meters high.

"Thirty meters has always been a good QRP DX band for me but since I just recently put the finishing touches on my 'combat ready' 38 Special, it gives me pleasure to make some good contacts with it. I can't wait to take it camping."

'Compulsory' DX milliwatt contesting

Roger Gonzaga, CT1ETT, writes from Portugal that he "was looking forward to an opportunity to work 'compulsory' DX with very low power like in the ARRL CW DX Contest (in February), where only contacts with USA or Canadian stations are valid, and I had decided to run a maximum of 750 mW.

"As aerials I chose the 2BDQ trapped dipole for 40/80 meters, and the TH6 for the 10/15/20 meters. The main rig has been my HW-9, with a VFO variable capacitor that tends to allow drift out of the very critical frequency where most contest stations have their very narrow filters tuned.

"My HW-9 has all the bands except the 160 meters but, of course, the lack of the top band was not a problem, as I did not intend to try this band with milliwatt power to work DX . . . I have used a cheap Zetaggi Power Reducer, a CB-dedicated power attenuator, that has the advantage of having several switchable levels of reduction, although the attenuation itself varies with the bands, in each position.

"I use a special B&W coaxial switch to eventually bypass the attenuator (which can be very useful as it reduces both the transmitter and the receiver) and the combination of moderate drive variations with the different positions of the attenuator makes the full power *or* the attenuated power usable, typically from a little more than 1 watt to less than 100 mW.

"However, on 80 meters there is a gap between the normal 4 to 5 watts, and the maximum power with the attenuator, that is 600 mW.

"The DSP-40 filter from Radio Shack, a frequency meter from Alan, the PM-20 QRP power meter from Lake Electronics, a homebrewed keyer, my Bencher paddle and a pair of Phillips headphones completed this contest

station.

"My previous experience in QRP contesting had taught me that while the big contest stations have beautiful ears, the smaller and less competitive stations are more deaf to the QRP signals, so I was prepared to look for the former, as 600 to 750 mW relate to my usual 4 to 5 watts, as a regular 100 watt powered station relates to a 700 watt station!

"I had no doubts that contacts in the higher bands would be relatively easy, but I was very curious about the lower bands results. I ran the contest for about 12 hours, and during that period 10 meters unfortunately did not open I was expecting good activity in this band.

RESULTS

For his single operator QRP (750 mw) CW effort: 111 QSOs (333 QSO points), 48 SPCs for a total of 15,984 points.

"All reports I have sent were 599, followed by 001 (although my maximum power was under 750 mW, I have prefered to say '1 watt' for the sake of simplicity.

"The two most challenging contacts were, of course, on 80 meters.

"As I said before, I had to do with 600 mW in a trapped dipole . . . For several reasons I was unable to be on the air on the first nights (after Friday midnight and from Saturday to Sunday) and had to rely on the Sunday, before midnight, knowing that from CT1, the best hours for 80 meter contacts with the United States are after 0200 UTC.

"By 1000 UTC I looked on 80 meters for a strong station. One of my preferred super-stations, **K1KI,** was there, but was not strong enough to try.

"The strongest was by that time **W1MK,** from Massashusetts, with a moderate pile-up. I listened for about half an hour, until I had a serious idea of his operating habits and the CW tone corresponding to the exact listening frequency.

"By that time the pile-up was gone, and after many unsuccessfull trials I could get the desired answer: CT1ETT 599 599 MA. *BINGO!* Of course, he doubted when I sent him my report 599 001. I had to repeat it several times, until he was more or less satisfied.

"After that, I came back to K1KI, from Connecticut. He was by that time much stronger than one hour before. I had already worked him on 15, 20 and 40 meters, so I knew his operating characteristics and he knew my call and power.

"With a good chance, I could get one answer at the second or third call — I could feel the enthusiasm of the operator when he sent me his report and the congratulations!

"On 40 meters, my chief enemy was the intense QRM, but I could run smoothly a dozen contacts. On 15 and 20 meters life was easier, although some of the contestants asked me to repeat my power several times before becoming more or less convinced.

"I was able to slide over a small pile-up with a **VO** station — mother fortune has been with me in this contest. However, all the worked stations were from the eastern and central United States or eastern Canada, and this time I was not able to reach the West Coast.

"The reason why I have selected the 2BDQ trapped dipole is simple: After a stupid accident while running high power — another stupid activity — I put *big* power in the T2FD that I used as a secondary aerial that could only handle 150 watts PEP. Of course it is now burnt.

"I have substituted it for a 2BDQ trapped dipole, hanging as a flat-top at 12 meters above ground level.

"For reasons I can't understand, it performs much better than my excellent FD4-like Windom or my new quarter-wave 80 meter sloper, both fed at 18 meters above ground level. And the difference seems to be at least one S-unit in all directions, meaning a 6 dB advantage.

"I think that this strange phenomenon has to do with radiation interference between the 18 antennas from 2 to 160 meters I have in the limited space of my garden."

Milliwatting along the gray line

Randy Foltz, AB7TK, writes from Moscow, ID that "recently **Bruce Hopkins, KL7JAF,** and I had an interesting QSO. We hooked up on 14.061 MHz just before 0200Z and exchanged the usual pleasantries.

"Signal reports were 449 to 439 depending upon the degree of fadding. Both of us were at 5 watts.

"Then he started dropping his power from 5 watts to 2 watts and finally to 1 watt. RST dropped but was still quite readable.

"Bruce couldn't go any lower, so I started dropping power. First from 5 to 2 then to 1 watt.

"Each time Bruce reported RST of 449 to 339. I went to 500 mW then to 100 mW. At that level he gave me a 339.

"I went to 30 mW and he reported he could hear me, but couldn't copy. We came back up to 5 watts and the QSB finally got us at 0211Z.

"Bruce's antenna was a 3 element beam and I had a Gap Titan.

"Fairbanks, AK to Moscow, ID is 1,696 miles. At 100 mW that makes for 16,960 miles per watt. Solar elevation in Moscow was -5 degrees and in Fairbanks was +7 degrees so we were getting some good gray line. Solar flux was 100 and A index was 5.

"Yes, as I've heard many times, you need a lot of power and a big beam to work 20 meters."

Goodie Giveaway

For the QRP homebrewer, the junk box is a critical part of the building scene. You can never have too many spares when it comes to chips, transistors, capacitors, diodes, and the like.

For his contribution to Members' News this quarter, **Larry East, W1HUE,** is the recipient of a dozen **2N3819** Field Effect Transistors and a half dozen **MV209** junction tuning diodes — just the right size for any good QRPer's junk box.

They come courtesy of QRP ARCI President **Mike Czuhajewski, WA8MCQ,** who so kindly donated them for this quarter's prize.

A tip of the ol' QRP hat to Larry for his submission. Simply submitting an item or photo for the next MN will assure that you're in the running for October's "Goodie Giveaway."

The addresses at the head of this column are all you'll need.

Hope to hear from you soon.

Items for the Members' News column should be sent to Richard Fisher, nu6SN, 1940 Wetherly Way, Riverside, CA 92506. Photographs — either black and white or color — are welcomed. Please include a self addressed, stamped envelope if you would like pictures returned. Submissions by e-mail (nu6SN@aol.com) are welcomed. To clarify intent, please state that your e-mail text "is offered for publication in QRP Quarterly."

IDEA EXCHANGE

Technical tidbits for the QRPer

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

IN THIS EDITION OF THE IDEA EXCHANGE:

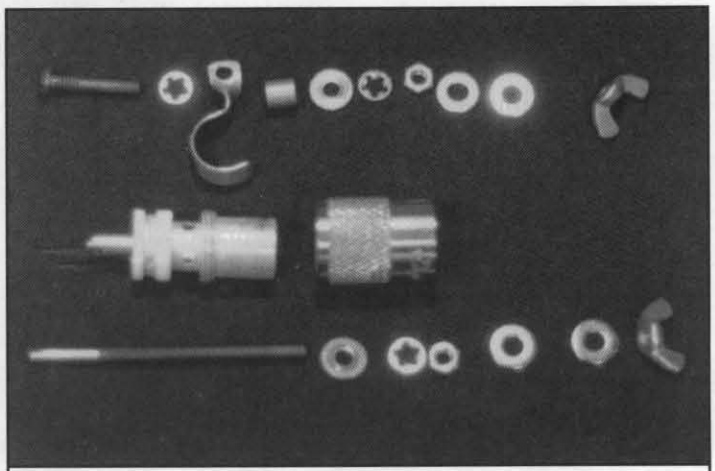


Photo 1—Parts used to make the device

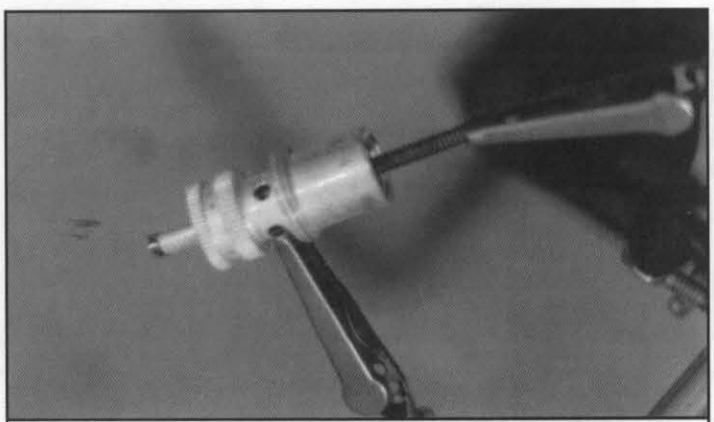


Photo 2—insert screw into plug

CONNECTING WIRES TO A PL-259

Pete Hoover, W6ZH *of San Marino, CA, W6ZH@ix.netcom.com, passes along this tip for easily attaching wires to SO-239 sockets*— On several occasions I have wanted to attach a single wire antenna and counterpoise to an antenna tuner that had only a coax-type output fitting. With a little work, a PL259 coax fitting can be adapted to the purpose. The idea is simple: extend the center post of the PL259 out the top so it can be used. Add a bracket to the outer shell for the ground connection. No exotic parts are needed - see Photo 1

1 - regular PL259 coax fitting
1 - 6-32 screw stock, 2 1/4" long
1 - 6-32 screw, 1" long
2 - 6-32 brass nuts
6 - 6-32 brass washers
2 - 6-32 lock washers
2 - 6-32 wing-nuts
1 - 1/4" x 1/4" brass spacer to clear 6-32 screw
1 - brass strip: 0.040" x 1/4" x 1 1/2"
1 - piece of rigid plastic tubing that will fit over the 6-32 center post screw and inside the PL-259 fitting - I used a part of a defunct ball point pen.

Step 1: file down one end of the 6-32 2 1/4" screw so that it will fit into the center post of the PL-259 and solder into fitting - see Photo 2.

Step 2: tin the top segment of the inner fitting where the brass piece will be placed - use a good hot iron.

Step 3: form 1" of the brass stock so that it fits around 180 degrees of the top part of the shell, bend the "long" end at a right angle, twist 90 degrees, and drill a hole in the end to take the 6-32, 1" screw. See Photo 1; it's the piece in the top row that looks like an upside down question mark.

Step 4; screw outer shell of PL-259 on the fitting - don't forget this step!!

Step 5: solder the brass piece in place.

Step 6: wait until everything is cool enough to handle!!

Step 7: solder the 1" 6-32 screw, facing "up" into the hole of the brass piece - originally I used a lock washer, etc., but that was just one more piece to lose if the screw came loose.

Step 8: slide the plastic over the center screw to check fit and length - it should extend about 3/16" or more above the metal end of

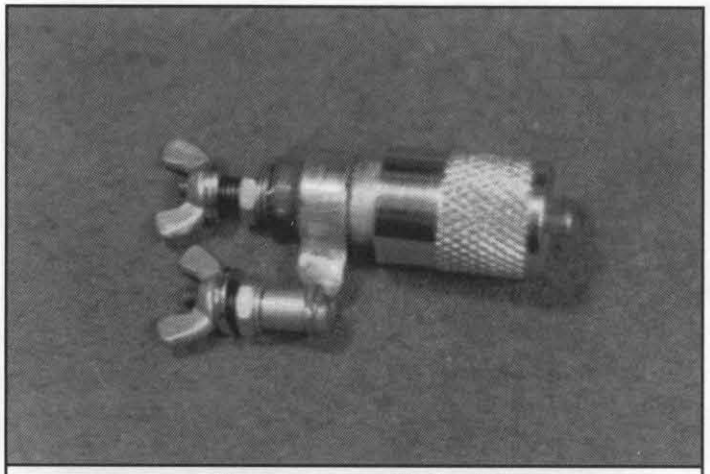


Photo 3—assembled unit

the center shell - if it's OK, put some epoxy around the inside of the PL-259 inner shell and push the plastic in, seat firmly, put a washer and a 6/32 nut on the center screw, and tighten firmly.

Step 9: add spacer to the ground screw, a washer, a lock washer, and nut - tighten firmly.

Step 10: add remaining parts - and you're finished - see photo 3 for the finished product. Easy, huh?

If your antenna tuning unit has a link-type output and you can insulate it's SO-239 socket from chassis ground, this modified PL-259

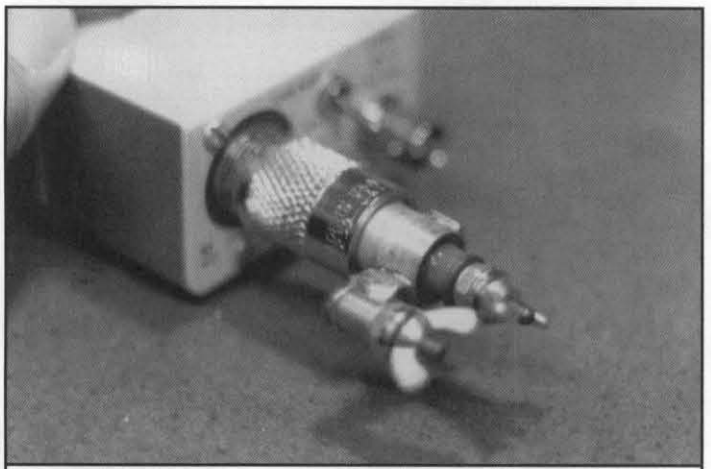


Photo 4—ready for balanced lines, using an SO-239 insulated from the chassis.

fitting can be used to feed balanced lines - see photo 4. If the body of the insulated SO-239 fitting can then be grounded by a switch this setup can be used to feed coax as well. I have used this modified PL-259 at the bottom of a ground plane with the radials attached to the ground fitting, the vertical to the center, and the PL-259 to the coax line via a barrel fitting. I've also used the same approach using this modified fitting to feed an inverted Vee dipole, using fishing line attached to the fitting and thrown over a tree limb to support the fitting and coax.

A "last resort" 20 meter antenna system is one of these connectors and two 17' pieces of flexible wire with a solder lug on one end of each wire. Attach the plug to the back of the 20 meter rig, and one wire to the ground post and is thrown on the floor. The other wire goes out the window, over the door, or whatever. If the band is open, you'll get out - in short, it works!

—DE W6ZH

RAINBOW BRIDGE AND TUNER DESIGN CONSIDERATIONS (PART 1)

***Joe Everhart, N2CX** of Brooklawn, NJ, and n2cx@voicenet.com, has been feeding me his Technical Quickies for quite some time—this is number 26 in the series! He told me years ago that he had an infinite supply of ideas if I wanted to print them, and so far he's holding up his end of the deal.*

A "hot topic" on QRP-L, the Internet QRP e-mail reflector these days is "Elmerism." In that spirit, this Quickie provides some design details for the Tuner portion of the Rainbow Bridge and Tuner. It is intended to provide some insight into the operation of a simple antenna tuner. While the ARRL Antenna Book gives an "intuitive" description of matching to an end-fed half wave antenna, this Quickie gives a more detailed explanation of the operating principles. There is some math shown so that those so inclined can duplicate my calculations, but my descriptions (I hope!) should be clear enough even without the math.

The Rainbow Bridge and Tuner was an entry in the 1996 NorCal Design competition and was introduced through articles in the Winter 1996 issue of QRPp and the January 1997 QRP Quarterly. It was intended to provide matching to an end-fed half-wave antenna on either 30 or 40 meters. The end-fed half-wave antenna is further discussed in the Spring 1998 QRPp.

At resonance, the half wave wire presents an impedance that theoretically approaches infinity. Practically speaking it is usually on the order of several thousand ohms. And at resonance, by definition, it is entirely resistive. Now impedances that high are very tough to step down to the usual 50 ohm coaxial feedline and the feed point impedance can vary drastically above and below the resonant point. To make things easier to handle, it is often best to cut the "half-wave" wire either 5% or so "long" to circumvent these problems. (One simple way to do this is to make the length equal to 492/Freq rather than the usual 468/Freq). This will lower the impedance somewhat and ensure that the tuning will not jump suddenly with frequency.

Even so, the impedance will still be somewhere between several hundred and several thousand ohms. While it is possible to construct toroidal core or balun core devices to match to 50 ohms, they may be

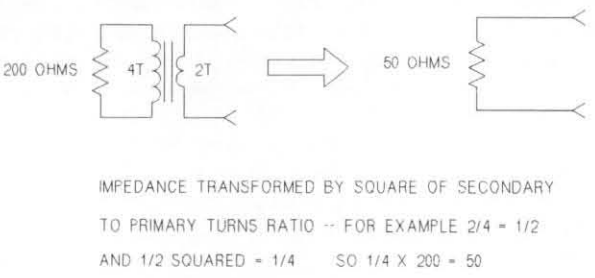


Figure 1—Impedance stepdown with transformer

difficult to reproduce without experience and some rather specialized test equipment. Even more difficult is making one that can handle a 10:1 or so range of impedances values.

Conventional transformers use two windings coupled magnetically by a common core to transform impedances. This is shown in figure 1. You may recall that the impedance from one side to the other is transformed by the square of the turns ratios. For example if the primary has 50 turns and the secondary 5 turns, the turns ratio is 10:1 so the impedance ratio is 10 X 10 or 100:1. So a 5000 ohm load on the primary is 50 ohms on the secondary side. All this is well and good, but for proper operation, the inductance of the primary should be enough to give an impedance of at least four times its load impedance,

or, in the example, 20000 ohms. Unfortunately this is impractical at high frequencies since stray capacitance will shunt it, drastically reducing the impedance.

A simpler type of transformer is the "autotransformer". This is a one

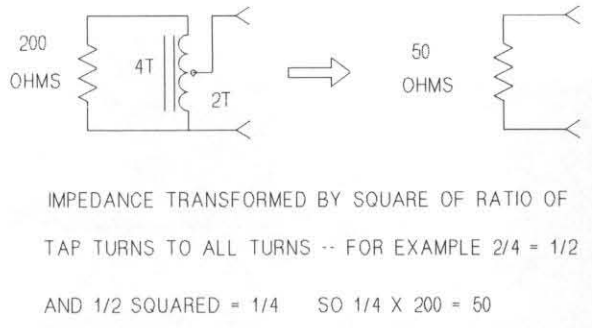


Figure 2—Impedance stepdown with autotransformer.

winding transformer that accomplishes its impedance step-down by virtue of a tapped winding as shown in Figure 2. As with the ordinary transformer the transformation ratio is the square of the turns ratios. This time the ratio is between the full number of turns and the number of turns at the tap. So if you use a 50 turn winding tapped at 5 turns, the step down ratio is the same 100:1. As with the two-winding

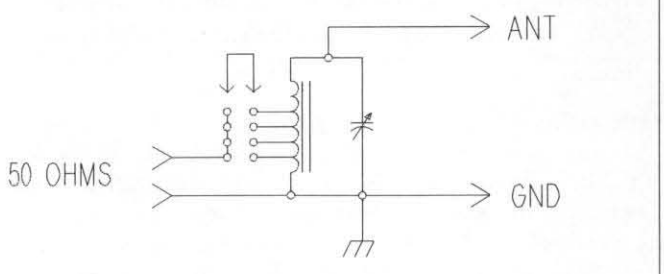


Figure 3—Rainbow Tuner schematic.

device, though, stray capacitance is a bugaboo for high impedances.

The Rainbow tuner (Figure 3) circumvents the problem by actually *adding* more capacitance across the autotransformer! It then becomes a parallel tuned circuit that resonates the inductance of the transformer at the desired operating frequency. So shunting action of capacitance is used to good advantage in canceling out the inductance of the transformer winding. The end result is an impedance that is much higher than the inductor alone would have. In fact, according to simple electronic theory, the impedance is multiplied by the ratio of the coil inductance to its loss resistance. This ratio is called the unloaded Q, which can be 100 or more for ordinary toroidal coils. A side benefit is that the "transformer" can tune out the inductance or capacitance of an antenna that is not exactly a half-wave. Using a variable capacitor also means that the tuner can be used on multiple ham bands. Of course different antennas must be used for each band since, for example, a half wave on 40 meters is about 70 feet and about 48 feet on 30 meters.

The inductor value was chosen to minimize loss in the tuner while being easy to make with fairly common components. An iron core T68-2 toroid core was used with a winding of 35 turns. This calculates out to an inductance of about 308 ohms on 40 meters. (XL = 2 PI F L) And, as mentioned above, the unloaded Q of this coil when used in a parallel tuned circuit is at least 150 times this value, or 46,000 ohms. So if a 5000 ohm antenna is placed across it, the "transformer" impedance will be almost 10 times the load resistance so the shunting effect should be minimal. Actually things are a little more complicated, but this is a fairly good approximation.

By the way, why use a toroid core? Well, transformer action requires a tight magnetic coupling between the windings. Toroidal cores have no "ends" so their magnetic field is contained almost entirely within the core rather than spilling out into the air as a cylindrical or other open-ended core might allow. Besides, winding toroids is FUN!

In order to resonate with the inductor, the variable capacitance needs to have a reactance of the same ohmic value. Rearranging the formula X = 1/(2 PI F C) to solve for capacitance shows that the capacitor needs to be about 74 Picofarads for 40 meter use and about 36 pF for 30 meters. A mica compression trimmer was used in the Rainbow tuner with an adjustment range of about 20 to 100 pF so it can be adjusted for both bands.

The tuner can be used on other bands as well if the tuned circuit can be resonated. Table 1 shows the capacitor values needed for 80 through 20 meters. Unfortunately mica compression trimmers do not give a wide capacitance variation, so the "stock" tuner will not cover more that 30 and 40 meters.

Table 1

Frequency	Capacitance
3.5 MHz	295 pF
7 MHz	73.8 pF
10.1 MHz	35.5 pF
14 MHz	18.5 pF

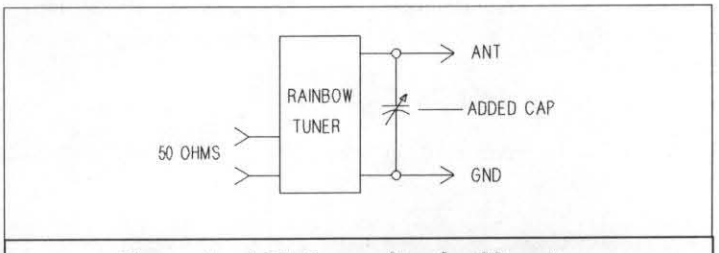


Figure 4—Added capacitor for 80 meters.

80 meter operation might be achieved by connecting a fixed 250 pF capacitor in shunt with the tuned circuit. Probably a better idea might be to use a variable 300 or 350 pF capacitor to give wider

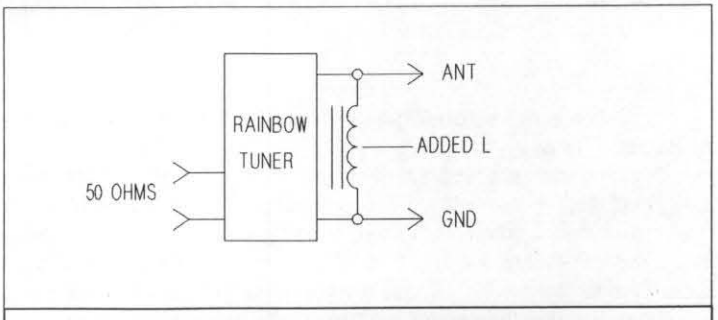


Figure 5—Added inductor for 20 meters.

adjustment range. This is shown in Figure 4.

For 20 meters, the tuned circuit inductance can be reduced by shunting an external coil in shunt with it as in Figure 5. A second T68-2 toroid with 35 turns will halve the tuned circuit inductance, allowing the tuner to resonate at 20 meters with about 37 pF. This is well within the adjustment range of the trimmer provided.

Several taps on the tuned circuit give it the ability to take care of a range of antenna impedances. For simplicity, only four taps were provided in the Rainbow Tuner. The reason for this is that tap selection is done by using a computer type jumper strip that is widely available.

Since the toroid core gives very tight magnetic coupling between turns, taps are achievable only at an integral number of turns. This means that, for example, you can't get a tap at 3-1/2 turns, only at 3 or 4 turns. This may seem to limit the ability to get an exact impedance match, but practically speaking, it is not much of a handicap.

The theoretical desired impedance matching range of the Rainbow is at least 500 to 5000 ohms. This should be able to handle most wires that are close to a half-wave. To get this range with only 4 taps on the toroidal inductor, taps were chosen to bracket this range. Since the tuner is intended to be used with a 50 ohm feedline, this means that the desired matching ratio varies from 500/50 = 10 to 1 at the low end to 5000/50 = 100 to 1 for the highest impedance. And, since the impedance transformation ratio is the square of the turns ratio, the tap ratios need to range from 3.16:1 to 10:1.

For the 35 turn toroid this means taps at 3.5 turns to 11.1 turns. As mentioned above only integral-turn taps are possible, so a decision has to be made to set the lowest tap at 3 or 4 turns.

With the tap at 3 turns, the match will be 35/3 = 11.67 * 11.67 * 50 equals 6809 ohms. Actually for a 1.5:1 SWR, values from 4540 to 10214 ohms. This is a little more than the desired high end, so let's look at a 4 turn tap. This will match 35/4 = 8.75 * 8.75 * 50 or 3828 ohms for an exact match or 2552 to 5742 with a 1.5:1 SWR.

At the low impedance end, with 11 turns, impedances of 337 to 759 ohms will be in range with an 11 turn tap. However what we want is a set of four taps that will cover *any* impedance between 500 and 5000 ohms to give less than 1.5:1 SWR, so let's look at all taps between 3 and 11. Table 2 enumerates the impedance matching values possible.

Table 2

Ratio	Z for 1:1 SWR	Z for 1.5:1 SWR Low	High
3:35	6809 ohms	4540 ohms	10214 ohms
4:35 *	3828	2552	5742
5:35	2450	1533	3675
6:35 *	1701	1134	2552
7:35	1250	833	1875
8:35 *	957	638	1436
9:35	756	504	1134
10:35 *	613	408	919
11:35	506	337	759

*The ratios with asterisks in Table 2 are the ones chosen for the Rainbow Tuner.

You can see that (at least in theory) the whole 500 to 5000 ohms range is covered with no gaps. Unfortunately the Rainbow Tuner manual had conflicting toroid winding info on the taps to be used. The text said to use 4, 6, 8 and 10 turns, while a toroid winding figure showed taps at 3, 5, 7 and 9 turns. The only handicap if the taps shown in the illustration are used is a range of impedances between 3675 and 4540 ohms that may not give a low enough SWR. However that is IN THEORY! I have built tuners with both sets of taps and had no problems.

Part 2 of this description will be the subject of a future Quickie and will discuss the Rainbow SWR bridge and LED display.

—DE N2CX

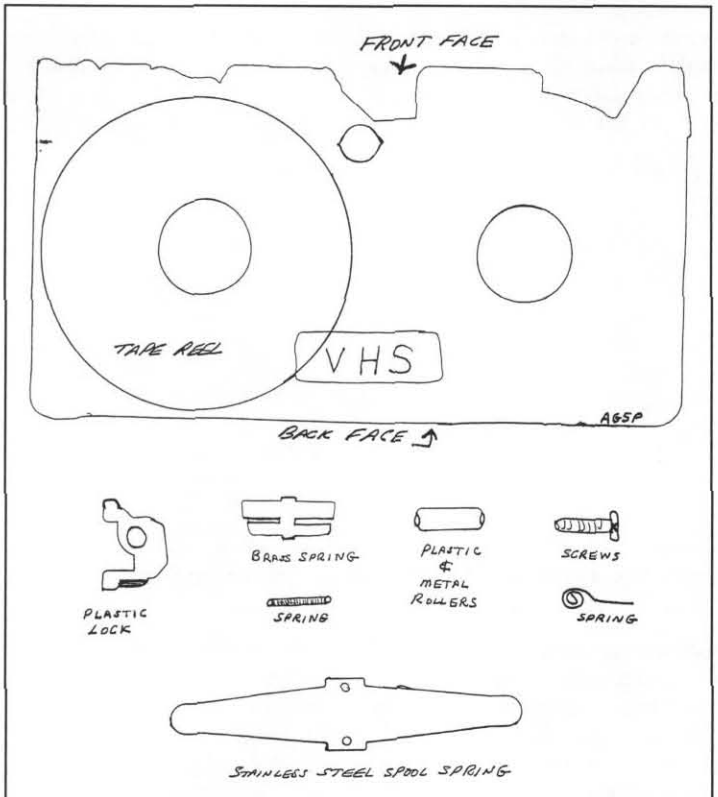


Figure 6—Parts harvested from an old VHS cassette tape (drawing taken from the Peanut Whistle)

THE VERSATILE VHS CASSETTE

This one comes from the pages of the Peanut Whistle, journal of the St. Louis (MO) QRP Society. It's from ***Walt Dufrain, AG5P*** *of Wright City, MO (walter@inlink.com). I've started receiving exchange copies of the Peanut Whistle and will be sharing some of their material in the future. (SLQS was founded as a local QRP and homebrew group in 1987. They feel now (as then) that the QRP world is well-served by QRP-ARCI, NorCal, Michigan QRP etc. and choose not to compete. They do not accept members from outside their area or accept outside subscribers to the Peanut Whistle.)*

There is just a wonderful mix of springs, plastic pieces, screws, brass and stainless steel in a cassette VHS tape. Being the inquiring sort, out comes the Phillips #2 driver and POOF, we have great QRP parts as shown in Figure 6.

1) The bow tie looking spring can be made into a set of iambic paddles.

2) The bow tie spring can be made into 2 simple straight keys.

3) The plastic and metal rollers are PC board spacers or standoffs.

4) The plastic locks are good spacers when you snip the ears off.

5) The tiny springs, screws and other plastic parts go to the junk box for another project.

6) The cassette makes a great tote box for wire antennas and feedlines; just put some fiber tape on the back face and snip the alignment pins and you have a tote case.

7) The 2 reels are great for winding wire antennas and feedline on them, and an added bonus is that the Radio Shack 300 ohm twin lead will fit just perfect.

8) If you are really bored you can stretch out the old VHS tape and mark it with a magic marker to create a monster measuring tape!

—DE AG5P

FILTER MOD FOR THE SST TRANSCEIVER

***Rich Arland, K7SZ** of Wilkes-Barre, PA (K7YHA in a former life), k7sz@juno.com, posted this modification for the SST to QRP-L a while back. The SST was designed by 1998 QRP Hall of Fame inductee Wayne Burdick, N6KR, featured in an article in QRPp (journal of the NorCal QRP Club), and sold in kit form by Wilderness Radio.*

The crystal filter in the receiver is much too narrow for my liking and I tried replacing C6 & C9 with 68 pF caps and C7 & C8 with 180 pF. This helped but I needed a wider passband. I tried 56 pF for C6 & C9 and 150 pF for C7 & C8. This is much better. These ratios are all basically 1:3 so I don't see why 47 pF and 120 pF could not be employed for those who desired a wider bandwidth.

—DE K7SZ

LOW VOLTAGE RECEIVER DESIGN

Bill Latta, N4LH of Louisville, KY, wrote to me a while back and suggested that I use his article. Originally appearing in the November 1997 issue of QEX under the title "The Belittler," he thought it might be of interest to QRP Quarterly readers. In fact, he said he had originally thought of sending it to us, but then published it in QEX instead. (That's something I have no problem with; I agree with the view of Bruce Muscolino, W6TOY, that if you have an article that you can sell to someone for money you should go ahead and do it without guilt.) I redrew the figures in KeyCAD; the article also contained two photos but I didn't bother scanning them in since they would probably lose something in the translation. Although this particular design is limited to fairly low frequencies due to the chip

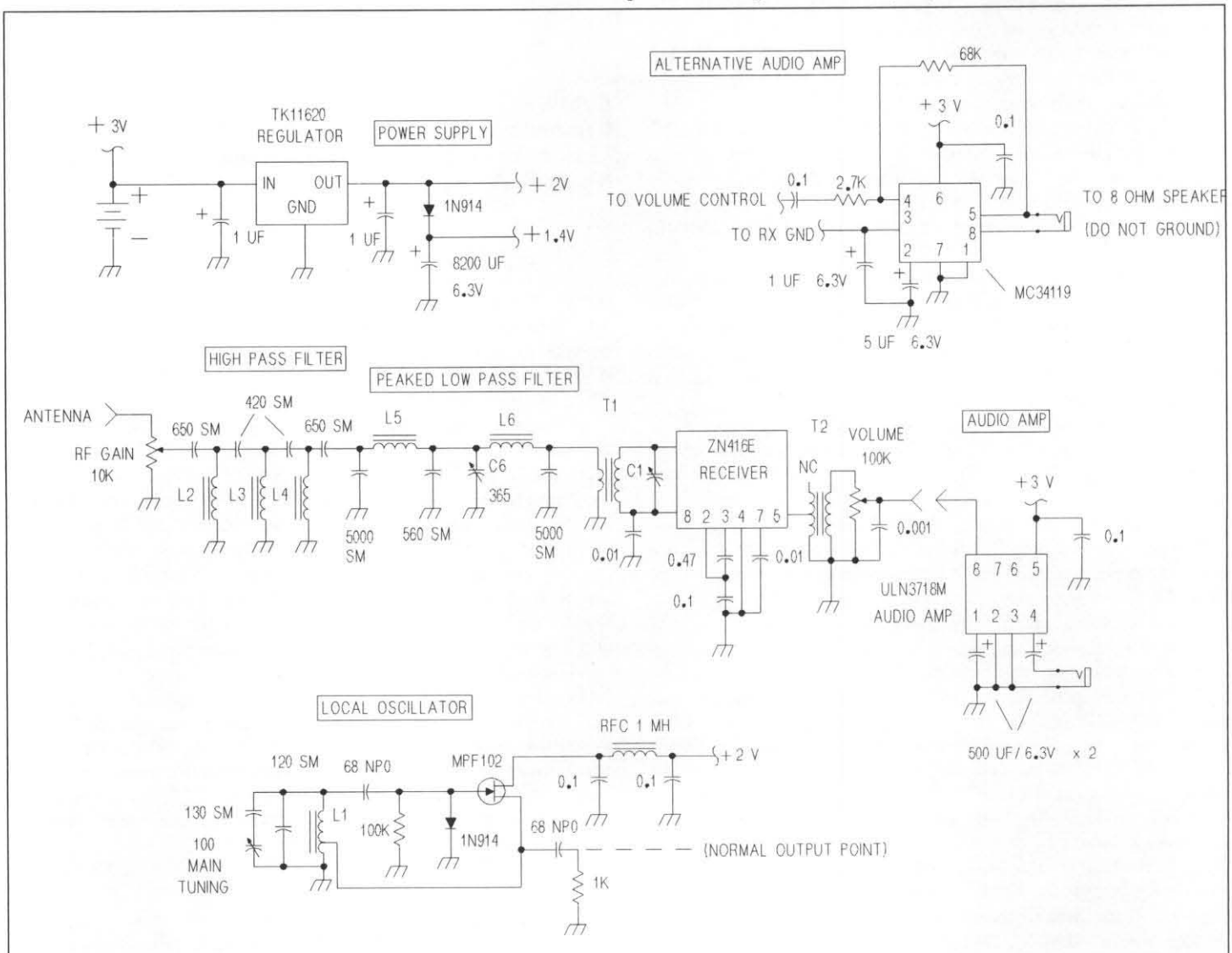


Figure 7—The complete receiver and alternative audio amplifier stage. The local oscillator board is proximity coupled—no physical connection—to the receiver board by spacing the two about 1 inch apart. Use 1/4 watt, 5% tolerance carbon composition or metal film resistors. Use 10% tolerance disc ceramic capacitors unless otherwise noted. See parts list for component values not shown. Capacitors marked SM are silver mica.

C1—25-280 pF trimmer (Arco 464)
L1—43T #26 enam. wire on T68-7 or 44T on a T68-6 core, tap at 11 turns
L2, L4—21T #22 on T50-2 core
L3—20T #22 on T50-2 core
L5, L6—30T #22 on T68-2 core
T1—70T #28 on T68-2 core with a 2T link over the cold end
T2—Audio transformer to match low impedance to high. (Argonne AR-153, use one half of input winding)

used, it's a good starting point for some low power receiver designs. And don't forget that the cellular phone industry successfully uses a huge number of chips at the 5 volt and even 3 volt level, for both transmit and receive!

The ZN414 chip is a favorite for building fun receivers for the AM broadcast band, operating on only 1.5 volts at 0.5 mA, capable of good DX with only a loopstick antenna. I tuned one such receiver up to 160 meters and was able to copy strong SSB and CW signals by beating them against my bench signal generator.

I was challenged to see what sort of low voltage ham receiver, if any, I could build using the ZN416, which is a ZN414 with an additional 16 dB audio amplifier built in. Though rated to only 3 MHz, these ICs work to 4 MHz and higher. I soon built an 80/75 meter receiver on a small piece of scrap board, using a trimmer capacitor and toroid coil, with external antenna in place of the typical loopstick. The tiny receiver brought in numerous strong signals in short order.

Where, I wondered, could I find schematics for a very low voltage oscillator? Data available showed 12, 9, or even 6.2 volts as typical choices. You never know until you try. I decided to build a regular FET Hartley oscillator on another board and see how well it worked—if at all—at lower voltages. Reducing the DC input from an adjustable power supply showed the circuit oscillating well down to below one volt. I tried several 2N4416's and MPF102's in the circuit; all started promptly and kept oscillating vigorously. Ah, I love the thrill of discovery.

The oscillator was built with a good double bearing capacitor to cover 3.4 to 4.0 MHz, and its output is terminated with a 1000 ohm resistor. When powered from the 1.5 volt battery and placed close to the receiver board, SSB/CW signals were readable at all frequencies in the oscillator's range. (The receiver board trimmer, C1, was left peaked at midband.)

Of course, during these tests strong out-of-band stations were leaking through. An RF GAIN pot at the antenna helped a bit. Then I added a high pass filter, but signals above the band were still very bothersome.

Next came a tunable 3.5-4.0 MHz band pass filter that was built on another small board. A 365 pF polyethylene variable capacitor serves as a peaking control, which I labeled Preselect on the schematic (figure 7). This filter arrangement does a good job of keeping signals above and below the band from interfering with reception.

Still, I was disappointed because the receiver could not "hear" weaker ham signals. I couldn't find a suitable audio amplifier chip for 1.5 volt operation, so I decided to build another module that uses a 3 volt audio amplifier IC. (Actually, I built two different audio boards. One uses a Sprague ULN3718M. The second one uses a Motorola MC34119P.) Both circuits perform well, as long as there is a matching transformer between the 64 ohm receiver output and the added audio module.) This extra amplification made it possible to hear many more signals.

The final receiver has several stages (see figure 8). Miniature coaxial cable carries the signals between the various boards that hold the stages. I mounted all those stages in an aluminum enclosure. A vernier dial slows the tuning rate. Now, an 8 inch speaker in a wooden cabinet with a closed back gives comfortable volume, so I no longer need headphones.

I can hear numerous signals by just connecting the antenna terminal to ground, or with a 20 foot indoor wire and separate ground.

As suspected, in-band selectivity is not always adequate, since this is a TRF (tuned RF) receiver. Donald Duck sounds from strong up-band SSB signals may sometimes interfere when I'm listening to down-band CW signals. An audio CW filter could help reduce this problem. Nonetheless, this is a fun receiver. For my purposes and location, I don't need it to be "competition grade." The sensitivity is good enough to hear strong European CW signals; the frequency

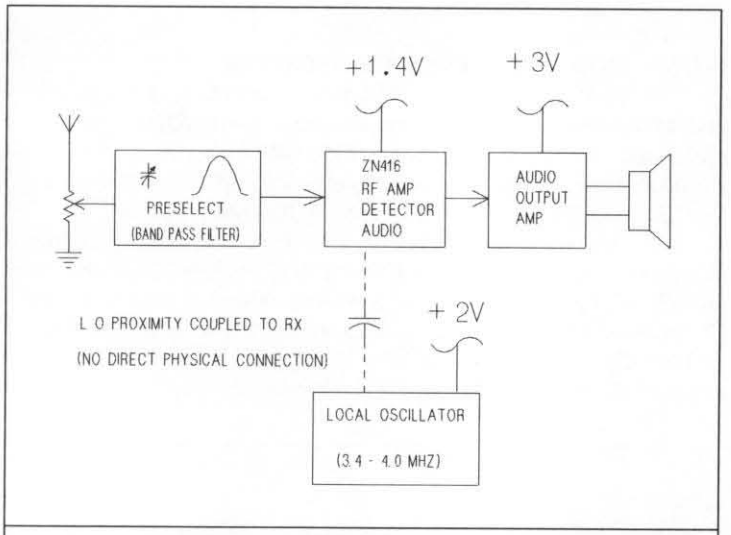


Figure 8—Block diagram of the receiver. Coaxial cable interconnects all the stages except for the LO. No wiring connects the LO and the other stages; coupling of the LO signal is sufficient due to the proximity of the circuits.

stability and sound quality are very good.

(I later installed an 88 mH toroid with a 0.47 uF capacitor, and a DPST switch on the back of the housing of the volume control pot. This "tuned audio circuit" connects across the outer terminals of the volume control. When I switch the circuit in and tune CW signals to peak at about 750 Hz, there is a substantial improvement in the selectivity. The circuit also greatly reduces static noise.)

For the power supply, I ultimately used two AA cells. They provide 3V for the audio stage. A 2V, low dropout regulator (TOKO TK11620, available from Digi-Key) powers the oscillator without sacrificing too much overhead voltage. A 1N914 diode connected to the 2V output drops 2.0V to 1.4V for the ZN416 board. This circuit requires a decoupling capacitor to prevent motorboating.

Current drain is only 30 mA at rest, so batteries last me a long time. I named this receiver "The Belittler" for two reasons" It belittles the use of power, and others have belittled me for even trying such a thing. The design is, of course, not altogether proper. Perhaps someone could build an improved model using some of the ideas presented here—maybe a superhet running totally from 1.5V.

There are many new ICs now being produced that will operate with low voltage and current requirements. Why not develop more efficient receivers? Light or other alternative energy sources could more easily power such equipment. At age 77, I may not be able to do much more of this work. So to others out there, the torch I throw! Bear it high, but keep the power low!

—DE N4LH

SOCKETS FOR NE-602? (QRP-L THREAD)

There was an interesting thread on QRP-L recently about use of sockets for the NE-602 and equivalent chips. It was started by **Scott Bauer, W3CV** (ke3nv@erols.com) admitting to some confusion since some QRP kits he built contained sockets for them, but others had no sockets and their manuals warned against using them. He noted that all of the rigs, with or without sockets, worked fine. Here is what followed:

*From **Paul Harden, NA5N** (pharden@aoc.nrao.edu)*--Using sockets for RF type IC's seems to be one of those emotional subjects, like whether QRP rigs should have AGC or not, or whether or not to use Brasso [metal polish] on your NorCal paddles! In life, we sometimes have a bad experience with something, and make it an

institution for ever more. I've been guilty of that too.

I have never experienced any problems associated with using IC sockets for NE602's, MC1350's, etc. at 7 MHz up to 21 MHz. Much above that, problems begin to occur due to the inductance in the longer lead lengths, RF radiation from the sockets, and signal attenuation. But for 15M and below, the advantages outweigh the possibility of trouble, in my opinion. The additional lead lengths causes several problems, which is why the industry moved to surface mounted components for today's electronics, which involves very high frequencies (cell phones, GPS receivers, 166 MHz computer mother boards, etc.).

I built my MXM simple receiver using IC sockets in spite of the warning in the manual., and it works fine. After all, the 1st IF is 4 MHz (if I remember right) and the 2nd is only 455 kHz.

Admittedly, soldering in the IC's will ensure a "tighter" build; using sockets may introduce some noise and extra radiation, but not to the extent that it outweighs the convenience of having socketted active devices. Ask anyone who had to replace the HC240 in their 38-Special! *[It's a 20 pin DIP IC. -- WA8MCQ]*

From ***Alan Kaul, W6RCL*** *(alan.kaul@worldnet.att.net)*--"Ask anyone who had to replace the HC240 in their 38-Special!" That would be me that Paul is talking about. The frustration is that I got abnormal voltages on several of the pins of two of the devices. I didn't use sockets, so I almost destroyed the board unsoldering the old chips, then decided to use sockets before I plugged in the new ones. The frustration was magnified when I discovered that the problem persisted. Turned out to be a flat crystal (or one that possibly had shorted out). Moral of the story, use sockets next time if the frequency isn't so critical!

I know there are RF purists out there who disagree with me, but my guess is that even the legendary Super-Elmers won't be able to measure any difference if they had one SW40+ [transceiver from Small Wonder Labs] with sockets and one SW40+ without sockets on the bench in front of them.

From ***Ray Lowe, WD5DHK*** *(wd5dhk@hotmail.com)*--A potential problem that I have seen several times with sockets is corrosion between the IC pins and the socket. I wish I had just a dime for every time that I have seen this. The equipment that I have seen this on was not just RF related, as I have had problems with even 741 op amps doing this and causing problems.

From ***Jim Owen, K4CGY*** *(owen@piper.eeel.nist.gov)*--I have had the same problems. In a previous job here I did a lot of construction of instrumentation for nuclear sources. I found that the cheap tin plated sockets didn't work very long. I solved the problem by buying only sockets with GOLD pins. They cost only a little bit more and are well worth the cost. Then again I also had units with cheap sockets that had no problems.

From ***Ed Manuel, N5EM*** *(n5em@flash.net)*--If you are going to use sockets, use GOOD ones. Bad ones (read that "cheap" ones) can cause intermittent problems down the road. If you don't know a good socket from a cheap one, we can help there.

If you use sockets, try to get low profile ones. If your socket is half an inch high, that adds lead length to each pin of your IC and, hence to the circuit. A thin socket with high-quality pins is almost invisible to your circuit. Also, if your rig will be subject to a lot of bouncing, jarring, vibration (you know, hiking, bicycling, snowmobiling), then the socket becomes a possible source of problems where a soldered IC would not. Of course, it's a lot easier on your beautiful circuit board when you change a bad or questionable IC by removing it from the socket rather than desoldering it.

One of the tried and true diagnostic techniques for circuits with ICs in sockets when they go flaky is to remove and re-seat the ICs in their sockets (essentially, wipe the legs to break up the oxide that has formed on the IC pins).

From ***Gary Surrency, AB7MY*** *(gsurrency@juno.com)*--"A potential problem that I have seen several times with sockets is corrosion between the IC pins and the socket." Must be that Gulf coast humidity! Not a problem in Arizona, but it was when I lived in Florida. Heath used poor quality sockets for IC's in their kits and on their PC card edge connectors. I was always cleaning or replacing those things when I lived there. If you use good quality gold plated IC sockets in these environments, you should have a lot less trouble. Otherwise, the tin-plated ones are just fine.

[From a subsequent posting] It's been said here before, but since there are some new [QRP-L] list members, it's probably worth mentioning again. If you suspect you have a bad IC and it is soldered in because you didn't use a socket, cut off all the pins of the IC with some side cutters before you attempt to desolder it. In other words, sacrifice the bad IC, not the PC board. That way you'll be able to desolder and pull out the pins one-by-one. Trying to desolder an 8 to 24 pin IC all at once simply isn't worth trashing the PC board and all the other components on it.

Clean out the holes with a Solder Sucker desoldering tool, a vacuum bulb, or some "Soder Wick" (tm) and the PCB will be good as new and ready for the new IC or socket - if you don't want to have to do this all over again. IC's are much cheaper than fully stuffed PCB's.

Regarding that last sentence ***John J. McDonough, WB8RCR*** *(jjmcd@mdn.net) said,* "Easy for you to say. When you're in Phoenix, or Houston or New York City, you can just run down to the local radio store for another IC. For those of us in the boonies, sacrificing that IC also means a week of waiting."

Marty Watt, KM7W *(mwattcpa@earthlink.net) had this rebuttal*--Better idea: order a couple extra at the same time as your kit, and more for more frequently used IC's (NE602/612 for example). You'll use them eventually, and no waiting on the parts for "busted replacements". Then you can reorder when you run short. I duplicated the IC's in the 38 special in a Mouser order, and was AWFULLY glad I did! Whole thing cost $10 including shipping. Really, it's an inexpensive way to build up your parts bin, if you think of it.

From ***Frank, G3YCC*** *(g3ycc@g3ycc.prestel.co.uk)*--It might not be a good idea to consider using IC sockets for some applications. For instance, some audio ICs rely on the ground plane of a PCB for heatsinking, such as the LM380N. I have known such devices to go "pop" when used in a socket rather than being directly soldered in, maybe due to bad heat conductivity. Anyone got any comments on this? Also, if you anticipate having to salvage an IC for other circuits, yes a socket is a good idea. I have many NE602's soldered into PCBs from 'failed' or obsolete projects. I wish I'd used sockets on them as they are becoming more difficult to find now manufacture has ceased. *[Don't panic over that last one; while the NE602 is said to have ceased production, they still make the SA602 which is the same thing but with a wider temperature range.. -- WA8MCQ]*

COMMENTS ON THE OHR100A (20M)

The QRP Quarterly had a review of the OHR100A (30 meters) by K5FO in the last issue. ***John King, KB3WK*** *of Ellicott City, MD (JOHN.P.KING@cpmx.saic.com) built the 20M version and passed along some comments of his own--*

1. In general, the kit quality was quite good. Three small components were missing, but a single e-mail to OHR owner Dick Witzke, KE8KL, caused the parts to be in the mail the next day. Now, if the US Post Office could only figure out how to get them to me in any reasonable length of time, we would be all set! The Post Office took over a week!

2. The instructions are intended to be maximally efficient, i.e."Install all the resistors." That works fine for an experienced builder, but it doesn't aid in troubleshooting. A "build a little, test a little" set of instructions might be more helpful.

3. Operation is excellent. Especially, it was a good idea to include a manual RF gain control, given that the rig does not have an AGC. It cuts down on overloading by strong nearby stations. Shades of operating CW before the days of hang AGC's!

4. Tuning is a bit touchy, given the tuning range allowed by the rig. It is workable, but a vernier drive would be a welcome addition. It would also increase the price of the rig, so the trade-off is obvious.

5. I did have one problem when the rig was first constructed. There was a tone which seemed to be associated with the 18 MHz band setting oscillator. (This oscillator mixes with the 5 MHz VFO to produce 23 MHz, which is then mixed with the signal to produce a 9 MHz IF.) That 18 MHz oscillator also seemed to be working on 9 MHz, and thus produced a tone in the IF. OHR cheerfully accepted the rig, to see if they could determine the problem, and replaced all the crystals at no charge. That fixed the problem. But it might be worth knowing that such a problem is possible, and if it occurs the most likely cause is the additional mode of this oscillator.

6. The only other problem was a few stray, internally generated signals at the lower end of the band. The frequency of these signals seemed to be sensitive to the oscillator crystals. These false signals were greatly diminished with the installation of new crystals. So, again, changing crystals may be a way to fix this problem.

7. On the whole, this is a great little rig, and well worth the money. I have had a great deal of fun with it. The best DX to date is Morocco.

—DE KB3WK

SPACERS PROTECT COMPONENTS DURING SOLDERING

*From me, **WA8MCQ** of Severn, MD*—I dug out my partially finished 38 Special kit to verify the pin count on the HC240 chip, and seeing it reminded me of something I do all the time but don't think I've mentioned in the Idea Exchange yet. When you stuff a PCB with parts, a common method is to install a number of them, flip the board over, solder the leads, cut off the excess wire, and repeat several times until the board is full. The problem is that when the board is turned upside down for soldering, the components absorb all of the downward pressure and get repeated abuse. This can result in some of them being bent over, and that could lead to damage.

Although there will often be some tall, rigid components already on the board, such as IF transformer cans, they will not protect all of the other components unless they are taller than everything else and spread out far enough to keep everything from touching the bench during soldering.

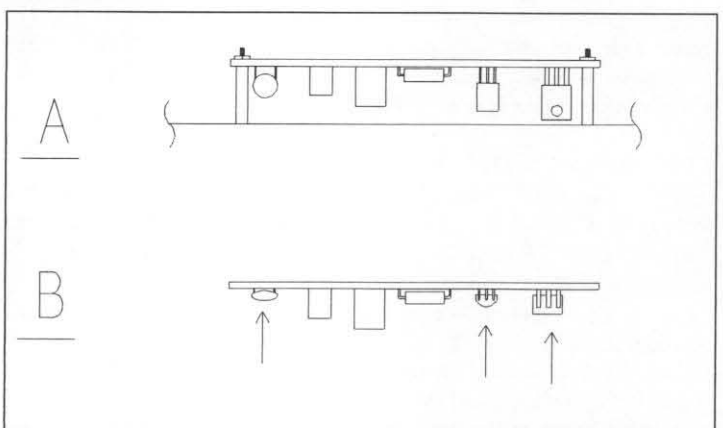


Figure 9—Spacers on 4 corners of PCB at A protect components from damage when board is upside down for soldering. Board at B is not protected, and several parts have been bent over, possibly resulting in damage.

Since most circuit boards have holes in the 4 corners, I temporarily mount some sort of spacer or standoff in each hole as shown in figure 9. When the board is turned upside down to solder, they support it and keep the components safe. The type is not important; they can be metal or plastic, threaded and mounted with nuts or screws or drilled out and used with a long screw and nut, or the plastic type that presses into a hole and is released by pushing in a little tab in the end. They don't need to be the same type or length, either, since they are only used during construction and then removed. As long as they keep all of the components from touching the bench while the board is upside down, they're OK.

—DE WA8MCQ

NEW TINY MIXER FOR TINY RIGS

*From me, **WA8MCQ of Severn, MD***—It's been over 8 years now since some of us folks in MD built our tiny rigs in the 3/4 cubic inch pill bottles, and two of us have been talking—talk only—about the next phase for quite a while. A few years ago we settled on one of those little boxes with sliding cover that 5 cartridge fuses come in, which is about half of a cubic inch in volume, and I later decided to do one in a Zippo lighter after that. I still haven't done much on either one, and people have since built rigs into those packages already, but I still plan on doing them. (WA6AHA, Jeff Anderson built one into an empty 9 volt battery case—one of our alternate packages—and showed it at Dayton a couple years back. W1REX had his Pixie in a Zippo at a NorCal meeting and at Dayton this year, and last year N8ET brought WD8PBR's Pixie in a fuse box to Dayton. My congratulations and admiration to all!)

In the first phase of the challenge, the pill bottle, use of surface mount parts was specifically forbidden, to keep things sporting. However, for the next phase we're allowed to use SMT. I was planning on doing something with a discrete component diode ring mixer for the NorCal 2N2222 building contest, but decided that it would take up too much real estate on the board; I decided to use an ASK-1 mixer from MiniCircuits and cut off the top to reduce the height a bit. Regrettably I consigned myself to entering the K5FO Unlimited Building Contest, since the NorCal rules specifically forbade use of packaged mixers. But even using a shaved-down ASK-1 was going to be a bit limiting due to the amount of height available in the package.

MiniCircuits came to the rescue recently with a new style of mixer construction that greatly reduces the height, and which was featured in the April 1998 issue of a couple of electronics trade journals. The basic style, the ADE series, has been around for a while and appears in their 1997 design guide. However, the lowest frequency unit available until now started at 50 MHz on the low side. A pair of recent additions to the line now extend the lower frequency limit of this series well below the 80 meter band.

The additions, which don't appear in their catalog yet but can be found on their web page, are the ADE-1ASK and ADE-2ASK. The former goes from 2 to 600 MHz on the RF/LO side, and DC to 600 MHz on the IF port. The price is $3.95 in quantities of 10 to 49. The latter device covers 1-1000 MHz on RF/LO and DC-1000 MHz on the IF side. It costs $4.25 in the same quantities. (These are what they call Level 7 mixers, ie, requiring an LO drive level of + 7 dBm, the same as the SBL-1.)

Here's the best part: these suckers are TINY! The footprint is nominally 0.220" X 0.310", good news in it's own right, but only 0.108" tall. They not only save on real estate like the RMS and ASK series, but they also significantly reduce the height of your board. If you're going to be doing something silly like stacking two circuit boards inside a cartridge fuse box or Zippo lighter, that's extremely important. It also doesn't hurt if you're designing a new HT or cell phone. Figure 10 shows the size compared to some popular mixers used by QRPers.

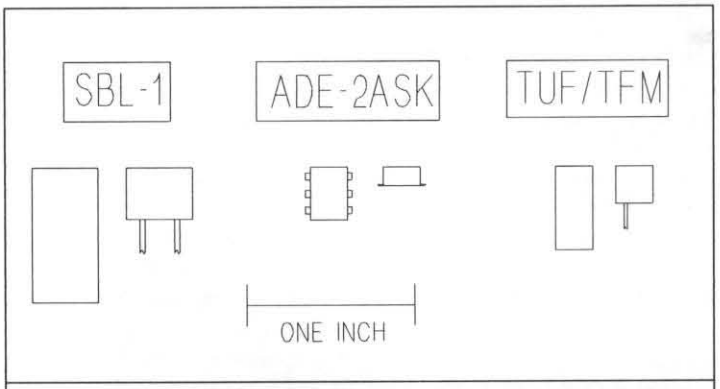


Figure 10—The new ADE-1ASK and ADE-2ASK mixers compared to the SBL-1 and TUF/TFM series. Performance is similar to the SBL-1 and TUF-1.

These units come in a thermoplastic package, so be careful with the soldering iron when you use them. If you slip a bit you could put a ding in it easily. Although I haven't soldered one onto a board yet, I'd be a bit careful about overheating the leads since they are held in place by the plastic body.

They also have no cover on the bottom—the components are all out in the open where you can see them, which took a little getting used to after using sealed mixers for years. That's a trade off for getting the lower height. According to the press release, it also allows for proper drainage of liquids during board cleaning operations on a production line.

One way they get the reduced height is by using a different shape of toroid. Instead of being circular, they are square and the wires are only wrapped around two of those sides, so the wire doesn't contribute to the height of the unit.

—DE WA8MCQ

SPREADSHEET AND JUNK CRYSTALS FOR SIGNAL SOURCE

John Kirk, VE6XT *(John.Kirk@frco.com) of Calgary, Alberta passed this along--* If you are like me, over the years your junk box has accumulated a variety of surplus crystals of dubious origin and/or value that were just too good to throw away, yet seldom end up in any workbench projects. Frustrated with a drifty, low-budget signal generator that simply would not stay put long enough to perform a receiver alignment, I turned to my "rock collection". Somewhere in there was probably a crystal with a harmonic very close to the band of interest. But what a job to find it! Visions of hours spent with a calculator, figuring out harmonics from 1 to n, where n = "lots" held no appeal. Enter the computer.

Mostly, the spreadsheet programs bundled "for free" with the purchase of a computer for the average ham shack are a solution looking for a problem. This, however, might be the exception. The spreadsheet will cheerfully calculate harmonics out to beyond any reasonable application. Furthermore, most have a "sort" function that will place our rock collection in ascending order, making it much easier to evaluate the possibilities.

Enter your crystal frequencies in column 1 in the order that they fall out of the jam jar. Then use the spreadsheet's sort function to put them in ascending order. For the first entry, create formulas in columns 2 to whatever:

R1C1x2, R1C1x3 etc. Copy these into the rest of your list and you are in business! See Table 3.

When preparing your spreadsheet, consider working out the fundamental frequency of all overtone crystals, and load them into the spreadsheet by fundamental frequency. Overtone crystals will quite cheerfully oscillate on their fundamental, albeit usually somewhat low in frequency. If the fundamental is not obvious from the case markings, now would be a good time to inscribe it on the case using some relatively permanent means like a scratch-awl. Tack a column onto the end of your spreadsheet for notes like "HC-25, marked 42R525" or suchlike.

In signal generator service, you will generally want to use the lowest harmonic possible, especially for receiver alignments where the sensitivity and condition of the patient is unknown. This means viewing the spreadsheet from lower left to upper right - something you will get the hang of much more rapidly by doing than by reading about.

What kind of oscillator to use? Just about anything will do, though we'd consider operation from 100 kHz to 20 MHz or so without circuit changes a major bonus. I use the hoary old bipolar Pierce circuit that has shown up in countless QRP projects and ancient ARRL Handbooks (Figure 11). Actual frequency of oscillation in this circuit correlates very closely with markings on the case of the crystal, leading me to believe that the load capacitance is somewhere near 30 pF, but your mileage may vary! Avoid the temptation to build elaborate oscillator/multiplier contraptions that more resemble transmitters than casual use test oscillators - I have yet to come across an application where lack of signal at the harmonic frequency was an issue. Quite the contrary, actually. What we lack in precisely-calibrated attenuators we can make up with physical separation. When you seriously contemplate parking the car, complete with test oscillator, in the next block you have truly "arrived" to the world of weak signal.

HARMONICS→								
XTAL FREQ↓	2	3	4	5	6	7	8	COMMENTS
6.198	12.396	18.594	24.792	30.990	37.188	43.386	49.584	HC-18
6.388	12.776	19.164	25.552	31.940	38.328	44.716	51.104	HC-6(MARKED 153T3125)
6.761	13.522	20.283	27.044	33.805	40.566	47.327	54.088	HC-6(3RD OVERTONE)
6.783	13.566	20.349	27.132	33.915	40.698	47.481	54.264	FT-243
6.811	13.622	20.433	27.244	34.055	40.866	47.677	54.488	HC-18(MARKED KDK)
6.866	13.732	20.598	27.464	34.330	41.196	48.062	54.928	HC-18
7.081	14.162	21.243	28.324	35.405	42.486	49.567	56.648	MUSEUM PIECE
7.090	14.180	21.270	28.360	35.450	42.540	49.630	56.720	FT-243
7.096	14.192	21.288	28.384	35.480	42.576	49.672	56.768	FT-243
7.097	14.194	21.291	28.388	35.485	42.582	49.679	56.776	FT-243
7.130	14.260	21.390	28.520	35.650	42.780	49.910	57.040	FT-243
7.335	14.670	22.005	29.340	36.675	44.010	51.345	58.680	HC-6(3RD OVERTONE
7.373	14.746	22.119	29.492	36.865	44.238	51.611	58.984	HC-18(COMPUTER)

Table 3—Output of spreadsheet showing harmonics of selected crystals.

In practical terms, how high can you go? My spreadsheet currently tops out at X27, a common multiplier in old Motorola boat-anchors, but as I write, the 81st harmonic of a 16 MHz microprocessor crystal is providing a signal source for long term testing of a failing 1296 MHz rig. The signal isn't real strong, but it is definitely usable, and surprisingly stable.

You've examined your rock collection, and it yields nothing even remotely suitable? Check out "The Great Xtal Swap Page" at http://www.chubs.demon.co.uk/xtals.htm and arrange a swap.

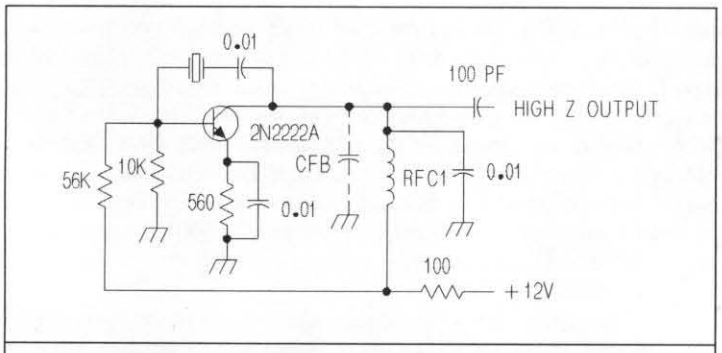


Figure 11—Pierce crystal oscillator for signal source. See text for description of CFB and RFC1.

Better yet, append column 1 from your spreadsheet to an e-mail message, and add to the list - the next person to benefit could be me!

[WA8MCQ notes on Figure 11, which is similar to Figure 57 on page 4-25 of the 1991 ARRL Handbook, the circuit John refers to. They show a value of 1 millihenry for choke RFC1, but I wouldn't feel too comfortable using that. The self resonant frequency of a choke with that much inductance would be relatively low and could cause problems. A better choice would be to make a coil with a few turns on a toroid such as type 43 or 61 material.

As for the capacitor labeled CFB, or Cfeedback, the handbook says that a capacitor may be needed there with some crystals to get them to oscillate. It indicates that the value will depend on the frequency as well as transistor gain. For fundamental mode crystals in the range of 1.8 to 20 MHz, it suggests values ranging from 25 to 100 pF, with the higher values being used at the lower end of the range.]

—DE VE6XT

CW MESSAGE RECORDER-KEYER

Tired of CW memory keyers that spit out everything with a dull, robotic precision and make everyone's fist sound exactly the same when sending out canned messages like contest CQ's? Here's an intriguing device from ***Floyd Carter, K6BSU****, which originally appeared in the Winter 1997 edition of QRPp, journal of the NorCal QRP Club (reprinted with permission). Instead of digitally reproducing your message, it lets you send audible CW with your own fist (using the sidetone in your rig or a code oscillator), records that in an audio message recorder IC, then plays it back and keys the rig. Your canned message now sounds like your own fist instead of a computer, since it IS your own sending! (I remember hearing someone in the CW SS a couple years back who could have used something like this. He was sending CQ SS with a computer or memory keyer, which had the usual machine-like perfection, but when someone answered and he responded by sending manually there was a rather disconcerting difference in the fist. Not that his own fist was bad, just different enough that it took a second to realize that it was the same station sending.)*

Here's a message keyer that will transmit your personal message or contest call at the touch of a button. Memory keyers which can do that are common with contest operators. The current crop of memory keyers all have a drawback. They all transmit perfect Morse and not the kind of CW that most people send! How about CW operators who use mechanical bugs, or who are reasonably good with a straight key? How about sending your calling message in your own fist?

The Message Recorder-Keyer is a handy device which will record your CW message up to 20 seconds, and then play it back exactly as you recorded it, with your own "swing" or other personal sending defects! During playback, the circuit will automatically key your transmitter in CW mode.

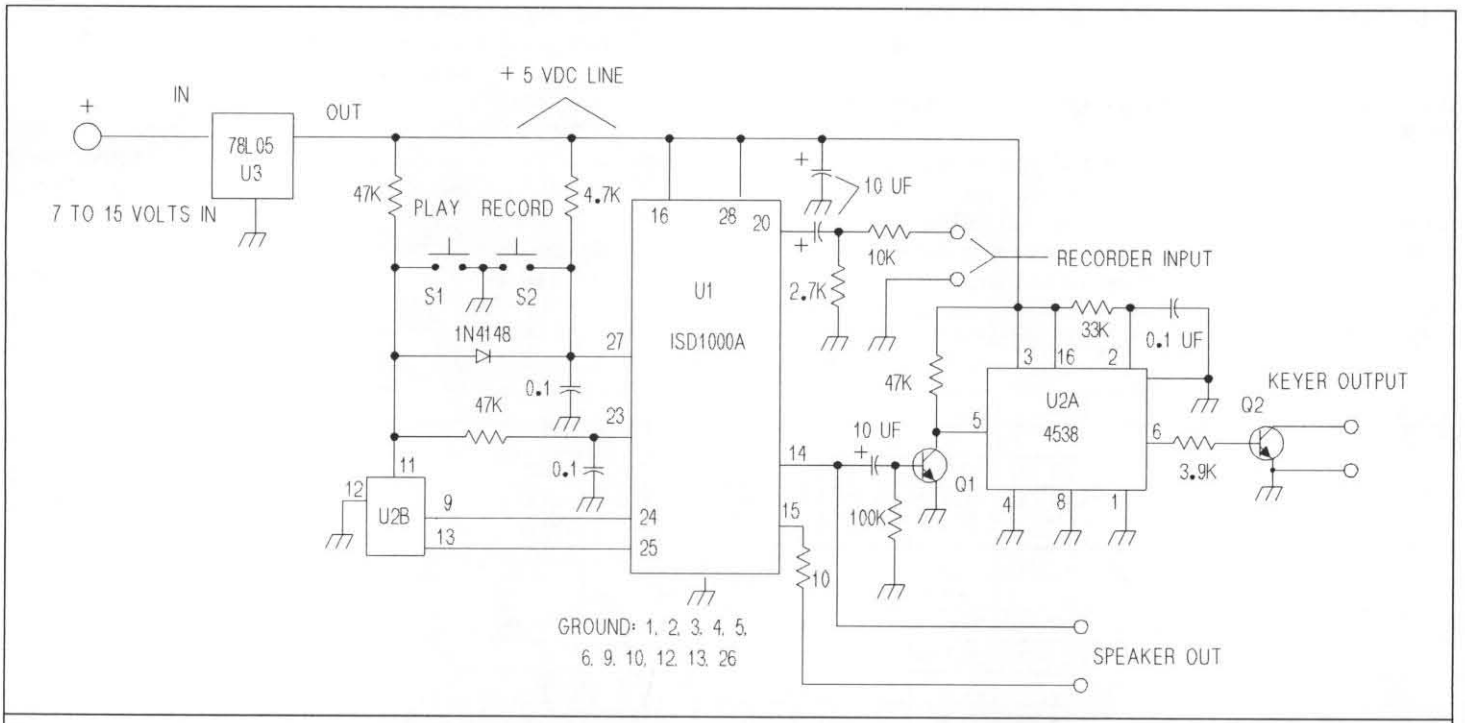


Figure 12—The Message-Recorder Keyer by K6BSU. The 10 uF capacitors are electrolytic, 10 volts or higher. The 0.1 uF caps can be disc or monolithic. Transistors are 2N2222 or 2N4401. S1 and S2 are SPST, normally open push buttons. Connect a small 8 ohm speaker to the speaker output. Depending on the characteristics of the rig used, it may be necessary to add some extra circuitry to drive a relay or PNP transistor for the keyer output. All resistors are 1/4 watt, 5%. IC PARTS LIST: U1 ISD100A (RS 275-1325) U2 CD4538A dual monostable multivibrator U3 78L05 5 volt three terminal regulator ***[This is the low power version in a TO92 case; the larger, full power 7805 can also be used. —WA8MCQ]***

If you connect the audio output of your receiver to the Message Recorder-Keyer input, you can record any receiver output, either voice or CW. This is handy for DX work, when the DX station seldom sends his own call, and the stations working the DX will not send it either. Sso each time the DX comes back, record his brief transmission. If a call sign is included, you can play it back repeatedly to make sure you have it down correctly. (You have to disconnect the keyline to your transmitter or else it will try to key your transmitter each time you listen to the playback.)

The Message Recorder-Keyer, shown in Figure 12, is designed around an interesting 28 pin chip from Radio Shack. When used as a CW keyer, the chip records the sidetone output of your transmitter or a code practice oscillator. Because it plays back exactly the CW tone recorded, the audio output must be "rectified" by a monostable multivibrator set to retrigger on each peak of the audio tone. The result is a key line to your transmitter, with a loudspeaker output thrown in for good measure.

Operation is simple. Connect your transmitter sidetone monitor, code oscillator or receiver output with about 1 volt RMS to the "record in" and record up to 20 seconds while holding down the "record" button. Releasing the Record button at any time terminates the recording function and sets an end-of-message marker. Connect the Message Recorder-Keyer key line output to your transmitter and momentarily press the "play" button. Your CW message will key your transmitter exactly as you recorded it, warts and all. The built-in loudspeaker lets you monitor the playback.

For the digitally enhanced reader, here is how it works. The Radio Shack chip comes with complete instructions and description so I will not repeat them here. Think of it as a variable length audio tape loop. U2A is set to generate a pulse of 0.0033 seconds, but it's output is continuously retriggered by each peak of the playback audio tone, as long as the tone is above 303 Hz. So U2A operates like a digital rectifier, converting audio to key closure. U2B is the other monostable multivibrator in the IC, but it is connected to act like an RS flipflop (Reset-Set). It puts the unit into a "sleep" mode for almost zero power consumption between uses. Memory is not erased with power off, so your recording will remain until the old message is recorded over by a new message.

The Radio Shack chip is designed for 5 volts. A 78L05 plus five volt regulator is shown so input power can be anything from a little over 5 to 15 volts DC. Current consumption at 5 volts is 25 mA during Record or Play. If a speaker is connected, expect the current to peak at about 75 mA. During standby, the "sleep" mode reduces current drain to 10 microamperes.

The prototype unit was built on single sided PC board material, using point to point wiring. S1 and S2 were epoxied to the circuit board, but the switches may be brought out to a front panel, if desired.

—DE K6BSU

QRP-L, THE "QRP DAILY"

As this is written in late May, the Fox Hunt on-the-air activity coordinated via QRP-L is over for the season and that should reduce the traffic load some for a few months. Still. it's bound to run into the high double digits of postings per day, so there will be plenty of QRP activity for all. (The record was an astounding 193 posts one day, but that's an aberration; it has never been anywhere near that before or since!) QRP-L is not for everyone—quite a number of people have subscribed and then unsubscribed since they find it takes too much time to keep up with it. But for those who want a good, healthy dose of QRP every day, this is a great place to get it!

To subscribe to the free Internet QRP forum, started up in 1993 by 1998 QRP Hall of Fame inductee **Chuck Adams, K5FO,** send e-mail to

listserv@lehigh.edu

and leave the subject blank unless your system requires something. In the text, put

subscribe QRP-L <your name> <your call>

That's your real name and real call, not your e-mail address—it gets that from the headers. The name and call are for the benefit of people who look at the subscriber list; unlike some mail reflectors, the one at lehigh.edu also gives names (or whatever you type in) in addition to e-mail address—which can be quite cryptic in some cases.

At one time this would result in your being signed up immediately, but not any longer. Apparently there has been trouble on the Internet with people signing up for mail reflectors with bogus or falsified e-mail addresses. Now when you try to subscribe to QRP-L (and many other mailing lists), you'll get an automated reply saying that someone tried signing up with your address. It instructs you to return a "conf-cookie" code, which it supplies, to verify that the request really did come from you and that you do want to subscribe. Send that code back in e-mail, and after it gets that verification from you it adds you to the list

Save the automatic "welcome" message you'll get after your subscription (free) is processed and read it thoroughly. And pay special attention to the part about enabling the Daily Digest function, which will still give you all the traffic but as a single, huge daily e-mail message instead of several dozen individual messages PER DAY cluttering up your mailbox; I couldn't live without it! The digest also includes a handy index at the top so you can decide which postings look interesting and skip the ones on topics you don't care for.(To reduce online connection time, download the digests and read them offline later with a word processing program.)

By the way, those of you using juno.com with its infamous file size limit of about 60K who want to get the daily digest don't need to worry. Just send e-mail to Jim Eshleman, N3VXI who administers QRP-L and he'll fix you up with an alternative that splits the daily digest into two smaller chunks that juno.com can handle. (His address is LUJCE@lehigh.edu.)

THE FINE PRINT

"Something old, something new, something borrowed, something blue." There sure hasn't been much of the "something old!" I had been thinking for a while of recycling some old items from the Idea Exchange, starting back in 1990. After all, that's eight years and there's been quite a lot of turnover in our readership since then, and lots of good things have passed through these pages. But it may be a while before I actually do it.

I was once worried about a shortage of material but it hasn't been a problem for a long time and so I've not yet gotten around to reprinting the old items. Between QRP-L and the many other QRP journals out there ("something borrowed"), plus lots of people who write articles to be published for the first time on these pages ("something new"), it looks like there's never going to be a shortage.

And how about "something blue?" If you want that, you can go down to your local Office Depot, Staples, etc and buy some blue highlighter pens to mark your favorite Idea Exchange items. ("Something blue" also describes what I say when I spend over an hour painstakingly drawing up a schematic on the computer and then accidentally delete the only copy from the disk. But at least I wait until the kids are out of earshot!)

A possible long term project is doing a reprinting of the Idea Exchange back to Day One (when it was written by W3TS), and selling it as a separate book, but that may be a while off.

And if you'd like to contribute anything of your own, send it to Severn via USPS or e-mail and sit back and await the fame and glory of being published in the QRP Quarterly!

—qrp—

Don't miss any copies of the QRP Quarterly! Check your address label to see if this is your last issue. If it is, renew now instead of waiting until the last minute and risk missing the next issue.

A Sealed Lead-Acid Battery Primer, Part 1

Richard Bachmann, N3SLR bachmann@ari.net

Introduction

There has been a lot of interest in gel-cells for operating QRP in the field. Sealed lead-acid batteries are available new and used in capacities ranging from .5 amp-hour to more than 100 amp-hours. The purpose of this article is to furnish some background on the basics of lead-acid batteries. The electrical characteristics of small sealed lead-acid batteries, battery selection, and battery load testing are presented. In addition, the details of a load test for checking the capacity of a battery are presented. This article also provides necessary background for a future article on charging small sealed lead-acid batteries.

Battery Basics

The cell is the basic building block of a battery. When cells are put in series, the voltage of each cell is added to produce the total battery voltage. The amp-hour capacity of the series string of cells is the same as for an individual cell. Series connection, as in 6-volt, 9-volt, and 12-volt batteries, is the most commonly seen configuration. Only identical cells in the same condition should be placed in series. Otherwise, uneven charging or discharging will occur and some of the cells will be damaged. Cells or series strings of cells can also be put in parallel to improve the capacity. When two 12-volt batteries are put in parallel, the amp-hour capacities of the batteries are added to get the total capacity.

Cells are categorized as primary or secondary cells. Primary cells, like Carbon-zinc and alkaline flashlight batteries, can be discharged only once and are discarded. Secondary cells, like NiCad and lead-acid cells, are rechargeable.

Lead-Acid Batteries

A 12-volt lead-acid battery is made from 6 cells in series. The nominal voltage is 2 volts per cell. At full charge, the open circuit (OC) voltage is between 2.1 and 2.2 volts per cell. For a 12-volt battery these open circuit voltages are 12.6 to 13.2 volts. The variation is due to differences in the cell chemistry used by the manufacturers. For a specific model of battery, the voltage is repeatable between batteries and can be used to determine if the battery is at full charge. A fully discharged cell has an open circuit voltage of about 1.95 volts, which works out to 11.7 volts for a 12-volt battery. Deep discharge (80% to 100% depth of discharge) is hard on a battery and full (100%) discharge is not recommended.

In the manufacture of lead-acid batteries, several design tradeoffs are made. One such trade is short-circuit current versus deep cycling ability. For a starting battery, high current is required for a short period of time. The high current is achieved by maximizing the surface area of the plates. The plates are made thinner so that more plates fit into the space. The thin plates are not tolerant of deep discharge. They shed and disintegrate under repeated deep discharge (deep cycling). For this kind of service, thick plates are used. The 'deep cycle' battery is heavier for the same case size and has a lower amp-hour capacity but the thicker plates can tolerate the shedding and give a much longer life in deep discharge service. The Trojan Battery Company, a reputable manufacturer of flooded cell deep cycle batteries, recommends sizing a battery for 80% depth of discharge.

Lead-Acid batteries are usually categorized as sealed or flooded cell. Sealed lead-acid (SLA) batteries, also called Valve Regulated Lead-Acid (VRLA) batteries, are either gel-cells or starved electrolyte absorbed glass mat (AGM) batteries. SLA batteries can be shipped by air and are not as position sensitive as a flooded battery. The disadvantage is that they are not serviceable. Flooded cell lead-acid batteries have caps for adding water and for checking the specific gravity of the electrolyte. They must remain upright or acid will spill. A main advantage is that the state of charge is easily determined by checking the specific gravity of the electrolyte with a hydrometer. If a flooded battery is accidentally overcharged, the lost water can be replaced.

Flooded-Cell Lead-Acid Batteries

Before 1960, the only type of commercial lead-acid battery was the flooded-cell type. Flooded cell batteries are tolerant of overcharging as long as the electrolyte level stays above the top of the plates. In fact, they are sometimes overcharged aggressively to overcome stratification of the electrolyte or to equalize the cells. Overcharging breaks the water down by electrolysis forming hydrogen and oxygen. The level of the electrolyte drops as the water is broken down and the gases escape, but the water can be replaced before any plates are exposed. Aggressive overcharging is catastrophic to SLA batteries because the lost water cannot be replaced and the battery has a shortage of electrolyte and a loss of capacity.

The flooded cell starting battery used in cars is probably the most common battery. Not nearly as common, deep-cycle flooded cell batteries have quite a variety of applications. They include solar energy storage, RVs, marine, floor machines, trolling motors, electric vehicles, mass transit, golf carts, and forklifts. They are ideal for backup power for a ham shack. If you are interested in flooded cell deep-cycle batteries, contact the Trojan Battery Company (references at the end of the article). They have tech notes available on charging, storage, and condition cycling.

Sealed Lead-Acid Batteries

Gel Cells and starved electrolyte AGM batteries are maintenance-free, sealed lead-acid batteries. The main difference is the method for immobilizing the electrolyte. In a gel cell, the electrolyte is contained in silica gel. Voids can develop in the gel during recharging that block some of the active plate area. Usually they refill, but over time, a loss in capacity results from the size and number of those that don't refill. In the starved electrolyte AGM cell, the electrolyte is absorbed in the separator between the plates. Glass mat is used and they are called absorbed glass-mat (AGM) cells. Starved electrolyte refers to the fact that the glass mat is not fully saturated, leaving small channels for gas to migrate. Some gel-cells also use glass mat in the separator. While 'gel cell' is the name commonly applied to all sealed lead-acid (SLA) batteries, most small SLA batteries manufactured today are AGM technology. CSB, Eagle-Picher, GNB (formerly Gould), GS, Hawker (formerly Gates), Panasonic, PowerSonic, and Yuasa-Exide use absorbed glass mat design. Most of the gel-cells available today are larger amp-hour capacity. The Johnson Controls Dynasty GC series starts at 40 amp-hours. The East Penn Manufacturing Deka Dominator series starts at 31.6 amp-hours.

From the Editor

This is the first of a two-part series on sealed lead-acid batteries written by Richard Bachmann, N3SLR. In this part, he gives us a very exhaustive treatise on the various types of batteries available, their characteristics, selection, and method of load testing. In the second installment, to be presented in a future issue, he will give the same treatment to charging and general care.

DE N7ZWY

Since water and electrolyte cannot be added to an SLA battery, measures are taken to keep the electrolyte intact. Gas recombination chemistry is used so that free oxygen and hydrogen are recombined to form water. In normal operations, the battery is sealed so gas recombination reclaims all of the gases to form water and the water is converted back to electrolyte when the battery is recharged. The seal prevents air exchange with the outside from drying out the battery and causing a shortage of electrolyte. A one-way valve regulation feature prevents pressure build-up within the battery in the event of overcharging or a short circuit condition. The valve vents at between 2 and 50 PSI (depending on the manufacturer.) The batteries are sometimes referred to as valve-regulated lead acid (VRLA) batteries. The valve is on the top of the battery so gravity keeps the valve clear as long as the battery is not upside down.

Because they are maintenance free, sealed lead acid batteries are not as forgiving as flooded cell batteries and can be damaged by short circuits or by overcharging. Excessive overcharging is a sure way to destroy an SLA battery. It causes water vapor and gases to leave the battery through the valve, resulting in a shortage of electrolyte and a loss of capacity. Although they can operate in any position, it is not recommended that they be charged upside down.

Small SLA batteries are somewhere between starting batteries and deep-cycle batteries. Most have features that help recover from deep discharge and have good cycle life under moderate discharge service.

Electrical Characteristics of Small Sealed Lead-Acid Batteries

Amp-hour capacity and voltage are the two specifications one uses to select a battery. While this would seem straightforward, in actuality it is more complicated. The amp-hour capacity and the requirement for the application are closely tied to the depth of discharge, a primary factor in the useful battery life. The terminal voltage is the only way to determine the state of charge (or depth of discharge) of a sealed battery. Since the terminal voltage varies under load, with temperature change, and at different states of charge, the user requires an understanding of these relationships to select a battery that will meet expectations.

Amp-hour Capacity

'C' is the symbol used for the nominal or rated capacity and is measured in amp-hours. It is measured by discharging a battery over a specified time interval with a constant load (resistance) until a specified cutoff voltage is reached. The amp-hr capacity is the average current in amps times the number of hours for the discharge. It is standard to use a 20-hour interval (.05 C) but sometimes a more stringent 10-hour interval (.1 C) is used. For all batteries, the capacity measured at the 10-hour rate is lower (~90%) than that measured at a 20-hour rate. The 10-hour rate is used for the Hawker Energy Products Cyclon series of batteries. A cutoff voltage of 10.5 volts (1.75 volts/cell) is commonly used. A 4 amp-hour battery would deliver an average current of 200 milliamps for 20 hours (the .05 C rate) with the voltage reaching 10.5 volts at which time the load is removed. At the end of the test, the battery is considered 100% discharged. Generally, SLA batteries deliver the rated capacity with the first discharge. The capacity improves as the battery is cycled several times.

Discharge rates that are greater than that used for the nominal rating will give lower effective amp-hour capacity. This is due to the non-linear relationship between the effective capacity and the discharge rate. This can be important when selecting a battery for an application. For instance, if the application requires 400 milliamps from the same 4 amp-hour battery (.1C), only 3.6 amp-hours (~90% of nominal capacity) is actually available before the battery is 100% discharged. The difference widens at greater discharge rates. At .25 C, a current of 1 amp is drawn from the 4 amp-hour battery and only 2.3 amp-hours are available at 100% discharge. This is not a permanent condition; the battery will still deliver 4 amp-hours if discharged at the .05C rate. The non-linear relationship between discharge rate and effective capacity reveals an interesting phenomenon. If you have two identical batteries that are to be used at a high discharge rate, you will get more effective capacity by discharging them in parallel than if they are discharged one at a time. This is because the discharge rate for each battery is cut in half by using them in parallel.

The effective capacity drops with temperature. At 0 degrees F., the capacity (discharged at a 20-hour rate) is about 60% of the nominal capacity. At 32 degrees F. and the same discharge rate, the capacity is about 85% of nominal.

Capacity also degrades with age, improper charging, and battery usage. The recommended end of life for a battery in standby or emergency power service is when the battery's capacity has dropped to a level between 60% and 80% of the nominal capacity.

Battery Life and Depth of Discharge

As mentioned above, the end of service life of a battery is reached when the amp-hour capacity has dropped to a predetermined percentage of the original capacity. Most manufacturers use a design life of 5 years. The Hawker Cyclon series has a design life of 8 years. The factors that affect the length of service life are number of charge/discharge cycles, depth of discharge, temperature, and charging voltage. The application is usually categorized as either float (standby or emergency) or cyclic service. The dividing line isn't clear, but if there is a two-week or longer interval of charging between discharges, it can be considered float service. In float service a battery generally has a long calendar life and the capacity gradually degrades with age, being hastened by deep discharging. In cyclic service, the battery capacity degrades due to the number of charge/discharge cycles and the depth-of-discharge. It 'wears out'; age is not an important factor.

The concept of 'Depth of Discharge' (DOD) was touched on earlier when referring to deep-cycle batteries. The open circuit voltage of a battery at 100% depth of discharge is ~11.7 volts. Battery manufacturers do not generally recommend deep discharge because the depth of discharge is one of the most important factors on cyclic life. A Yuasa comparison illustrates this relationship for the NP battery series. Three data points are given: 1200 cycles at 30% DOD. 450 cycles at 50% DOD. 166 cycles at 100% DOD. The end-of-life amp-hour capacity is 60% of the initial capacity.

To illustrate the relationship between battery capacity and battery life, we 'interpret' the data in a different way. Assume that the test draws 4 amp-hours at a rate of 200 milliamps for 20 hours (.05 C for a 4 amp-hour battery) in each discharge cycle from each of three batteries. The Data summary is shown in Table 1.

For the first battery, rated at 4 amp-hours, the capacity degrades to end of life in only 166 cycles. This battery delivers 2.4 amp-hours (60% of original capacity) at the end of life. If it is used at a cold temperature or at a current much greater than .05C (200 milliamps), it cannot meet the desired capacity when new. It is undersized for a 4 amp-hour goal. For the second battery, rated at 8 amp-hours, the capacity degrades to end of life in 450 cycles, 2.7 times the life of the 4 amp-hour

Table 1 Capacity Selection Example

Battery Capacity	Depth of Discharge	Cycle Life	Capacity at End of Life	200 ma. rate for 20 hours	Cycle Life *
4 amp-hour	100%	166 cycles	2.4 amp-hours	.05 C	undersize
8 amp-hour	50%	450 cycles	4.8 amp-hours	.025 C	1.5 years
12 amp-hour	33%	1200 cycles	7.2 amp-hours	.01667 C	3.8 years

*** Calculated value, continuous charge/discharge, 28 hours per charge/discharge cycle.**

battery. It can still deliver 4.8 amp-hours at end of life, even if the temperature drops to 32 degrees F., where the effective capacity is 85% of that at room temperature. For the third battery, rated at 12 amp-hours, the capacity degrades to end of life in 1200 cycles, 7.2 times the life of the 4 amp-hour battery. The 12 amp-hour battery can deliver 7.2 amp-hour at end of life. Unless this battery is needed to run at a cold temperature or deliver a high current, it is oversized. For the 8 amp-hour battery, a 200 milliamp current drawing down to 50% DOD would take 20 hours (ignoring any benefit in the capacity from the low rate.) A charge/discharge cycle would take at least 28 hours, translating to almost 1.5 years of non-stop charging/discharging. For the 12 amp-hour battery, the same service works out to ~3.8 years of non-stop charging/discharging. This example is a generous interpretation of the test data. It ignores effects due to aging, and is used only for illustrating some of the considerations for determining proper battery capacity.

Batteries also lose capacity due to corrosion of the plates. A Yuasa estimate of float service life for an NP battery at room temperature is around 5 years when the float voltage is 13.65 volts and the battery experiences 100% DOD every 3 months. This is 20 cycles at 100% DOD over the 5 years. In this case, most of the battery capacity was lost due to age, the number of 100% DOD cycles was less than 1/8 the number in the cyclic service example above.

Sizing a Battery for QRP Use

The main hitch in determining the necessary battery size for QRP is determining the receive/transmit duty cycle. One approach is to bound the problem by making a few assumptions. For example, assume that you spend half the time listening while looking for contacts and the other half of the time in QSOs. During the QSO, half the time is spent listening and half the time is spent transmitting using full QSK. Using a 50% transmit duty cycle, the total receive time is 87.5% and transmitting time is 12.5%. If receive current is 100 milliamps and transmit current is 1 amp, the average current works out to (.875 x .1 amp) + (.125 x 1 amp) = .2125 amps. For 20 hours of operation, 4.25 amp-hours is required (20 hours x .2125 amps = 4.25). Next, pick a depth of discharge that will give the number of cycles you will need over the life of the battery. The reciprocal of the depth of discharge is the multiplier. For example, if you plan to discharge to 60% DOD, the multiplier is 1 / .6 = 1.667. The nominal amp-hour capacity of the battery is 4.25 x 1.667 = 7.1 amp-hours, a 7 amp-hour battery should suffice. Check that the nominal amp-hour capacity is accurate at the discharge rate: .2125 amps / 7 amp-hours = .03 C. Since this is lower than the .05 C (20-hour rate), no adjustment to the amp-hour capacity is needed. Using your own estimates of the receive/transmit ratio, transmit duty cycle, and receive/transmit current draw, you can make an estimate of the average current and the required amp-hour capacity.

After you have the battery, put a load on it that draws the receive current. Run the test until the required amp-hour capacity has been extracted from the battery and measure the terminal voltage while still under load. This is the cutoff voltage that you use to switch batteries. It is acceptable to use receive current rather than average current because most of the time is spent at the discharge rate for receive.

The transmit current may be enough to cause a chirp before the cutoff voltage is reached. The sensitivity of a local oscillator(s) to voltage varies from one model of QRP rig to the next, so you have to find out by experimenting.

Self-discharge

Due to a chemical reaction, lead acid batteries self-discharge. The rate increases with temperature. If the storage temperature is changed from 75 to 95 degrees F., the rate of self-discharge will double. The lead-antimony construction of most flooded cell batteries gives a relatively high rate of self-discharge. The Lead-calcium construction used for most SLA batteries has a considerably lower self-discharge rate. In time, self-discharge can discharge a battery to the point at which it will not take a charge. A discharged battery should always be charged before it is stored. If it is stored discharged, it has a head start on the self-discharge curve. When kept in a cool dry place an SLA battery should be recharged at least every 4 months to ensure that self-discharge doesn't do it in. The myth that a cement floor discharges a battery is probably based on the self-discharge phenomenon.

Introduction to Charging

Charging is an interesting topic that requires an entire article of its own, which is forthcoming. This is just a brief overview to give some basics. Replacing about 1.05 times the expended amp-hour capacity recharges a battery. Battery manufacturers usually recommend charging values on the battery. A charging current limit of C/4 or C/5 is common. If charged at higher currents for a sustained period, there is danger of thermal runaway. Two voltages are usually on the battery case: the float charging voltage, and the cyclic charging voltage. The float voltage can be applied to a battery indefinitely without damage and ranges from 13.5 to 13.8 volts at 68 degrees F. If this voltage is used to recharge the battery, it should be left on charge for two weeks or more to ensure full charge. Some battery manufacturers do not require a current limit at float voltage levels. Cyclic charging voltages are usually around 14.5 volts. For cyclic charging, the battery is charged at a constant current that is lower than the current limit of C/4 until the terminal voltage rises to 14.5 volts. At this first switch point, the voltage is clamped to 14.5 volts until the current tapers down to 1% or 2% of the amp-hour capacity. At the second switch point, the voltage is reduced to the float voltage. Hydrogen produced during overcharging is flammable. A lead-acid battery should never be charged in a sealed container or near open flame or something that may spark.

A Note on Temperature

When discussing voltages, capacity, or other electrical specifications of a battery, a temperature is specified. It is usually either 20 degrees C. (68 degrees F.) or 25 degrees C. (77 degrees F.). Since a battery is based on chemical reactions and the rate of chemical reaction changes with temperature, all battery curves are a function of temperature. This phenomenon must be considered when charging a battery. For instance, recommended charging voltage varies inversely with temperature. Yuasa-Exide gives a maximum float voltage at room temperature (68 degrees F.) of 13.8 volts. At freezing, the maximum float voltage is ~14.3 volts. If the charging voltage is not adjusted for temperature, the battery will either be overcharged or undercharged, both of which cause a loss of capacity.

Terminal Voltage

As mentioned above, the best way to determine the state of charge of a lead-acid battery is to check the specific gravity of the electrolyte. In the sealed lead-acid battery, this is not possible, and the terminal voltage is the only way to determine the percentage of capacity remaining.

The concept of internal resistance is useful in understanding the behavior of the terminal voltage. In this model, the resistance is considered to be separate from (but internal to) the battery. It is a function of current, temperature, state of charge, battery design, etc. If the battery is shorted, this resistor limits the current, and the entire battery voltage appears across the resistor. All the power is dissipated in this internal resistance as heat, damaging the battery. While this case is the extreme, some voltage is dropped across the internal resistance whenever a current is drawn from the battery. The internal resistance is at a minimum when the battery is fully charged and increases as the battery is discharged. At full charge the voltage drops slightly when a load is applied and then recovers when it is removed. When fully discharged, the voltage will drop substantially when a load is connected but recover when it is removed. The change in voltage with the change in load is called load regulation. The formula is given by the following equation:

$$\frac{V_{oc} - V_{Load}}{V_{Load}} \times 100 \quad \%$$

Table 2 Battery Voltages

Battery Model	OC Voltage Full Charge	OC Voltage Full Discharge	EODV @ .05 C	EODV @ .2 C	EODV @ 1.0 C
Eagle-Picher CF	12.90	*	10.5	9.90	9.0
GS Battery PE	13.00	11.52	10.5	10.20	9.0
Hawker Cyclon	12.84	11.58*	10.5	10.00	9.6
PowerSonic PS	12.90	11.64	10.5	10.25	9.0
Yuasa-Exide NP	12.75	11.50	10.5	10.25	9.0

These manufacturers suggest that the OC voltage should not be allowed to go below 12 volts.

For a given brand and model of battery, the voltage at full charge will be very repeatable from one battery to another when new. Two things cloud the issue when checking this voltage. First, it takes time for the voltage to drop down after it is removed from the charger. Secondly, if a battery is overcharged and water is lost, the specific gravity will be higher than is normal when new. The higher specific gravity will cause the terminal voltage to rise. If the battery has been sitting off of the charger for a few days or more and the open circuit voltage is higher than the full charge OCV value in Table 2, consider the battery fully charged. When a light load is applied to the battery, the 'top charge' quickly dissipates and the voltage will be near the full charge OCV.

The difference in voltage between different battery models or different manufacturers has to do with the specific gravity of the electrolyte and variations in the cell chemistry. For example, one aspect of the cell chemistry is the makeup of the plates. Many SLA plates are lead-calcium. Flooded cell batteries are usually lead-antimony. Hawker Energy Products (formerly Gates Energy Products) uses lead-tin in their AGM batteries and GNB uses lead-antimony-cadmium. The different plate alloys also affect other electrical performance parameters of the battery such as internal resistance.

There are two discharged voltages that are of interest, the end-of-discharge voltage (EODV) or cutoff voltage and the open circuit voltage (OCV.) The cutoff voltage is the lowest voltage that should appear at the battery terminals while under a load. It corresponds to 100% depth of discharge, hence the other name, end-of-discharge voltage. Manufacturers do not recommend such deep discharge if battery life is a concern. The cutoff voltage changes with the discharge rate. At light discharge rates, below .1 C, the cutoff voltage is 10.5 volts (1.75 volts/cell). At a discharge rate of 1 C, the cutoff voltage is ~ 9 volts (1.5 volts/cell). Discharging past the cutoff voltage damages the battery, reducing the ampere hour capacity and the useful life. There is a 'knee' in the voltage curve before the cutoff voltage is reached. In the 'knee' the voltage drop accelerates with time and the load regulation deteriorates dramatically. In this region, the voltage fluctuates sharply when the load is changed. The 'knee' begins between 12 and 11 volts, depending on the load. At 11 volts, the slope is very sharp at light loads and nearly vertical at heavy loads. In the region of the 'knee' most of the amp-hour capacity has been delivered

When the load is removed the battery terminal voltage will eventually recover to a stable value. When a battery is being used, the OC voltage is not convenient for determining the state of charge because of the time it takes for the voltage to recover. This voltage is more useful for determining how deeply a stored battery has discharged. Power Sonic gives an open circuit voltage of 11.64 volts (1.94 volts/cell) for a fully discharged battery. Yuasa gives an open circuit voltage of 11.5 volts after full discharge. Fully discharged in this sense means that the battery has delivered most of the energy that it can deliver and can still be recharged. A battery should never be completely discharged. If it is discharged too far, it will not be able to accept any charging current. At levels where the battery can still be recovered, the excessive discharge is still disastrous to the number of charge/discharge cycles remaining in a battery's life. An amp-hour capacity of 1.5 to 2.0 C is possible when an SLA battery is completely discharged to 0 volts (and destroyed).

Amp-hour Capacity Testing

The only way to determine the condition of a used SLA battery is to measure the capacity. Comparing the measured capacity to the nominal capacity (after adjusting for the discharge rate) gives an indication of the current point in the battery's life cycle. For instance, a 7 amp-hour battery that only gives up 4 amp-hours at the 20-hour rate has used up most of its life. By running an amp-hour test that draws the same current the application uses, a 'baseline' is generated. The baseline will give you an idea of the capacity left in your battery as a function of the terminal voltage while the battery is in use. The important part of the test is to determine where the 'knee' is. This requires jotting down the voltages and times every ten minutes or so after the voltage drops below 12 volts. The test may be stopped early if the knee is obvious. If not, don't go below 10.5 volts unless the adjustments have been made for a high discharge rate.

This test was run on a Yuasa-Exide NP7-12 battery. It is a used 12-volt, 7 amp-hour battery that was purchased recently. The date code indicates manufacture on April 26, 1996. The history of this battery is not known; the discharge curve is shown as an example to check its condition. The load for the test was a 16.0 ohm (measured just after the test while still hot), 40 watt resistor (two series connected Radio Shack audio test resistors, part number 271-120). A required power rating was calculated at 9 watts (12.0 x 12.0 / 16.0.) The average voltage, calculated from measured values was 12.0 volts. Using the resistor value and the average measured voltage, the average current was calculated at 750 milliamps or approximately .11 C. The voltage was measured on a Radio Shack DVM with a serial interface to the PC, part number 22-168. The voltage was logged to a data file every 15 seconds for over 10 hours. A total of 2,446 voltage measurements were logged. The test was done at room temperature, 70 degrees F.

The expected amp-hour capacity is 90% of the nominal 7 amp-hour capacity, 6.3 amp-hours. It is adjusted down because of the greater discharge rate, .11 C. At this rate, the battery should be fully discharged at 8 hours, 24 minutes (6.3 amp-hours/ .75 amps).

Figure 1 Discharge Test for Yuasa NP7-12

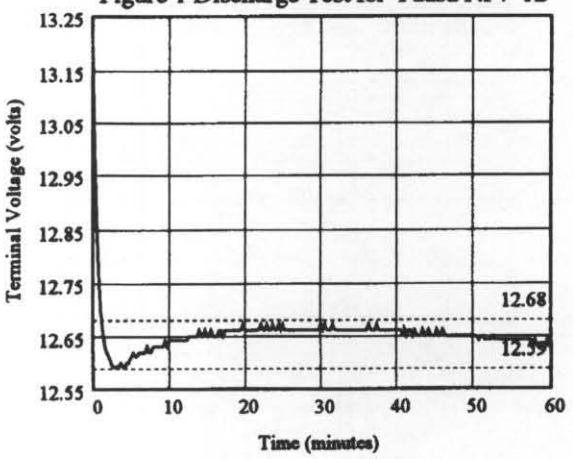
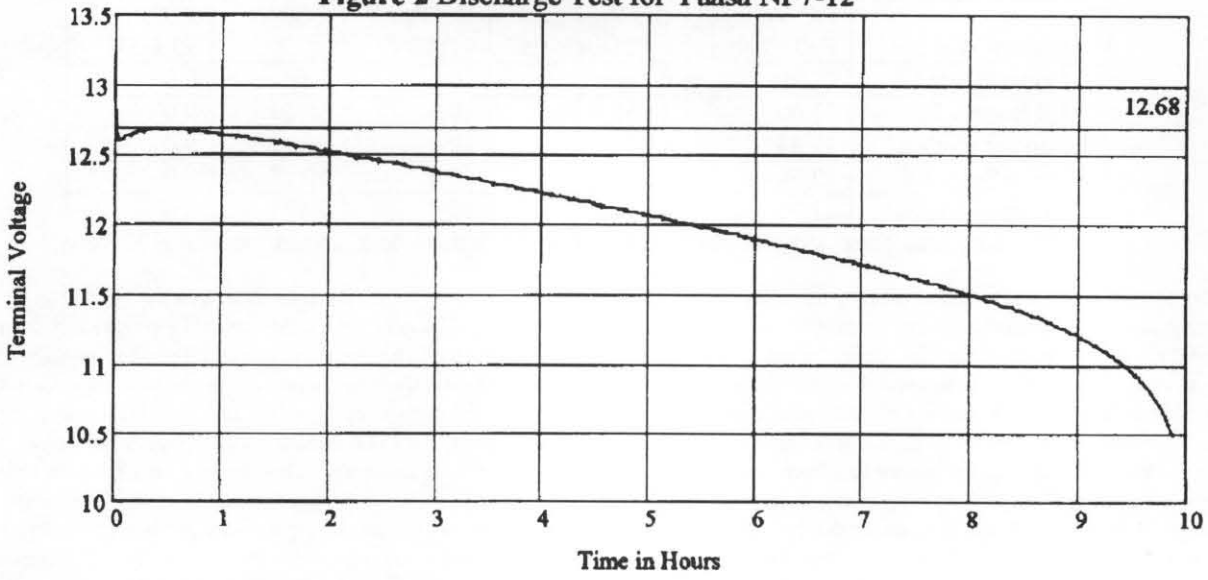


Figure 2 Discharge Test for Yuasa NP7-12



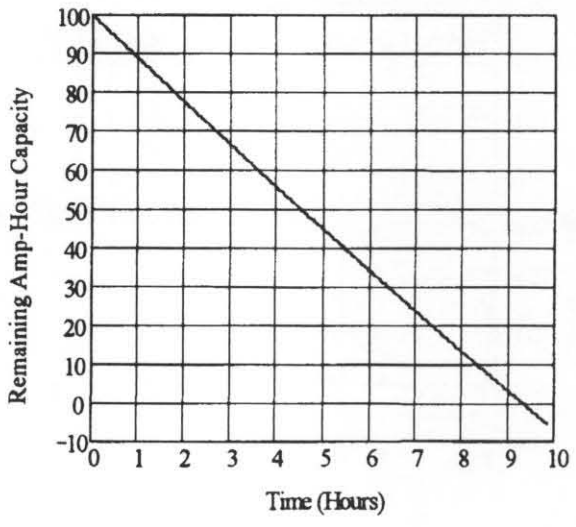
Test Results

The first graph, Figure 1, shows the terminal voltage versus time during the first hour. This is the data that was measured. The initial, open circuit voltage was 13.22 volts, the battery having been off a float charger for about 5 hours. The voltage dipped and recovered slightly at the beginning of the test. This writer assumed that this was due to a slight change in the resistance, as the resistor heated, and/or slight internal heating of the battery. It was later learned that this is a normal battery phenomenon called "coup de fouet." (It only occurs on a freshly charged battery at the beginning of discharge when a supersaturation of lead ions builds before lead sulfate crystals start to form.) The highest steady state level at the beginning of the test is 12.68 volts, down slightly from the 12.75 OC voltage in Table 2.

Figure 2 shows the full discharge curve stopping at the EODV of 10.5 volts. The total discharge time was 9 hours, 53 minutes. The knee becomes noticeable between 8 and 9 hours into the test and really starts down in the last 53 minutes. At the 8-hour point, more than 80% of the amp-hour capacity has been consumed in the test. For normal operation the battery should be sized so that the knee is not reached.

Figure 3 shows the remaining amp-hour capacity (calculated) as a function of time. The calculation is done in several steps. First, the current is calculated by dividing the resistance into the voltage for each sample in the terminal voltage graph. Next a running total of the current at each sample is calculated. The number of samples per hour (240) is divided into each value in the running total. This represents the amp-hour capacity expended at each sample point. The expended capacity is normalized by the nominal amp-hour capacity of the battery. Finally the normalized, expended capacity is subtracted from 1.0 to get the normalized remaining capacity.

Figure 3 Amp-Hour Capacity Versus Time



The capacity removed from the battery in the test was 7.39 amp-hours when the EODV of 10.5 volts was reached. The 7 amp-hour nominal capacity was picked (the 6.3 amp-hour expected capacity would be more conservative) to normalize the data. The negative capacity at the end of the discharge interval indicates over-discharge. If the 6.3 amp-hour rating had been used to normalize the data, a greater over-discharge would be indicated. The curve appears to be linear, but it is curving upward with time. This is because the current is dropping off (the voltage across the load resistor is dropping), delivering the capacity to the load at a lower rate. If the battery continued to discharge to zero volts, the discharge curve could go down as low as -50% to -100% indicating a capacity of 1.5 to 2.0 C.

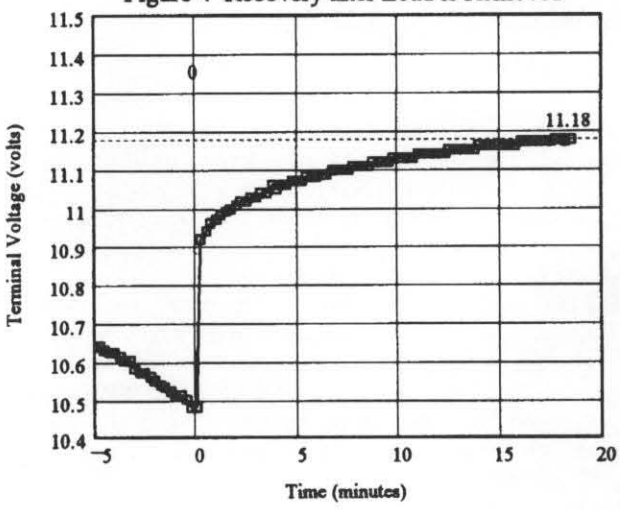
Table 3 relates some depth of discharge values to terminal voltage. For this load, the voltages could be used to stop the discharge at a desired depth. Considering the example summarized in Table 1, a cutoff voltage of 12 volts would give a working capacity of 3.75 amp-hours and good battery life.

Figure 4 shows the recovery after the load is removed at 9 hours, 53 minutes. The time scale has been adjusted so that 0 minutes is

Table 3, Depth of Discharge Vs Terminal Voltage

Time Hours:Minutes	Depth of Discharge	Terminal Voltage
4:30	50.0%	12.10 volts
5:20	59.1%	12.00 volts
6:45	74.0%	11.75 volts
7:20	80.0%	11.60 volts
8:00	87.0%	11.50 volts
9:18	100%	11.10 volts

Figure 4 Recovery after Load is Removed



the last time at which the load is present. Each box represents a sample point. During the 15 seconds after t = 0, the load was removed and the voltage recovered by more than .4 volts. The test was terminated after about 18 minutes of recovery. If the open-circuit voltage had eventually stabilized at a value as high as 11.5 volts (the fully discharged OC voltage) it would have taken an hour or more.

Conclusion

When selecting an SLA battery for QRP, use a multiplier of 1.25 (80% DOD) to 2 times (50% DOD) the required amp-hour capacity. If the discharge rate is much above the .05 C rate or if it will be used in cold temperatures, take this into account when figuring the battery capacity. To determine a cutoff voltage, run the freshly charged battery under the intended load until the required amp-hour capacity is expended and measure the voltage before the load is removed. This will be the cutoff voltage. The open circuit voltages aren't as practical for indicating the state of charge as the voltage under load. Recharge the battery as soon as possible after use, even if it has only been lightly discharged. Store it in a cool place on float charge (constant voltage of 13.65 volts) if possible. If float charging is not possible put it back on the charger every couple of months (certainly before the open circuit voltage drops below 12.5 volts.) One final recommendation is that the user should get an applications manual for the brand of battery used.

Acknowledgements

I'd like to thank the battery manufacturers for their materials and the time they spent on the phone answering questions. Special thanks to Gary Parsons, of Yuasa-Exide for reviewing the article and for furnishing text book material on the "coup de fouet".

References

Information was requested from gel cell manufacturers, numerous AGM battery manufacturers and one deep-cycle flooded battery manufacturer. Here is a list of those references in alphabetical order:

1. CSB Battery Technologies offers specifications for the GP series of Lead Calcium VRLA batteries. The web site offers a little more technical information. Telephone 1-817-732-2258. WWW address: http://www.csb-battery.com/existing.html

2. Eagle-Picher provided their application manual for Rechargeable, Valve Regulated Lead-Acid Batteries. This manual was particularly informative about testing and can be found on the WWW at: http://www.synergysls.com/library/epapp1.html. Telephone 417-776-2256.

3. East Penn Manufacturing gel cell batteries are sold under the Deka brand name and the smallest is 31 ampere-hours. The technical manual is titled " Sealed Valve Regulated (SVR) Gelled Electrolyte Lead-Acid Batteries." Telephone 610-682-6361. Email address: eastpenn@eastpenn-deka.com. WWW address: http://www.eastpenn-deka.com.

4. GNB Technologies (formerly Gould) is new to small batteries with the Small Power series of VRLA batteries. Their large industrial batteries are well known. Telephone 630-691-7879. WWW address: http://www.gnb.com.

5. GS Battery, Inc. offers a technical information booklet and a brochure on the Portalac PE series. Between the two, it is complete and concise. Telephone 1-800-235-4535.

6 Hawker Energy Products sent the second edition of the Battery Application Handbook for Cyclon and Genesis Sealed-Lead Products, selection guides and a Cyclon Technical Data book. WWW address: http://www.hepi.com. Telephone 816-429-2165.

7. Johnson Controls, Inc. Telephone 1-800-DYNASTY. WWW address: http://www.johnsoncontrols.com/bg/special.htm.

8. Panasonic offers a battery catalog with 4 pages on sealed lead-acid batteries. While brief, it presents charging information and the essential curves describing the Panasonic line. Panasonic refers to their SLA batteries as lead-calcium (LC) using an absorbed electrolyte system. Telephone 201-348-7029.

9. PowerSonic offers a Technical Handbook for Sealed Lead-Acid Batteries. Telephone: 415-364-5001. Email address: battery@power-sonic.com. WWW address: http://www.power-sonic.com.

10. Trojan Battery Company offers 3 technical notes on charging, condition cycling, and storage of deep-cycle batteries. They also have brochures on battery recycling and deep-cycle battery maintenance. Telephone 1-800-423-6569.

11. Yuasa-Exide offers the NP series Application Manual. Telephone: 1-800-538-3627. WWW address: http://www.yuasa-exide.com

THIS GANG OF OURS
QRP ARCI Banquet Speech, 1998
Adrian Weiss, W0RSP

This is the speach that Ade gave at the QRP ARCI Banquet last May. After hearing this talk I begged Ade to get it into ASCII format so it would never be lost. I urge you all to read this and to think about the hard work these people did (and still do) to lead the club into the position it is in today. Thanks Ade, Ron, KU7Y

Let me begin by explaining the rationale behind this talk. In fact, it applies to more than just that -- it is about why Dayton is so important to us, why the Four Days in May QRP extravaganza has burgeoned into what it is, why this banquet is held every year, why select QRP'rs are inducted in the HoF, and why someone gets up and gives a speech which everyone hopes is brief and to the point. Usually most speakers will make that a promise -- not me -- the doors have been locked, so hunker down for the duration! Kidding of course! But, back to the rationale.

Psychologists tell us that group-identification is essential for a personal sense of well-being. The individual who identifies with no specific group is indeed unfortunate: self-esteem, the sense of belonging, the sense of a shared set of values and activities, the opportunity to be instantly accepted and included upon arriving -- all these aspects of experience are lacking to such an individual. The formation of clubs based on shared interests has long been a social method of providing a source of group-identity.

Individuals join clubs for a variety of reasons, and their expectations and degrees of involvement vary accordingly. As far as we're concerned, we QRP'rs have told similar stories over the years about finding our way into QRP and this club. Several common themes thread their way thru our accounts: they all boil down to discovering that a large number of hams are actually out there using QRP and having a ball.

Many have been attracted to QRP by reading about the underlying philosophy and experience in books and articles -- there probably has never been a boring, un-enthusiastic piece about QRP to appear in print. The excitement exhibited by QRP writers inevitably strikes a note with some readers. The challenge of working the world with a few watts, doing battle with the QRO Goliaths and winning, as most of us know, produces a rare kind of exquisite satisfaction -- I've tried many times to find just the right terms to describe it. Several years ago a book, then the movie, carried a title that hits home for me: "The Unbearable Lightness of Being". Many of you know this feeling -- it is an excitement and sense of awe and disbelief that is almost painful. I felt that as a kid, WN3COB working CA in the wee hours after slipping down into the basement when I felt the coast was clear. I felt it in the late 60's when I built my first transistor rigs, not having much of an idea of what made them work. That they did work was part of the disbelief. Working 1-w dsb on 160 around the east coast was simply incredible to me. During the 80's while on research trips to England, this time carrying miniaturized transceivers that I had designed and using antennas slung out of windows, the same feeling was there. It still is -- most recently in my love-affair with a 30m SST transceiver by Wayne Burdick N6KR marketed by Wilderness Radio. Love affair surely applies -- you know how lovers just love hearing the sounds and words spoken by each other. That is exactly why I love the SST -- I love hearing how it sounds in my ears and what it says!

Let me pause to comment on this important development in QRP. For many, the promise of being able to build our own mini-rigs was the allurement that led us out of the world of powerful complex computerized QRO transceivers. It's not that a little QRP transceiver is all that simple, but at least an average QRP'r has an outside chance of figuring it out and fixing it. And there's always an enthusiastic QRP Elmer off- frequency to help out if it doesn't work. The world of QRP kits that has developed in the past decade makes building a rig so much easier than in the old days.

Back when we started up THE MILLIWATT, followed by the G-QRPC and MI-QRPC, the main challenge was finding QRP circuits to publish so as to encourage homebrewing. The G-QRPC's journal SPRAT was devoted primarily to publishing homebrew circuits from the start and initiated the concept of the club kit project with GM3OXX's famous Oner, then later came the Twofer by the 5-watt QRP ARCI. Jim Fitton, W1FMR, has just reminded me of why it was called the Twofer: if there's was a Oner, ours had to be better. But, behind the kits were the designers.

Ultimately, it is impossible to tell the designers like Wayne N6KR, Doug DeMaw W1FB, Wes Hayward W7ZOI, Roy Lewallen W7EL, John Liebenrood K7RO, Joe Stivec VE7TX, Dave Benson NN1G and others how much enjoyment they have contributed to our lives. If your QRP'ing has been enhanced by their work -- drop them a line and let them know - - they get little else out of the effort they put into designing and developing rigs.

Likewise, the club kit distribution projects by NORCAL, the New England QRP Club, the Knightlights Club, Colorado QRP Club, Columbus QRP Club, the ST. Louis QRP Club and others have constituted a massive contribution to the growth of QRP by dedicated QRP'rs who want to spread the joy. I still can't quite fathom the amount of effort that has gone into these projects.

I'll never forget reading Doug Hendricks KI6DS's editorial which announced that all 1000 kits in a NORCAL project were gone, and noted in passing that the project required the sorting of 100,000 parts into kits! Which of us has ever even owned a total of 100,000 parts? How many of us have looked at a circuit with 92 parts, mentally calculated the amount of time it will take to search for and order the parts, layout and etch a p.c.b., and then say "looks like a fun rig, but I don't have the time..." This group of dedicated QRP'rs has eliminated that obstacle.

So, I think we should give all these named and unnamed QRP soldiers a hearty round of applause! The QRP movement is greatly indebted to all of you.

Another group of dedicated QRP'rs ought to be recognized -- those who commit time and financial resources to searching for and making available the parts and kits for those of us who want to homebrew our rigs. We're familiar with them -- Dan's Small Parts, Small Wonder Labs, Oak Hills Research, Embedded Research, Far Circuits, Jade Products, EMTECH, Radio Devices, Whiterook Radio, S&S Engineerin,and Wilderness Radio. When we see one of their ads or browse their WEB pages for information on products, we have to

keep one idea sharply focused as we chose and reject. We're numbed into a market-place insensitivity by the avalanche of commercial ads that buffet us every day, everywhere we look or listen. But behind each of these QRP ads is a QRP'r who has to be committed to the QRP cause, who cannot possibly be in it to make a lot of money.

In this context, one story of joining a QRP club is especially touching to me in a personal way. Along with his order for JOY OF QRP and HISTORY OF QRP, Bob Dyer of Wilderness Radio noted that he'd read the local library's copy of JOY OF QRP many times, and that he was overjoyed that I'd reprinted it. He confided:

"I consider your book a large influence in my decision to become a QRP-DXer. (I worked all states in 6 months, and have now worked 152 countries with 5 watts or less)."

Notice the evidence of a genuine enthusiastic QRP'r here -- Bob couldn't just stop with saying he was a QRP DX'er -- he had to go on and give me his list! We all do that, don't we? At least I do and just about everyone who talks to me does. We all understand the excitement that lay behind each number as the total accumulated, don't we? To return to Bob's letter, he continued:

"Little did I realize what a profound change your book and ham radio would make in my life. Shortly after becoming KD6VIO, I met Doug Hendricks, Jim Cates, and Wayne Burdick. I got involved with the NORCAL Club -- I'm member #8. For the last two years I've been making my living as the owner of Wilderness Radio..."

I'm sure Bob's story is typical of many in the basic process-- some QRP enthusiast, me in this case, lit a fire that enticed a new ham into the QRP ranks, and that newcomer is now passing on the torch and in his own way advancing the cause, spreading the JOY OF QRP. *The important point here is: when you're looking at the QRP* commercial ads, just remember that, if you scratch the surface, what you'll see is a Bob Dyer whether it's Wilderness Radio or Dan's Small Parts or Oak Hills Research or the other companies. These ventures are built on dedication and the desire to contribute to the QRP cause, not on the profit motive of the marketplace. When you pick up one of their products at the Hospitality Suite, sneak a glance at their faces as they enthusiastically explain what it does and why it is so good -- and you'll see a glint of the QRP fire in their eyes! I'm sure you'll all agree *that these folks deserve a healthy round of applause.*

And if you're teeter-tottering about whether to buy the Wilderness Radio or the Embeded Research kit, buy them both! The Fourth Commandment of QRP applies here: Thou shalt never have too many QRP rigs! Am I right?

At this point in my life, I'm looking down a short tunnel at retirement. There isn't much excitement to look forward to professionally. So, more than ever before, I am getting to appreciate how really important the thrill of QRP is in my life. I know that, in ten years or twenty years, our QRP rigs may be a bit different, but finishing up a rig and working other QRP'rs and DX will always produce that "Unbearable Lightness of Being" feeling. I don't expect the circumstances or results to be the same as with the 30m SST -- when I fired it up and worked P40J and 3D2KT right off, I couldn't *believe it! I had never even heard a* 3D2 before, and I'd just worked one! Pardon my French, but I kept on listening to him and excitedly repeating aloud "Holy Shit, a 3D2! Wow!" for a while. And I had to run upstairs and shake the XYL awake to tell her about it. Like she cared enough about 3D2's and SST's and 30 meters to be shocked out of a deep sleep at 0100, with the alarm set for 0600! But sometimes the excitement is so intense a guy just has to tell someone about it, awake or not! You know what I'm taking about? How many of you have had this same irrepressible need? Let's see a show of hands...

We all know that the sharing is ever so much more satisfying if the other person is awake, interested, and better yet, impressed! And only another QRP'r fits that list of qualifications. That's where our QRP ARCI and all of the other QRP Clubs come in. It is important to bear in mind that clubs are nothing more than a method of giving QRP'rs a place to share ideas and experiences with other QRP'rs. The clubs don't make QRP'rs, rather, QRP'rs make the clubs. Our interest and enthusiasm and desire to share are the lifeblood of the clubs. So, most of us belong to several clubs. It's not a case of QRP ARCI Vs NORCAL vs. NWQRPC vs. MI-QRPC etc. WE are the clubs!

The end result of having all these QRP clubs is that we share a strong sense of group-identity. Each of you -- glance around and all you see are more QRP'rs like yourself -- wall to wall QRP'rs! In the words of Joe Cocker at Woodstock, "Wow! Hey man, like this must be Heaven!" You may not personally know the QRP'rs sitting at the next table, but you know that you belong with them and with all the rest of us. Isn't this sense of group identity special?

How many times have you been in some other kind of group, like at a boring department meeting, silently wishing that it was a bunch of QRP'rs so you could really enjoy yourself and feel that sense of belonging? I certainly have on many occasions. My identity as a QRP'er is a very important value in my life. Every tower and yagi, every wire, and most of the tall trees that I see in the world remind me *that I'm a QRP'r at heart.*

I suspect that the same applies to many of you. The existence of QRP clubs makes this group-identity possible. Without the clubs and the activities that they sponsor, we'd all be a bunch of QRP operators pursuing our hobby in isolation except for the occasional two-way QRP contact that lets us know that there are others out there like ourselves, different from the rest of the world's hams. Perhaps abnormal, weird, a lunatic fringe, but in any event, not belonging. A very lonely kind of hobby indeed.

For those of you who haven't been around long enough to remember, that is precisely the situation that QRP'rs found themselves in during the 1960's before the QRP movement crystallized. You can't appreciate the magnitude of what has happened to provide you with your QRP group-identity unless you know what it was like before Mike Czuhajewski WA8MCQ started up the QRPp Corner in the July 1969 issue of his QRP/8 newsletter. In short, you have to know the HISTORY OF QRP to appreciate what QRP is today and what you actually belong to. That's why I wrote HISTORY OF QRP IN THE US 1924-60 -- to give QRP'rs a historical tradition that stretches back to the beginning of ham radio. And that, finally, brings me to the subject of this talk.

See what I mean about having to lock the doors?

(Incidentally, I still have 500 copies left after a decade. That means *that a lot of QRP'rs don't know that they belong to a group of* hams that began with the introduction of the 1-watt and 5-watt vacuum tubes in 1923 or so! If you don't know the HISTORY, you're missing a very important component of that feeling of belong.)

Part I: The 100-W QRP ARCI

The original 100-w QRP ARCI Club grew out of a letter in the August 1961 issue of QST. Harry Blomquist K6JSS wrote, in part:

"I admire those with a KW. final, but I don't need nor want one. It should be readily apparent to all of us that now is the time to cease interfering with one another through high power and also to cease alienating our fellow hams in other countries (limited to a lot less power) through our brute force tactics. Anyone interested in joining up with me building up a *QRP Communications Club, to* prove the point?" - --Harry F. Blomquist, K6JSS, Saratoga, Calif.

A response from self-proclaimed California Kilowatt WA6TKT countered with the reliability argument in the December 1961 issue. It seems fair to say that many hams agreed with him when he said:

If anything, more reliable communications could be obtained by increasing, not decreasing, present power levels, not only because an

increase would mean higher signal strengths, but also because the present QRP operators would be less tempted to use an already occupied channel where they should not be trying to operate anyway. --Gary B. Jordan, WA6TKT, Downey, CA

Bear in mind that K6JSS defined QRP as 100 watts, not 5 watts. Just imagine, for a moment, how you would have felt when reading K6JSS's letter and trying to figure out just where you belonged if QRP meant 100 watts. And then being told by WA6TKT that even 100-watters don't belong on the air if a KW decides to plop down on a frequency?

K6JSS's first newsletter of Sept. 1961 entitled QRP NEWS listed 25 charter members, including Mac McCullough W4VNE, Joe Szempias W8JKB, and Sandy Wagner K6TBW, QRP'rs who would later make a big difference in our club. The total focus of the club was on the reduction of QRM by voluntarily running no more than 100-watts input, unless you wanted to, in which case you could join up as an Associate Member.

That was the fatal flaw in K6JSS's conception of a QRP Club. His definition of QRP at 100 watts called for US hams to limit themselves to the maximum power level allowed by the vast majority of IARU countries. And a majority of US hams operated at that level or below anyhow -- most commercially available transmitters like the Viking Ranger or Heath DX100 were within his definition of QRP. And as HISTORY OF QRP IN THE US, 1924-1960 reveals, in choosing the 100-watt limit, K6JSS rejected a concept of QRP that had been accepted since the beginning of the vacuum tube era. For a club to generate enthusiasm and group-identity, its boundaries must clearly distinguish its purpose and its members from the rest of the world. The 100-w limit did not.

Part II. The Mike and Ade Show

The club had sown the seeds of its own destruction in the 100-w limit. A kid in Paw Paw MI -- don't ask where that is! -- had joined the club, and risen to the Board of Directors by 1969. He wanted action, and the club was not providing it. So, he, as eighth district representative, decided to start up a newsletter for the district,

> I was kind of disappointed that you labeled the papers as you did KORNER with a "K". I would do that kind of thing, but somehow I can't see that from a prof. at a big university, an English prof. no less! (Wrote Mike to Ade)

appropriately titled QRP/8. At the same time, he pestered the board about recognizing genuine 5-watt QRPp achievements with an award. As a result WAS-QRPP was approved. The announcement in the Sept. 1969 issue of QRP/8, if read suspiciously, raises some concern about his motivation in getting the WAS-QRPP award approved. He noted:

[NOTE: THE LABELED AND FOLLOWING ENCLOSED SECTIONS OF TEXT WERE HANDED TO MIKE WA8MCQ AT THIS POINT IN THE TALK AS A SCRIPT. HE HAD NO KNOWLEDGE BEFOREHAND THAT I WOULD CALL HIM TO THE MIC AND ASK HIM TO READ THESE SECTIONS. NONETHELESS, HE GLIDED THRU THEM WITHOUT A HITCH.

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(A) Certificate #1 has already been applied for, and has been promised to WA8MCQ, who will get the basic certificate plus endorsements for 45 states and using under one watt.

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Now, Mike is a nice guy, and all of us who know him just know that he wouldn't go as far as having an award created just so he could get the first one! If anyone would make such a charge against me for starting up the MILLIWATT DXCC QRPp Trophy program, well, I'd just have to say,"how'd you guess?" At least I didn't have anywhere near a 100 countries in the bag when I started up the program! To be fair to Mike, he also hassled the BoD into adding a QRPp section to the QSO Parties, and eventually, a stand-alone QRPP QSO Party. Now, we could never be convinced that he did that because he actually believed that he could win!

But seriously folks, WA8MCQ's newsletter entitled QRP/8 is where this club actually began. In the July 1969 issue, which was the 6th in the series, Mike reprinted a whole page of a letter from W7NUN about lack of participation in RANDOM RADIATION, the newsletter of the PACIFIC AMATEUR RADIO GUILD, a group which had splintered off from K6JSS's QRP ARCI in 1968 or so in order to provide a more clearly defined focus. On p.10, Mike struggled to find such a focus for QRPP within the 100-watt club, reporting:

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(B) I have suggested to W4RNL that the membership lists include some indication of those who use QRPp, or else a separate list of QRPp'ers, to enable them to get together, exchange ideas and brags, and to get together on the air with two-way QRPP QSO's.

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Little did he suspect that this statement of focus was soon to define THE MILLIWATT: NATIONAL JOURNAL OF QRPP. That took a bit of doing on my part -- but we're getting ahead of the story. And incidentally, you heard correctly -- "Mr. Antennas of the QRP World", L.B. Cebik, is the same W4RNL mentioned by Mike -- he was on the BoD at the time. Now he officiates over an incredibly valuable WEB page featuring materials about antennas -- hit it and you'll see what you've been missing.

After a page or so of the usual QRO club trash in the July issue, a new heading appeared with the title QRPP CORNER, which Mike resurrected from a section of Don Stoner's column, and under it, the introduction that launched us. He wrote:

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(C) THE QRPP CORNER. I hope to make this a regular feature, with news about what is going on in the way of QRPp. Please send in anything you can. Hunt thru the old mags if you have to, just send me some information on what guys are doing with QRPP. For those of you who haven't heard of it before, QRPP is the generally accepted designation for low power, up to a maximum of five watts...

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Mike went on to report some QRP news and finished up with a half-page description of Doug DeMaw's The QRP 80-40 CW Transmitter found in the June 1969 issue of QST, noting: it looks kind of complicated, using three transistors, but it is worth the complexity.

At this point, very few ordinary QRP'rs were designing their own rigs -- there was virtually no information out there to guide us. Luckily DeMaw, and Wes Hayward with his seminal article on the direct conversion receiver, paved the way for the rest of us imitators who, lacking the technical expertise to design our own, have taken bits and pieces of published circuits that looked good and combined them into rigs without actually knowing why they worked and whether they were working! WA8MCQ's closing plea for circuits reflects this situation:

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(D) That's about it for this month. Let's see some stuff for this column. It's OK if you dig something out of a magazine, but be sure to tell me where you got it, so I can ask the editor for permission to steal it!

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Two actual circuits were included -- W7IGV's unit from RANDOM RADIATION, used a 2N3053 xtal oscillator to drive a pair of 2N3053's in the amplifier.

Ultimately, our 5-watt QRP ARCI evolved from this humble beginning -- a report of a few QRP QSO's and two QRP circuits -- a total of roughly two pages of QRPP stuff. But the process would take a decade.

By chance, as K8EEG, I received this issue of QRP/8 courtesy of Mike's sample mailing to 8th district members. It was a fire and gasoline situation. His complaints of no materials being submitted, the mind-blowing stuff in QRPP CORNER, the bit about the list of QRPP'rs, the statement of focus, and the phrase "exchange of ideas" ignited an enthusiasm in me that has never waned. I fired off an excited letter offering to write up my QRPP info and rig and Mike welcomed the offer.

But I was to discover that we were on two different frequencies. He was a QRP ARCI BoD member and a loyal one at that. It had never occurred to him that the 100-w QRP ARCI was not an environment conducive to the flourishing of QRPP. My instant reaction to the stuff in the July issue was simple -- who needs the 100-w QRP Club anyhow! It will never become a place focusing on the exchange of ideas for genuine QRPP'rs, not in a thousand years!

There was another slight misunderstanding. Mike apparently thought I'd write a tidbit that he could include in his QRPP CORNER. What he got was two pages of text, followed by another page of schematic and instructions for duplicating my rig and making it work. I kind of sensed that he didn't realize I wanted to write QRPP CORNER while he edited the QRP/8 QRO stuff. So, I titled my piece "QRPP KORNER", spelled with a "K". When my QRPP KORNER sheets arrived, Mike replied on 8/25.

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(1) 8/25: Got your papers today. You did a wonderful job, both with the machine and with the content. I did not expect you to, or especially want you to, do the QRPP Corner, but that's OK. I mean, LABEL it the QRPP CORNER, seeing as how we already have such a column by the same name.... Boy, you really went and did it now, cuz now I am going to send all my QRPP dope to you and you will forever be responsible for writing the QRPP KORNER! If you have no objections, I really would appreciate it if you would...

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As for my strategy of spelling the title, Mike commented:

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(2) 8/25: I was kind of disappointed that you labeled the papers as you did KORNER with a "K". I would do that kind of thing, but somehow I can't see that from a prof. at a big university, an English prof. no less!

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Both QRPP CORNER and QRPP KORNER, spelled with a "K", appeared in the Sept. issue of QRP/8. Mike introduced me in the section titled "NEW WRITER FOR QRP-89" and explained:

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(2B) With this issue, perhaps, we acquire a new writer for the QRPP CORNER. K8EEG said he would write me a little bit, with some QRPP news he has gathered over the air, and include the schematic of his QRPP rig. I told him to go ahead, and he wrote up a nice little column, ran them off for me, and sent them in. He titled his contribution QRPP KORNER, so in this issue we have two such columns. In the future, I hope to get Ade to write the entire column. He did an excellent job this time, and am sure he can continue to produce such fine work.

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In the regular news section, I am quoted as saying: "Perhaps it would be well to set up an editorial staff for this QRP/8 thing, and even better, consolidate with other newsletters being published ... I'm less inclined to contribute some item that I know will not get out of the 8th district, or if it does, only a little farther...."

Mike was trying to expand -- but just into the combined 8th/9th district newsletter. Big expansion! I guess that, to a kid in Paw Paw, MI, the 9th district looked pretty far away! But that idea never worked out.

The Sept. issue of QRP/8 was a landmark in the history of QRP. Mike's QRPP CORNER and my QRPP KORNER, spelled with a "K", together put into print 5 solid pages of genuine QRPP stuff plus three QRPP rig circuits. It also contained the first TenTec advertisement with photos of the four basic modules, at $7.95 each, which could be purchased separately or combined into the first ever full-fledged QRPP transceiver for 80-40 meters. THE MILLIWATT and TEN-TEC grew up together. Almost five months would pass before THE MILLIWATT replaced QRP/8. And therein lies a story of its own -- you'll see why I've titled this section "THE MIKE AND ADE SHOW".

It took two months of correspondence, during which Wes Mattox K6EIL/2 came on board, to talk Mike into ditching QRP/8 and going to an exclusively QRPP national publication.

The Sept. issue of QRP/8 arrived on Sept. 16, and I wrote Mike congratulating him for the fine job, and then I started planting the seeds for THE MILLIWATT. Mike had suggested that I mail the QRP CORNER directly from SD, and I replied:

"Somehow, the separation of QRPP CORNER from the main newsletter seems to imply a separate existence, that is, QRPP CORNER could become an organ in itself. On the one hand, I think that this is undesirable because it has been an organic element of QRP/8. As such, it has attracted readers to QRP/8 (I hope!) and is perhaps the mainstay of the QRP/8 newsletter."

Note my strategy in the last sentence. On Sept. 21, Mike replied associating mainstay with new subscriptions as opposed to what I actually mean, that is, the only part of QRP/8 that was worth publishing . He seized on the not enough time yet issue, and broadsided me with that vein of pessimism that seems to have grown out of his experience with the lack of interest in QRP/8:

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(3) 9/21: So far, no guys have been attracted to QRP/8 by the QRPP CORNER, either yours or mine. There hasn't been time for anyone to subscribe because of it yet, and I very seriously doubt if they would just to get it. Strike that last -- I think they WILL, eventually.

But the mainstay of the publication? If you refer to your own contribution, your head is getting kind of swelled, isn't it?

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In my letter, I had continued with: "If QRP CORNER were to be handled separately, then two advantages might accrue. First, a much wider distribution could be drummed up among the other call area guys interested in QRPP, and the thing could eventually become the national newsletter of QRPP. This is an eventuality which I consider very desirable, because it is in line with my interests in QRPP, my desire to see operating info from W5's or W1's, or, in short,

the happenings on the national QRPP scene."

Mike replied:

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(4) 9/21: Yes, it has great possibility for becoming the national QRPP scandal sheet. I don't know how to go about it. We really should keep it a part of the QRP/89, as it helps the newsletter considerably, plus QRP/8 started it so QRP/8 keeps it! HI!

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The problem of getting materials for QRPP CORNER was the next problem: I had commented:

"It seems clear from this latest issue of QRP/8 that there is much more than adequate material for QRPP CORNER as a separate publication. If we build up a good intelligence network here in the 8,9,0 areas, there will be adequate info for a good four-page issue six times per year, especially with the anticipated rise in QRPP with the advent of the winter season. Your QRPP CIRCUITS booklet idea would be a very helpful item in any effort to render QRPP CORNER separate but organically related to QRP/89."

Now when I look back, I don't recall whether the reference to a good four page issue six times a year was my actual expectation, or whether I watered it down so as not to pull Mike's pessimism chain. At any rate, Mike replied with a word of encouragement about my job of writing up QRPP CORNER for future issues of QRP/8:

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(5) 9/21: I hate to say this, but you think there is more than adequate material for it? Just try to make another sheet as good as your last! Actually, it seems like the typical QRPPer is not dedicated to the art of QRPP, but is in it for the momentary fun of it, then goes QRO again. Result -- the guys give lots of QRPP news for short periods of time, then run dry, and you have to seek new sources of information ... In any event, don't ever give up for lack of information -- just do some editorializing on QRPP when space runs rampant.

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Before Mike's reply had even arrived with his reactions, I had written On Sept. 19 to Howard Pyle, W7OE, General Manager of PARG:

"Mike WA8MCQ and I are thinking of running the QRPP CORNER off separately and mailing it separately to both subscribers and non-subscribers to QRP/89, ... I don't envision getting this underway as a separate operation until the first of the year. I'd like to ask you to insert a simple query into your RANDOM RADIATION to the effect that an effort is being made to provide a general QRPP newsletter designed specifically for the QRPP'er ... it will the only source of operating information for them. ... Once it is underway, we'll push for separate subscriptions so that it can support itself...."

Four days later I responded to several issues in Mike's letter of 9/21.

(9/23) "About the problem of the QRPP sources running dry, I think you're right in this respect ...Actually, you've hit the nail on the head in your inimitable manner in regard to the weakest part of my expectations regarding information -- and the challenge about repeating the last QRPP KORNER was well placed. It led me to question why such an attitude of pessimism is so possible and prevalent, and my answer is: if we sit on our asses waiting for the stuff to come in, it won't! But if we go out and get it, it probably will come in."

I then went into a half-page paragraph about setting up an intelligence network and mailing samples and query sheets to anyone who seemed remotely interested in QRPP. The end result was that we both cranked out query sheets and started mailing them. I had to back away from the idea of a separate publication because I sensed that the turf issue was a sensitive one for Mike:

"You're response to the idea of a separate QRPP Corner is well-taken. I hesitated to make my suggestion, because I, too, see QRPP Corner as an integral part of QRP/8, and essentially your creation ... To be clear then, QRPP CORNER should remain in the QRP/8, and in no way become totally separate -- if I had had that idea, I'd probably start up my own operation, which I have no desire to do."

Admittedly, I was diplomatically lying thru my teeth, as should be clear from my 9/19 explanation to W7OE mentioned above, and it would not have taken a Ken Starr and his Grand Jury to prove it! But Mike had to be nudged along step by step. With the turf issue temporarily settled, Mike got down to business in his Oct. 3 letter:

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(6) 10/3: First off, QRP-89 is dead. Lack of interest, so K9VCM and I aborted by mutual consent. I am glad, as it would have been much more work for me, and also, I changed my mind and now feel that I really like QRP/8, and don't want to end it all after it has, hopefully, built up a good reputation.

About the sheets asking for QRPP info, this is an excellent idea, so go ahead with it if you will. However, send me 25-cents for each person you promise a free issue of QRP/8!!!. No free issues just for news! However, you could promise them a free issue of "The QRPP Corner, a regular column appearing in QRP/8 which is devoted to news of what is going on with 5w or less..."

Frankly, I do not want to use QRPP CORNER as bait to get more subscribers. I have so much trouble with the memeo machine, the 70 copies I run off now is a real experience, and if I went to more, it would kill me.

Okay buddy, how about this --- what I want is QUALITY, not quantity necessarily, but I would much prefer to have the QUANTITY to be made up of 8th district members, and QUALITY, which I want the most of, to be QRPP. I want all the QRPP news I can get, regardless of whether it comes from a member or not.

About the QRPP CORNER -- I sent you some news recently. Now, will you be willing to be editor of that part of the newsletter? I would appreciate it. It is enough to know that it is my creation. I do not really care to get the credit for the actual work. I'm getting lazy, and getting tired of all this work!

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As you'll notice, 25-cents for a free issue meant that I had to pay for the samples I promised! Under his signature, Mike scribbled the reminder: "YOU (underlined) are paid up for 4 after this issue, but as you are printing it, you may get some extra, HI!" Mike always counted the pennies! I was grateful for that because I had no interest in the business end of the operation.

Something happened between the 3 Oct. letter and Mike's next letter on 16 October. I hadn't written him since 9/23. But whatever happened, it pushed him over the edge. Perhaps the ideas I'd been feeding him finally gelled. In any event, it was the turning point for the QRP movement in the US and indeed worldwide. Mike wrote:

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(7) 10/16: Starting with the Jan. issue, QRP/8 will change its purpose from that of being an 8th district QRP ARCI newsletter to be a QRPP newsletter, with no geographical restrictions. I've been thinking about this all day, and finally decided it would be the best thing ... You mentioned that, really, an 8th district newsletter is useless unless it coordinates a lot with other newsletters, and this is not being done. Finally, there is NO bulletin devoted to QRPP news. So, starting with the January issue, we will devote our pages to QRPP news from all over the country, and not just to member news of

QRPP'rs. We will print regular-type QRO news if we have room, but will devote our pages mostly to QRPP news. You had a good idea about making the QRPP CORNER the national QRPP newsletter, and this is sort of what we are going to do now. The name will stay the same...

I would like you to be my helper and associate, helping to get the news, and helping to put it out. One reason I need you is in case I get drafted or something, the newsletter can go on... Please let me know what you think of the idea. It is going to come to pass anyhow but would really like any suggestions you have. Again, I think this will really be welcomed by all those interested in QRPP whether associated with the club or not.

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My response of 20 Oct. crossed Mike's next letter of the same day. I informed him:

"As far as your earlier comments to the effect that we'll never match last issue's QRPP CORNER stuff, I can only say that was a rather naive statement! So far, I've gotten five pages of stuff, including three VFO rigs for 80/40 and 20 m from K4OCE, including one computer-designed attentuator for dropping to QRPP from QRO rigs etc. This stuff can keep until the Jan. issue."

I included a list of 13 items about the operational organization. I tossed out a couple possible names: QRPP CORNER: JOURNAL OF THE MINIWATTER and MILLIWATT JOURNAL. And I asked about what my role would be in the new QRPP newsletter: "Who is chief editor of QRPP CORNER, now that QRP/8 isn't any longer?"

Mike's letter on 10/20 anticipated my question and added the clarification.:

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(8) 10/20: Now that we are converting QRP/8 to a national QRPP newsletter, I will assume most of the responsibility for handling the QRPP news. I suppose you can stay on as Associate Editor or some such ... Now that we are going nationwide, we should get more interest, but I doubt if we will reach 100 or even 75. Maybe we will, I don't know. ...

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Now it was MY turf that had to be defended! This was red-flag stuff! Now that I read over my letter to Mike of Oct. 22, I get the distinct impression that I was really infuriated about being phased out of QRPP CORNER. :

10/22: "Got your letter today and I feel the need to clarify a few matters. I don't see why you have to assume responsibility for the QRPP news, unless (a) you consider yourself the only one who can do it, (b) consider yourself indispensable to the QRPP movement, (c) you consider me totally incompetent. As I see it, WE should make the thing a success ... I don't want to stay on as an associate editor, whatever that is, or as chief editor. You can be chief editor if you want -- I am in it to serve the common need of QRPP'rs. I suggest that you decide to take a similar attitude if you don't already have it.

"Secondly, I think that I can help by providing a counterpoise to your pessimistic approach to (a) work, (b) the actual value of what we can accomplish, and (c) the desire to serve as many QRPP'rs as we possibly can. We have to stabilize so that I know what we're doing, so that the guys know what's going to be going on next month, so that we don't change form and purpose every time you get to thinking about something .... In short, we need a succinct statement of purpose that will stand for the newsletter and its whole setup. Individuals then don't come in too much, but are agents for the common goal. So, let's get down to writing a batch of articles for this newsletter, pick a name if we can think up something better than QRPP CORNER, and get going on this in a professional manner."

The key to the whole shift from QRP/8 to THE MILLIWATT was Mike's flexibility and readiness to accept new ideas and ways of doing things. If he had chosen to dig in and fight the inevitable at any point, we'd probably have gone separate ways -- I was already committed to an exclusively QRPP publication. So, his reply of Oct. 25 was a great relief. In addressing the turf issue, his first comment was:

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(9) 10/25: I don't quite know what to call you. You certainly aren't going to be editor in chief, as it's my baby, and no one is going to take it away from me. Well, now let's see -- choose either arrangement that suits you best. I am the editor and you are the reporter; or, I am editor in chief, and you are associate editor; or, and this would be closest to what actually is, we are both co-editors.

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Two days later he crossed that out and rephrased it:

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(10) 10/25: Well, you're right on all of that. The main trouble is that I look on the newsletter as my baby, a personal project, and was acting like you were trying to take the thing away from me. However, you're right about it all, and the important thing is just to get it out. Let's both be co-editors of whatever it would be called...

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He seemed relieved now that the issue of focus was resolved, and commented:

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(11) 10/25 Remember, this November issue is still QRP/8 technically, and I am obligated to print the QRP Club news that I have, even though I don't really want to print it. So please do not omit any of it. I certainly will be glad when the January issue comes. We will no longer have to print that trash we have been doing. It has been lots of fun, but I am getting sick of it at least in the present form. Glad to hear that you have so much QRPP stuff. Well, if you want, you can try and save a lot of it for the January issue.....

Now about the name for the newsletter -- I would have liked to keep QRP/8, but now I don't think that is such a good idea. MILLIWATT JOURNAL sounds good, but perhaps something a little more unique is in order. But unless you come up with something better, I suggest that we use either MILLIWATT JOURNAL or QRPP CORNER.

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Along with his four page letter, Mike included an organizational sheet including all the items we had settled, including our early concept of format.

One of my favorite WA8MCQ-esque passages is in this letter, a revealing item that I'm sure you all will find interesting:

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(12) 10/25: You can write the ads if you want to, but I don't know if you can do a good job of it. I have this bad habit -- when I see something in print, I always feel that I can do a better job and explain it more clearly. That's why I wrote my article for 73 after reading W6TYP's article, which I felt was quite confusing and "Yechyy". For instance, from reading his article, one gets the feeling that one must build a one watt rig (no other power will do) and work a guy exactly 1000 miles away to get started in QRPP. Perhaps I cannot do better after all, but at least I try. Oh well. Now, getting back to the ads, I am going to tear your last ad in the HAM TRADER to pieces. I have a

copy right here. I hope you take this criticism in the spirit in which it is offered.

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What gall! I had a Ph.D. in English and therefore no need to prove my command of the language to this kid from PawPaw! However, having said that, I must note that Mike was a superb writer -- and not just because he was a kid. I haven't edited anything of the parts he's read -- that is how they rolled out of the typewriter platten.

Five exclamation points after each adjective. Instead of mimeographing it, I managed to have it offset printed and folded into a booklet of 16 pages. It wasn't a newsletter and it sure wasn't going to look like one. The rest is history.

To get back to the story, the die was sunk, and all we had to do was file off the rough edges and pour in the stuff to make THE MILLIWATT. We put out perfunctory November and December issues of QRP/8 and saved the good stuff for the first issue of THE MILLIWATT, scheduled for January 1970. By December, Wes K6EIL/2 joined us with responsibility for handling the 1-2-3 call areas and listing active QRP'rs; I handled the 5,6,7 areas, and Mike took the 4,8,9, and 0 areas. We commenced mailing queries and running some ads. Mike added an ominous note at the end of his Dec. 13 letter:

"I am draft #361, but the Michigan head of the Selective Service says all will go, so I am sweating it."

The Vietnam War wasn't over yet. Mike delayed mailing his material until after the Xmas rush on the theory there was less chance that it would be lost. So the PO lost it out of spite. That created a delay. By Feb. 26, Mike complained:

"No newsletter yet. Come on, we are now fully one issue behind. Never again will I trust the PO with anything."

When I told him I was printing 300 copies, he said "Wow!!" with 2 exclamation points. When he got the first issue of THE MILLIWATT: NATIONAL JOURNAL OF QRPP two days later, he wrote:

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(13) 2/28: Got my issue of THE MILLIWATT today. All I can say is Fantastic!!!!! WOW!!!!! Well worth waiting for!!!!!

[Interestingly, while reading this, Mike anticipated my next comment by adding his count of the exclamation points after each phrase -- great extemporaneous addition!]

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Five exclamation points after each adjective. Instead of mimeographing it, I managed to have it offset printed and folded into a booklet of 16 pages. It wasn't a newsletter and it sure wasn't going to look like one. The rest is history.

Mike pre-empted the draft by enlisting later in the year and disappeared into the Far East. C.F. Rockey came on as Contributing Editor. Word got out about THE MILLIWATT. We started up the MILLIWATT DXCC QRPP TROPHY Program and the QRP FIELD DAY TROPHY PROGRAM. At the end of the second year, the 300 copies of the first year's run were gone -- QRP'rs subscribed and bought the lot, so running reprints became a regular chore. By 1975 when it ceased publication after 33 issues, we had over 800 subscribers in over 40 countries! George Dobbs G3RJV had started up the G-QRPC in the meantime and published its excellent journal SPRAT.

[At this point, I called George to the mic so that he could read his line below]

A couple of years later genuine 5-watt QRP clubs began to appear, first in Michigan. They carried the torch until the QRP ARCI was transformed into a genuine 5-watt organization in 1980. That is another story in itself, time is running short, so we'll have to rush thru Part III, entitled:

Part III: G3RJV's Role in US QRP History.

George helped bring about the transformation of the 100-w club into our 5-watt QRP Club by repeatingly making snide remarks such as:

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George:
Bloody yanks still think that 100-watts is QRP, ho-ho!

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and sniggering or chuckling or chortling or whatever it is that these Brits do with that attitude of superiority that is directed at the former colonies. But all joking aside, George, over here, we QRP'ers loved it every time you took a potshot at the 100-watt club. It was a joke to foreigners and a pain to us.

Part IV. The QRP Takeover of the 100-w QRP ARCI.

When the takeover of the QRP-ARCI occurred in 1980, the news letter was headed by a logos consisting of a 2-inch square meter with the needle pinned under the 100 watt tick-mark. Previously, the logos was simply a QRP with a 5/8-inch "Q", at the top of which 100 was inscribed, and a needle inside the "Q" pointing at the 100. The change to the huge 100-watt meter made the focus of the club obvious, and was a kick in the face to genuine QRP'ers. The takeover began when a QRPr, Bill Dickerson, WA2JOC, winner of QRPp DXCC Trophy #10, took over the editorship in 1977. Bill, Sandy Blaize W5TVW, Mayford Flynn WB4ZOJ, and Joe Szempias W8JKB were the other QRP'rs on the 11-member BoD. Bill got the ball rolling in two steps.

(1) First, he turned the newsletter into a 5-watt QRP forum by running news from genuine QRP'rs. For example, the January 1978 issue contained 7 pages of member news, including reports by QRP'rs WB9HPV, WA3TNJ, K6GKU, W6JTH, WA6DKD, WA6YPE, WA2ICK, KH6JHS, WB0RSW, WB0GRJ, VE1BQQ, W9SCH, W3CMI, W6PQZ, WB4ZOJ, and W8JKB, many recognizable as former MILLIWATT contributors. Articles by QRP'rs WA3ZXK/5, W9SCH, and WA2PGA rounded out the genuine QRP offerings. Several QRP'rs called for lowering the power limit. W8ILC, who should be in the Hall of Fame, reported 180 countries with 1-watt SSB. In the midst of 5-w QRP reports about all the DX being worked, one QRO type asked at the end of his brag: "What type of person wants to jump into a pile-up for EI2, VR2, 9J2, or an IG9 while using less than 100-watts input? I am proud to be that kind of person." Stark contrast. Totally defused focus.

The genuine QRP'rs reports had had an impact on the 100-w club Founder Harry Blomquist K6JSS, who wrote:

"For lo! these many years I have noted club members doing marvelous things with 5 watts or less. But, after 20 years of building my own gear I finally had to buy, getting an Argonaut. After a months use of two watts output, and getting one contact each ten tries, I bowed to those QRPp giants; and went out an bought a 50-watt linear."

A different crowd, those "QRPp giants" "doing marvelous things". But it was the active crowd. The results of the QSO Parties showed that. In the 1977 Fall Party results appeared entries from 63 QRP'rs and 23 QRO'rs. The Spring 1978 event produced 89 QRP and

36 QRO entries. Fall 1978 showed 70 QRP and 40 QRO entries. QRP'rs were in the overwhelming majority. The newsletter continued to bulge with reports from QRP'rs.

(2) The second and biggest step was taken when Bill began poking the hornet's nest in the October 1978 by raising the question: "do QRP QSO's initiated with QRO really count as QRP contacts?" He followed up in the January 1979 issue by reporting that he was up to 132 countries with his Argonaut, and then whacked the hornet's nest with a full swing:

"As one whose major interest is DX, I would be embarrassed to categorize a 100-watt contact as QRP to a DX station on the air. However, there is no question that the 100-watt limit for joining the QRP ARCI attracts a number of hams who might otherwise not become exposed to QRP/ QRPp. If one is serious about low power, 100 watts is simply not QRP for the vast majority of hams. Therefore, I propose that the QRP ARCI lower the maximum power allowed by full members to TEN watts input. OK GANG -- WHAT DO YOU THINK?"

That began the battle for the club. Within the news section, Mac McCullough, W4VNE / W8LZK, made the point:

"The only problem is that perhaps it is now after the fact since I think that the QRP ARCI dragged its feet too long and let those of us who have been interested for years in what a watt or so would do, get more interested in Ade Weiss and his MILLIWATT. That is now past history but the awards have already been made through Ade and there is no real achievement goal left except to collect more paper for the shack's wall."

The rest of the 11 pages of news, typically, was almost entirely about real QRP.

But Bill's editorial ignited an explosion of controversy in the April issue. More importantly, out of nowhere, Tom Davis K8IF, who had been running the QRPp nets, was elected President of the QRP ARCI. His sole purpose in becoming president was to transform the QRP ARCI into a 5-watt club. So, Tom, Bill and I put our heads together on the strategy.

The main concern was to avoid panicking the 100-watt types into action. This would leave the field open for the normally active 5-watt types. In the April issue, then, Bill clarified the point that his personal opinion about a ten-watt limit in the previous issue was not to be construed as being anti-QRP ARCI, and closed by quoting W8JKB's reminder that club policy is decided by a vote of the BoD. That was a 6 to 5 QRO majority at the time, and a 2/3 majority was needed to make the change. He commented that, judging from the deluge of replies he'd gotten,

"common agreement about the club's power limit, is unobtainable".

In other words, without saying it, the point was: it will have to be either 100-watts or 5-watts. Bill selected the replies to the power limit question to quiet the fears of the 100-w crowd -- most expressed the theme: "5-watts can be fun, but let's keep it at 100-watts for various reasons."

Among these, K6JSS laconically noted that:

"the newsletter indicates a revived interest in changing the club level to 10 watts maximum. My records and memories say this is the fifth time... I see nothing to be gained by going to 10 watts."

My contribution to the plot appeared last in the issue and stood as the "final word". After pointing out that the QRP ARCI was the only organization in the world to define QRP as 100-watts, I suggested, as we had decided, that the membership be polled, and "if a majority of the members considers QRP as five watts... it is time to make a basic change in the club by-laws."

By no means were 100-watt types to be excluded -- an Associate Membership should be created for them. For his part, Tom entirely ignored the power limit issue in introducing himself as the new president, noting only that "1979 may prove to be a tough year and we can all see that".

Tom let the power limit issue fade until the July 1980 issue. By that time, everyone thought it had gone away again. Then he popped in a questionnaire and a return postcard in that issue. Only 43 replies out of a mailing of 600 were received by the October issue. With respect to the input vs. output issue, 58% favored output. However, only 25% favored the 5-watt limit, with 46% undecided and 14% for 100-watts. In the meantime, QRP'rs Ed Lappi WD4LOO and Red Reynolds, K5VOL, had been newly elected to the board along with Pete Spotts, N1ABS, the new editor. In reviewing the results, Tom noted that

"there is a strong feeling among at least half the members of the BoD that the poll is insufficient to reflect the wishes of the membership as a whole."

Behind the scenes, Tom had submitted two proposals for changing the by-laws -- output power and the 5-watt limit -- to the BoD. He strategically avoided trying to change the club's power limit per se, and limited it merely to claims of QRP achievement, that is,

"All QRP ARCI Certificates of Achievement will, therefore, be endorsed as QRP - 10w input, or QRP - 5w output. No endorsement would be carried on 100-w certificates."

Despite Tom's diplomatic approach, one member of the BoD in particular produced a three-page diatribe about the sampling ratio of 43/600, the impracticality of RF. output power measurements, QRPp not being his cup of tea -- "never has been, never will be" -- and closed with a half-page attack on me -- "He's never been an officer or done nuttin for us!" -- and proposed ejecting me from the club because I had used the wrong QRP number during the latest QSO Party. Needless to say, I responded in kind, with the ferocity cranked up all the way. He resigned after the takeover.

It was in such an atmosphere of controversy that Tom courageously planted his feet and confronted the opposition head-on:

"While those of us who wish to see a change may find this disappointing, such a vote at this time does not mean that the issue cannot be raised again, either when we get a more widespread response from the membership, or when the composition of the BoD changes to reflect what, at least by the poll results, appears to be the wishes of you, the members."

After a pep-talk about voter turn-out, Tom took the bull by the horns and announced that a new poll was enclosed in that issue.

The new poll produced the desired results. Of 221 replies, 33% favored the 5-watt level, and 23% favored the 10-watt level. Only 28% favored the higher power levels. In the January 1980 issue, Tom reported that the by-laws had been amended by a vote of the BoD to the output standard and the club's definition of QRP was now 5-watts RF. output. The QRP-25 Award would still be available for working members at up to the 100-watt level. The club logos would be changed to reflect the new 5-watt power definition. The old 100-watt meter logos still appeared on the cover of the April 1981 issue, but the rest was real QRP.

At Dayton 1981, Tom announced at dinner to Red K5VOL, me, and a couple other QRP'rs that he was getting married and he did not know how much time he'd have for the club. We all moaned -- his innocent boyish smile told us what to expect. He didn't have a clue. For us, that "I do" surely would translate into "I'm out of here". But look around you now and sense that QRP ARCI group-identity. Tom Davis K8IF made this happen and he's here in spirit. He belongs, as he is, in the QRP Hall of Fame, and also in your understanding of why YOU belong here. Thanks to him, the QRP ARCI is a 5-watt club. He got rid of the two-inch square 100-watt meter logos. But the job is unfinished. HE ought to be on the club logos instead of the founder of the 100-watt club who was against changing the QRP ARCI into our 5-watt club.

DAYTON, FDIM, QRP ARCI Banquet Spech, 1998— Ade

The Murphy Files

Edited by Joe Gervais, AB7TT, vole@primenet.com

Howdy Folks, and welcome to a new feature in QRP Quarterly - **The Murphy Files**. Let's face it, all of us are constantly hounded by ol' Murphy. Seems the fellow doesn't have enough to keep himself busy and has made it his sole mission to badger, harass, and humble us at every turn. So what are the Murphy Files? A collection of stories from YOU, the reader. There must be hundreds of amusing tales of Murphy QRP encounters to be told by our readers. And who better to share them with than your fellow QRPers?

So how is this going to work? This column will only exist as long as **YOU** submit your tales of Great QRP Murphy Moments. A few paragraphs, a few pages, whatever you've got, we want to see it! Ideally they'll be something we all can laugh at with you. You don't have to be the world's greatest author - we'll take care of spell checking, formatting, and proofreading. Just send them along to either Ron (KU7Y) or myself (AB7TT) at the addresses on the back of your QRP Quarterly. Email/ASCII text is preferred. Of course since this is the first time we've announced it we don't have any stories from you yet, so I guess I may as well start or it's going to be a very short column today! Next time it's your turn. ;-)

Murphy the Snowman

submitted by Joe Gervais, AB7TT

It had been far too long since my last snow camping/QRP expedition. I love the outdoors, and when snow blankets the backcountry it's even better. The solitude, the absolute quiet, it's like you're frozen in time. (Or at least just frozen!) Anyway, I'd finally managed to sucker... er... convince a buddy of mine at work that he was long overdue for a snowy adventure as well. To add an extra twist to my diabolical plans, my buddy is a former ham who seems to be the perfect candidate for being lured back into ham radio through QRP. And what better way to show the power of QRP than being field-portable deep in the snowy mountains?

The weekend was finally here. Now I'm a relative greenhorn at life compared to many of you, but I like to think I've got a handle on ol' Murphy, especially on my backcountry expeditions. Every last detail planned out, gear tested, backup plans in place, emergency gear, you name it. Mr. Prepared, that's me. This trip was no different. Picked up my rented snowshoes and started going through my normal Murphy exorcism rituals.

Everything was going smoothly (of course!). I smiled to myself the whole time I was packing/checking/rechecking. Murphy didn't have a chance. Not here. No way. Needless to say, Murphy was hiding around the corner and ready to give me an overdue visit....

Almost as a formality, I decided to fire up the Sierra and make sure I had all the cables, connectors, etc. No problem. Hooked up the battery and antenna feedline and turned on the xcvr and sent "QRL?" followed by some V's and then a CQ. May as well snag a quick QSO, I figured. Murphy gave a wry smile as an odd odor filled the room. I sniffed a bit. What the heck was that?!? Laundry had just been done, so it wasn't my old socks. Hmm.... We'd taken that dead mouse out of the attic weeks ago... Then I saw it. Smoke! The life's blood of any rig! The precious smoke was coming out of my beloved Sierra! If you let the smoke out, it stops working! AAAARRRGH!

For the next hour I played with my Sierra. Carefully, delicately. It was no use. It seemed OK on receive, but any transmit, even into a dummy load, and that odd burning smell appeared. Needless to say I didn't spend much time with the key down! I probed around, I scrutinized solder connections and components. I couldn't find anything wrong!

There was no time left to mess with it. Murphy had won this round, but I was still going to win. I pulled out my QRP+ - Hah! Take that, Murphy! I'd need to take a much heavier battery, and the QRP+ was much heavier than the Sierra, but we were only going to snowshoe about five miles or so off the road. I could handle it. I'd used the QRP+ a few hours earlier, so I didn't bother op-checking it. (Astute readers and Murphy Hunters will note the red flag here.) All that was left now was to op-check my backpacking stove - my trusty ol' reliable white-gas MSR Whisperlite. Been all over the mountains of North America and Mexico with it. A good, trustworthy ally. Murphy smiled deviously again....

I'd set up the stove and fuel bottle on the back patio (never op-check a backpacking stove indoors!). So safe, so sure. I pumped up the pressure in the fuel bottle, primed the stove and fired it up. Whoosh! A beautiful blue flame roared up. Figured I'd let it burn for a few minutes to clean some crud out. Then it happened. WHUUMPH! Not a good sound! The entire stove/fuel assembly erupted in flames. (I later learned it was probably a faulty O-ring in the pump.) Well shoot, that's why I test these things, and test them outside at that! Figured I'd just cover it up with a doormat and smother it. Wrong. The vapor caused the mat to burst into flames!

Yikers! I now had a situation on my hands! If the plastic pump melted through and the seal was lost, I'd have a full liter of flaming pressurized white gas spewing around my patio. Not good! I leaped over the fence to the pool and got the hose. I knew I wasn't likely to put out the fire this way, I just needed to keep it cool until I had a better idea. It was a vapor fire (NOT a fuel spill, yet!), so water was safe to use. Finally I managed to knock the entire soaked, flaming assembly onto a low spot in the grass, where I drowned it in a few inches of water. Whew!

My wife wandered out, bleary-eyed at this now very late hour, and having heard my tales so far asked me if I should just cancel the trip, since it seemed I was having a run of bad luck. What? Give in to Murphy?!? No way, not that easily! I picked up my buddy on schedule the next morning, and off we went. We finally got to our destination, about 15 miles NW of Flagstaff, AZ, elevation near 8,000 ft. It was a beautiful, sunny day. A bit warmer than we preferred, but plenty of snow. We snowshoed to our site and set up camp. That evening the snowy woods were unbelievably quiet. No wind, no birds, no machines. You could literally hear your own heartbeat, it was so quiet. Humphreys Peak (12,600 ft.) towered to east, bathed in the golden glow of the sunset. Murphy indeed. Hah!

After dinner, we battled with the dense tree canopy to set up the antenna (a fan dipole) and holed up in our tent. Fired up the QRP+ and started working fellow QRPers. Managed to work Steve (NOTU/M, on his way home) , fellow ScQRPion Gary (AB7MY), Ed (WE6W) and even Dwight (WA6NAE). Fun stuff! To top it off, Gary had offered to call my wife and tell her all was well, then contacted me later to confirm. Who needs cell phones? (Thanks again, Gary!)

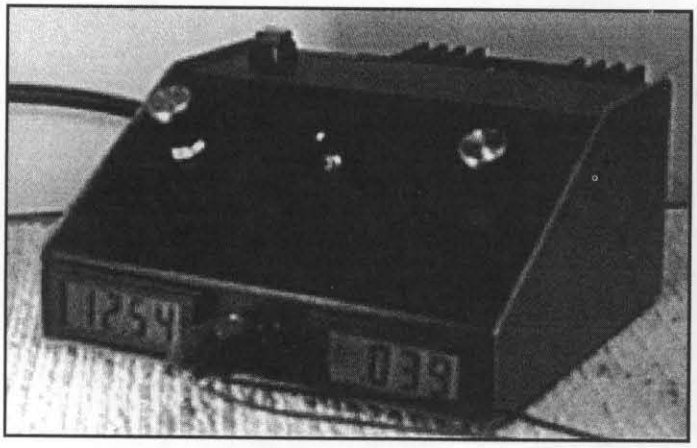
Again Murphy gave an evil grin. Power out from my QRP+ dropped to near zero. I checked connections. I rechecked connections. Argh! The 7AHr battery should've been fine, even in the cold wx! I had to QRT for the rest of the trip. But Murphy had only won the battle, not the war. We had a great time in the snow, worked friends on 40m, and came back out with all of our fingers and toes. Good enough for me!

Back home, I started going over every bit of my ham gear with the multimeter. Turns out the coax pigtail I use to connect my rigs to my tuner had developed a flaky connection on one end. When I thought I was feeding my rigs with a good load, they were seeing a wide-open mismatch! Out in the snow, the condensation was apparently enough to make the connection work(?), but only temporarily. Murphy had the last laugh after all.... But I had all the fun.

So... What's YOUR story?

The W5VBO Power Supply

By Brian Kassel, W5VBO, bkassel@dancris.com



I've built my share of power supplies over the years, and maybe you have too. So, why build still another? Well, this one is a bit different. For one thing, it's specifically designed for powering breadboard, or untested circuits and devices. It also supplies power to external 9 volt test devices, like DVM's, inductance and capacitance bridges, an Autek RF-1 etc. How many times have you come back to the bench, only to find that you had forgotten to turn off your battery operated test equipment? Those 9V batteries can get mighty expensive. It's pretty cheap compared to anything commercially produced that has the same features:

- Variable from + 1.2 VDC to +17.5 VDC using 10 Turn pot.

- I.C. regulators used throughout.

- Current capacity to 5 amps continuous, with full over-temperature and over-current protection.

- 2 Digital LCD meters to monitor both voltage and current (up to 2 amps) to 2 decimal places. Each is powered by it's own internal separate power supply.

- Unique current limit mode allows switchable and adjustable current limiting down to 10 ma up to over 1 A. This feature allows new circuits and projects to be "smoke tested", but with no harm to the circuit in case of short, or incorrectly wired components.

- Accessory 5 way jacks in rear provide IC regulated + 9 VDC to power DVM, Inductance and capacitance bridge etc.

- Using mostly surplus components, total cost was less than $30.

You might consider this to be more of an idea article, than a detailed step-by-step piece. There is no PC board, or physical layout supplied. All wiring is point to point. Most builders probably have accrued at least some, if not most, of the parts required to build this unit. And then, there are those who might just want to beef up their existing home-brew bench power supply.

Let's review the overall circuit. First, notice that there are two distinct thickness of lines drawn in the schematic. The light, or thin line, are the paths of relatively low current. These connections can be made with fairly thin wire, like # 22. The dark, or thick lines denote paths that are relatively high current. They carry the full current being supplied to the external device. These runs should be something like # 16, or # 18. Too thin a wire, and unwanted voltage drops may occur at full power supply current output. Too thick a wire, and it will be too difficult with which to bend, solder etc. Two LCD meters are incorporated. They are both identical, except for the way that they are set up with their jumpers and programming resistors. These are the PM-128 units available from many sources. They sell for about $10 each, are 3 1/2 digit capacity, and can be easily set to measure voltages as low as 200 mv, and come fully assembled. Their major disadvantage is that each device MUST have it's own power supply. Each unit's power ground MUST be isolated from all other power supply grounds. This rule applies only to the power supplied to the LCD's, NOT to the voltage or current being measured. More about the set up for these devices later.

Now let's discuss each section of the overall circuit. The power transformers that power each of the displays can be quite small in current capacity. I used two 24 V 300 ma. center tapped units, as that was what was in the venerable "junque" box. Since the little 9 volt regulators only require a voltage input that is at least about 3 volts above the 9 volt output, I used the center tap for the minus return, and two diodes in the familiar full wave configuration. A 12 volt transformer can also be used, and a bridge rectifier utilized instead of the two diodes and center tap arrangement. remember: do not ground the voltage minus bus for the displays. A floating ground is a must here.

Note that only a fairly small filter capacitor can be used here, as the current draw for the displays is quite small. Each of these two supplies has an auxiliary output available on the rear of my enclosure to serve as a power supply for 9 volt external test equipment. As long as the ground for the external test device is not also the ground for the LCD meters, all is well. Even if the grounds meet, no harm is done. The meter in question simply "pegs out" at a"1", or over range indication. It isn't very often if at all, that you will be concerned with the instantaneous reading of Supply voltage, and supply current, along with using other equipment anyway.

The main supply's power transformer is an 18 volt, 5 A unit. Again, one can use other transformer types here as well. Just remember that the DC output at the rectifier output must be at least 3 volts above whatever the output voltage is adjusted to. Too high a voltage output, and U-4 will be dissipating a lot of heat in order for it to regulate it's incoming voltage down to the adjusted level.

So, how many times have you hooked up your newly created pride and joy breadboarded circuit, only t allow huge amounts of smoke to escape from those expensive little solid state devices? Wouldn't it be nice to have your power supply detect any possible problem, and drop the supplied voltage to a safe level? Well that's just what this circuit accomplishes.

Here's how it works. Note the unusual configuration of the 2 regulator chips, along with the SPDT switch. Assume, for the moment, that this switch is moved to the "current Limit" position. The LM-317, U-3, is configured as a constant current regulator. Only a certain amount of current can be drawn from the device. By turning the 100 ohm single turn pot, R-1, fully CCW, the supply will no put out any more than about 10 ma. After that point is reached, the output voltage drops dramatically.

This maximum current point can be adjusted up to about 1 amp or so, which is the maximum that the LM-317 is capable of. When the switch is in the upper, or off position, this feature is bypassed. In this position, the supply is capable of it's full 5 amp output. The current limit point is now set by the built-in non-adjustable protection within the LM-338, U-5 I.C. R-2 and R-3 were selected to make the 10 turn voltage adjust pot (R-5) more linear. Any pot can be used here from 1K up to a bit above 10K or so. (Note that if R-5 is

changed to a 2K pot, then R-3, the 3.9 K resistor, should be omitted.) D-9, C-5 and C-4 provide additional protection for U-5. R-4 allows the output current to be measured by the "current" LCD. Let's now discuss how the 2 PM-128 LCD VOM modules are set up. Each unit is shipped with a small spec. sheet that describes how to set the jumpers and resistors for different voltage ranges. Also, there was a great article in the "Nuts and Volts" electronics magazine for October 1997 that does a great job of explaining in detail how to use these little modules. I'll give you a short tutorial here.

We will look at the "Voltage" unit first. Since we will never exceed 20 volts output, we will use the 20 volt range. We set up the meter by selecting RA as 100 K, RB as 10 M, and solder a simple wire jumper in at position P-2. That's it! For the "Current" LCD things are a bit different. Since the maximum sensitivity is set at 200 mv, there is a bit of a problem. If we make the current sense resistor, R-4, a value large enough to yield a usable result on the LCD read-out, it's value will be so large as to make the voltage regulation unacceptable to me. Of course, one could install an additional switch to switch in different values of R-4, but in my unit, I felt that the 2 amp scale would be sufficient. After all, how many designs need more than 2 amps, anyway?

Therefore, the "Current" LCD unit was set up as shown with R-4 having a value of .1 Ohm. Since the maximum power that this resistor will dissipate will be about 2.5 watts, a 5 watt unit should be fine. Of course if you only use the supply at ratings less than 5 A, or at 5 A only intermittently, then the power rating could be much less. So, having settled on a 2 A (well, ok, actually 1.999 A), the only setting that we have to do in the "Current" LCD module is to solder a jumper in a P-1.

So now, I finally have been able to homebrew, and not worry too much about the power supply being the weak link. It's also great to be able to leave all of my 9 volt test equipment switched on. When the creative mood hits, I just saunter over to the bench, throw on the single power supply on/off switch and watch the world of QRP creativity come to life!

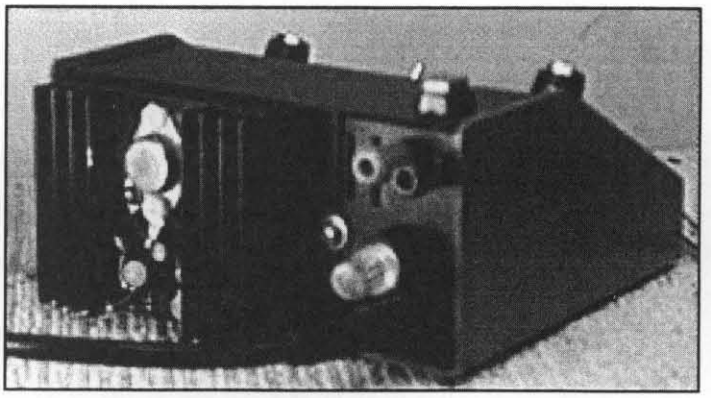
Home Brewer's Power Supply Parts List:

C-1, C-2	100 UF @ 35V or greater electrolytic
C-3	6,800 UF @ 50V or greater electrolytic
C-4	.1 UF @ 50V or greater monolithic or disc
C-5	2.2 UF @ 50V or greater tantalum
D-1, D-2	1N4004
D-3, D-4	
D-5, D-6	Diode Bridge 10 A @ 200V or greater
D-7, D-8	
F-1	2 Amp
R-1	100 Ohm single turn pot, panel mount
R-2	180 Ohm 1/4 W
R-3	3,900 Ohm (see text)
R-4	.1 (I.E. 1/10) Ohm @ 5W or greater
R-5	1K Ohm to 10K ohm 10 turn pot, panel mount (see text)
SPST	Both switches are SPST toggle types. The AC On/Off unit should be rated at 250 VAC, 1 Amp or greater. The Current Limit unit should be rated at 32V, 7A or greater.
T-1, T-2	Power transformer, 6.3 VAC Center Tapped @ 100 ma or greater.
T-3	Power transformer, 18 VAC @ 5A or greater
U-1, U-2	78L09 voltage regulator I.C. (9 VDC@100ma)
U-3	LM317 voltage regulator I.C.(1 A adjustable)
U-4	LM338 voltage regulator I.C.(5 A adjustable)
Misc.	5 Way jacks, terminal strips (if used) enclosure, A.C. fuse holder, Heatsink etc.
LCD	PM-128 units available from several vendors, including:

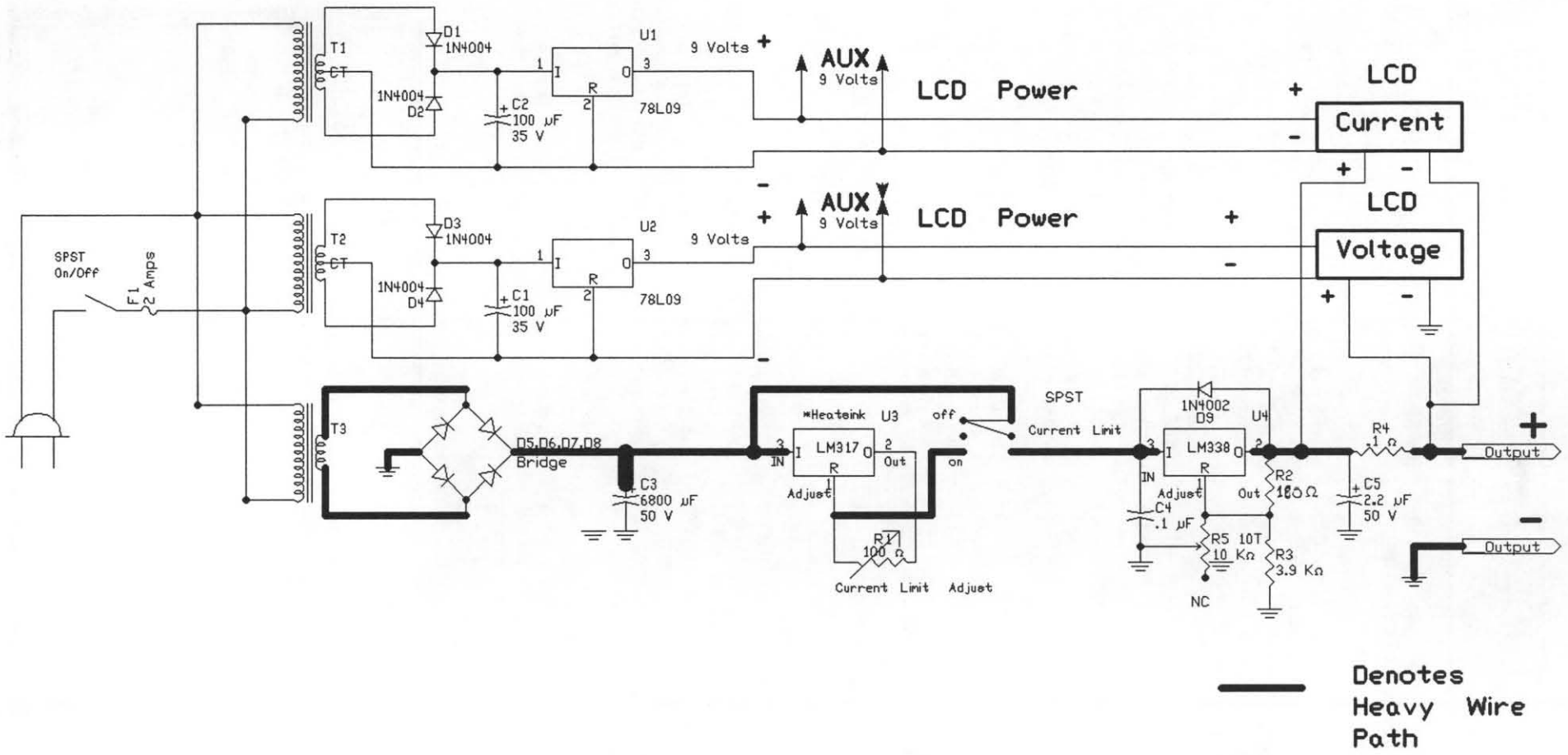
Black Feather Electronics
645 Temple Avenue #7
Long Beach, CA 90814
1-800-526-3717
CAT# PM-1
$9.95 + S/H

Circuit Specialists Inc.
P.O. Box 3047
Scottsdale, AZ 85271-3047
1-800-528-1417
CAT# PM-128
$9.90 + S/H

B.G. Micro
P.O. Box 280298
Dallas, TX 75228
1-800-276-2206
$9.95 + S/H



Got an idea just itching to get out? Figured out a clever tweak for the latest QRP kit to hit the streets? Or to improve the performance of an old rig? Just returned from a QRP DX-pedition or other adventure? Or darn near anything else related to QRP? We want to hear about it! Submit an article to the QRP Quarterly! Share your wisdom/humor with your fellow QRPers and help keep QRP the most active, lively corner in ham radio! See details on the back page of your Quarterly.



Co:	ARCI QQ
Title:	HomeBrewer's Power Supply
Board:	None — Revision: A
Author:	W5VBO Brian Kassel — Size: A
Date:	2-98 — Sheet 1 of 1

Review: The WM-2 QRP Wattmeter from Oak Hills Research

Ralph Irons, N7RI 113 David Terrace, Charlottesville, VA 22903 email: N7RI@juno.com

Santa brought me an Oak Hills Research WM-2 QRP Wattmeter kit, and as soon as I finished helping my kids get their presents running, *this* kid switched on the soldering station!

The kit was complete except for the stick-on cabinet feet. The manual is truly step-by-step, e.g., "Install the 100 Ohm (brn-blk-brn-gld) resistor at R13." The PCB is very clearly silk-screened and not overcrowded. Building the WM-2 is straightforward and enjoyable. However, there are no opportunities to test the Wattmeter as you build, nor are there any troubleshooting hints. The first test of the Wattmeter occurs after the PCB and chassis wiring are complete. If the test is not successful, connections to the SO-239s would have to be unsoldered and the PCB and controls detached from the chassis to give access to the underside of the board. Thus it is very important to heed the manual when it says, upon completion of the PCB wiring: "Take the time now to inspect the PC board for proper solder connections and for any solder bridges. *Do not* skip this step. It may save you some frustration later."

One test you ought to perform before wiring the WM-2 is checking the 1N34A diodes D1 and D2 (which rectify RF for measurement) to be sure they are matched. One QRP-L correspondent reported a 10% error in measurement to OHR, and was advised to check the diodes. After replacing D1 and D2 with a pair of Radio Shack 1N34A's matched using a DVM diode test function, the meter was on the money. If you're like me and don't have a DVM, you can match the diodes by comparing their forward resistance with an Ohmmeter.

The Wattmeter case is the clamshell type, with a sturdy cover, but no bracing joining the tops of the front and rear panels. The meter is large and easy to read, though there are few tick marks on the three meter scales. For example, the 100 mW scale has marks only at the following values: 0, 5, 10, 20, 30, 50, 70 and 100 mW. Now this is fine with me – I don't need readings any more accurate than that. Yet the manual claims a plus or minus 5% full-scale accuracy. That's 5 mW on the 100 mW scale. I'd be hard pressed to tell the difference between 80 and 85 mW on the scale, since there are no marks of any kind between 70 and 100 mW. This is a minor point. I'm delighted to have an instrument that can distinguish between 50 and 70 mW!

RF connectors are Amphenol SO-239s, and a slide-switch on the back panel lets you select the internal 9V battery or an external supply (9-13.6V). The external power connector is coaxial, and a cable with connector is supplied with the kit. One of the two small knobs on the front panel allows switching between forward and reflected power and the other turns the unit on and selects the 10W, 1W or 100mW range.

Alignment is very simple and requires only a voltmeter capable of measuring three test voltages (one for each meter range): 2.56V, 0.800V and 0.251 V. The manual recommends a digital voltmeter, but I used my analog voltmeter. I doubt that my readings on the sparsely marked WM-2 scale will be much affected by the fact that I used 0.25V instead of 0.251V.

I was delighted to be able to actually measure the output of my 2N2222 DSB transmitter, and tweak the output transformer for a 50-Ohm match. Turns out I've been operating QRPp phone on 40M (at roughly 850 mW), while racking up NY, NJ, WV, KY, GA, FL, PA and NH. One guy in NY actually swore I was 10 dB over 9. I'm betting that our antennas are directly connected by a gigantic poison ivy vine! *[Your SSB peak output will be more than indicated by an "average reading" meter like the WM-2 – see note below.]*

I also discovered I've been checking into the KnightLites net at 2W instead of 5W (a rough guess made using the barely wiggling needle on my 3kW MFJ tuner), and that my Centennial is running 3 to 4W on peaks on 80M. I'd been *claiming* to be QRP, but I didn't really know just how QRP I was!

The WM-2 kit is available for about $90 plus shipping from:

Oak Hills Research
20879 Madison Street, Big Rapids, MI 49307
phone: (616) 796-0920 email: qrp@ohr.com

Editor's note: The WM-2, like its predecessor the WM-1, does not measure "peak envelope power" (PEP). What it measures is closer to "average power" which is fine for a steady carrier. However, the readings obtained with SSB will not give a true representation of the rig's output. A simple modification can be made to the WM-2 to allow it to measure either average or PEP. This mod was described on page 8 of the January 1995 issue of the **QRP Quarterly**. It can also be obtained from the Internet by pointing your WEB browser to http://qrp.cc.nd.edu/qrp-l/hints/w1hue/mods_wm1.html. Although the mod was published for the WM-1, it is applicable to the WM-2 as well (but the board layout will not be as shown in the article). – W1HUE

Edited by W1HUE

Back Issues of The QRP Quarterly Available

George "Danny" Gingell, K3TKS, is now handling sales of back issues of the QRP Quarterly for the club. He currently has copies of all issues back to the beginning of 1995 and a few assorted issues for earlier years. Back issues are $2.50 to $7.00 each (depending on the issue) plus shipping. Four issues can be shipped Priority Mail in the US for $3.00. Contact Danny before ordering to make sure he has the issues that you need. (Please include your call, QRP ARCI number and telephone number in all correspondence.) Danny can be contacted as follows:

G. Danny Gingell, K3TKS
3052 Fairland Road
Silver Spring, MD 20904
phone: (301) 572-6789
email: K3TKS@abs.net

Announcing the NorCal 20 Transceiver Kit

Doug Hendricks, KI6DS, *announced the latest NorCal kit at Dayton this year, and they had a prototype to exhibit. I had a chance to look at it, and it's a neat rig! Designed by Dave Fifield, AD6AY, it's a 20 meter superhet with a lot of neat features, including a frequency readout in CW. Even more intriguing, they've come up with a new twist for this kit: for every one that is sold, a second kit will be given to a ham in a third world country, with the GQRP Club handling the distribution. If this looks like a rig you might be interested in, you'd better order one as soon as they start taking orders, since NorCal will no longer do unlimited kit runs; they are going to make 500 NorCal 20's (plus an additional 500 to give away overseas), and that's all there will be. Note that they will not be taking orders until the first of August..*

Straight off the NorCal web page, here's the text of the announcement, authored by KI6DS. (If you want to take a look at the NorCal web page, maintained by Jerry Parker, WA6OWR, surf over to www.fix.net/norcal.html.)—WA8MCQ

"NorCal 20"
by Doug Hendricks KI6DS

The NorCal QRP Club is pleased to announce it's newest kit, the NorCal 20, designed by Dave Fifield, AD6AY. The NorCal 20 is a 20 meter CW transceiver with the following features:

* Superhet receiver
* TUF-1 Mixer for the front end (designed for the harshest European conditions) NOT another NE602 front end.
* Variable output power from 0 - 5 Watts
* VFO controlled, user bandwidth selectable from 10 kHz to 200 kHz on any portion of the 20 meter band. This means that if you only want your VFO to cover 25 kHz of the band, you may set it up to do so.
* Varactor tuned VFO, 10 K pot supplied, but board laid out for 10 Turn Pot
* Self Contained Keyer custom designed for NorCal by Embedded Research.
* LM380N 2 Watt Audio chip. Easily drives a speaker.
* Frequency readout via Audio Frequency Annunciator. A PIC chip is used as a frequency counter with audio output. In the Automatic mode, as you tune the radio, a beep is generated every kHz. Then when you stop, the last two digits of your frequency are announced in Morse code. You may also push a button to generate the frequency that you are on. The manual mode does not have the beeps and you must push the button to get your frequency. Designed by Mike Gipe, K1MG.
* Custom clam shell case, made from .090 aluminum. 4.5" x 4.25" x 2.25" Designed by Bill Jones, KD7S, and made by Doug Hauff, KE6RIE
* All controls, knobs and connectors supplied.
* Double sided, plated through, solder masked, silk screened board, commercial quality.
* Comprehensive manual, written in the build a section, test a section style.
* 5 pole crystal filter.
* 220 board mounted parts, no surface mount.
* Full QSK, NO relays.
* IRF510 Final, 2N4427driver.

We will sell only 500 of these kits, and orders will not be accepted until Aug. 1st. There will only be one run, and there will not be another. NorCal will no longer produce unlimited kits. The price is $95 for the kit, and $5 shipping and handling in the US, $10 DX to Canada and Europe, $15 to Asia and the Pacific Rim. Payment must be in US funds only, and checks made out to Jim Cates, not NorCal. (European members may order from our European agent, Stephen Farthing and the price is 70 pounds sterling.) The kits will be shipped after Pacificon, with a shipping date of Oct. 20, 1998, providing our parts suppliers ship to us in a timely manner.

The exciting part of this project is that for every kit sold, NorCal will produce a second kit and send it to the G-QRP Club, which will handle distribution to hams in third world countries at no charge to the receiving hams. We will give the kits away! 500 kits sold, equals 500 kits for third world hams. George Dobbs has been selected to handle the distribution of the third world kits because of his extensive network of contacts with hams in these countries. Every effort will be made to assure that the kits get to deserving hams.

This is a huge project, and one that has never been done successfully before. The NorCal has been designed to be easy to build with minimal test equipment, yet be a quality radio capable of world wide contacts when finished. Dave has many years of experience of operating in Europe, and is very familiar with the requirements of radios in that environment. He has designed the front end with the operating environment in mind.

George Dobbs suggested during my visit last summer that NorCal come up with a way to provide kits for needy hams in third world countries. We have done it. The NorCal 20 team of Dave Fifield, George Dobbs, Jim Cates, Mike Gipe, Doug Hauff, Gary Diana, Brad Mitchell, Bill Jones, Richard Fisher, Jerry Parker, Paul Harden and Doug Hendricks have worked very hard to insure success. We hope you enjoy the new kit, and thank you for your help to further QRP throughout the world.

Remember, no checks will be accepted until August 1st, in order to insure that everyone has a chance to learn of the project and has an opportunity to buy a kit.

Here is the address to send your order to when the time comes: Please send your check and a self addressed mailing label to:

Jim Cates
3241 Eastwood Rd.
Sacramento, CA 95821.

European orders may chose to send their order in British Pound Sterling to:

Stephen Farthing
38 Duxford Close
Melksham, Wiltshire
SN12 6XN
England

72,
Doug, KI6DS on behalf of the NorCal 20 team

The ZM-40 – A Tiny QRP Antenna Tuner for 40 Meters

Pete Hoover, W6ZH 1520 Circle Dr. San Marino, CA 91108

You are probably thinking: "Geez, not another antenna tuner!" Yes, another antenna tuner (ATU for short, and yes, "LB", I know it's not really an antenna tuning unit but indulge me), but perhaps one with a few new twists.

The ZM-40 is a Z-Match type of ATU that was put together to meet some very specific objectives: 1) It had to be *small* (to be part of a back-packable set-up); 2) it should be usable on 40 meters with antennas ranging from a coax-fed vertical to a loop fed with tuned lines to a W3EDP with counterpoise to a random length wire – therefore it would have to handle both balanced and unbalanced antennas; and, 3) it should include something to indicate a match to 50 Ohms. The ZM-40 does all that, and fits in a package that is 2 1/4 in. wide, 1 3/8 in. high, and 1 1/2 in. deep – and weighs just 4.5 oz. (See Photo 1.)

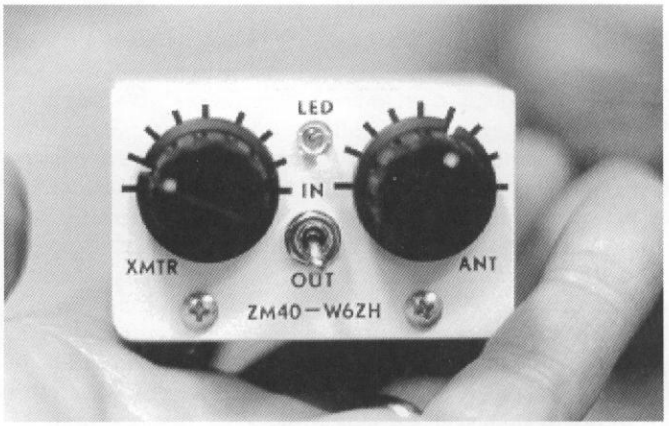


Photo 1. Front view of the ZM-40 QRP ATU. (W6ZH Photo)

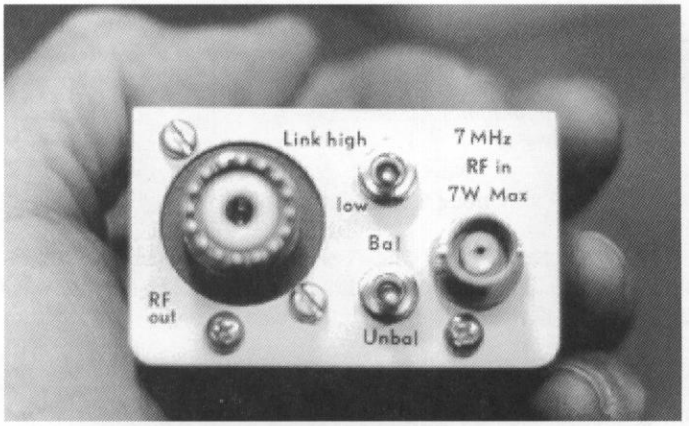


Photo 2. ZM-40 rear view. (W6ZH Photo)

The design of the ZM-40 was taken directly from W6JJZ's article in the ARRL Antenna Compendium, Vol. 5 (1996), page 196. That article will tell you all you need know about Z-Matches, how they work, and how to build a multiband unit. The challenge of the ZM-40 was not a technical one, but one of packaging – how to cram all the needed circuitry into a really small space. This is possible by using a pair of small plastic variable capacitors intended for use in transistor AM-FM receivers. The ones I used, found at a swap meet by W6JJZ, are cubes that measure 13/16 in. on a side. The FM segments are ignored, and the AM oscillator and mixer sections when paralleled show a range of 12 pF to 240 pF on my Autek RF-1. Putting a pair of those (see schematic) on the front panel leave precious little room for the SWR in/out switch and LED indicator, but it just fit. The shafts of the caps had to be extended using 2.5 mm metric screws cut to length and 1/4 in. diameter stand-offs 3/8 in. long. The caps are held to the front panel by two short 2.5 mm screws. Since both caps are above ground, make sure that the holes for the tuning shafts are large to keep the shafts from touching the chassis. Also make sure you use plastic knobs; even 2 Watts of RF can give a nasty tingle.

I used an Amidon T-68-2 toroid for the Z-Match coil. Once again, size was a critical factor; a T-80-2 might have been better but would not fit! With 28 turns of #24 enamel wire spread over most of the form, the main winding measured 4.91 µH. The 20 turn high-Z link (2.96 µH) and then the 8 turn low-Z link (1.02µH) were wound in that order over the main winding, centered on the center-tap of the main winding. According to the Gospel of W6JJZ, these evenly distributed link windings account for the ability of the ZM-40 to handle balanced antennas. *[The link in the EMTEC ZM-2 ATU is wound on the "cold" end of the coil and it seems to handle balanced antennas without problems. See review in the April 1998* ***QRP Quarterly****. –W1HUE.]* Grounding one side of the link to feed an unbalanced antenna doesn't seem to bother either the ATU or W6JJZ.

Switch S_2 permits selection of either a high or low Z link output, to best accommodate the particular antenna being used. To meet the balanced/unbalanced antenna input requirement (without using a balun) meant that the antenna connector had to be isolated from ground. My junk box had an SO-239 fitting that was held in place by a threaded nut on the back instead of the usual flange. I made a 7/8 in. hole in the back panel to clear the coax fitting and used a 1 in. square piece of plastic fastened to the back panel with a couple of 4-40 screws and nuts (see Photo 2) to provide an insulated antenna output. A "ground lug" fabricated from flashing copper is between the plastic mount and the nut holding the SO-239 in place. This "ground lug" is connected to both S_2 (the link switch) and one terminal of S_3 that connects the "barrel" of the SO-239 and one side of the selected link to ground when it is desired to feed an unbalanced antenna. A regular SO-239 flanged coax fitting could be used: Make a 7/8 in. diameter hole to clear the "barrel" and use nylon screws and insulating washers to keep the fitting insulated. Use regular metal 4-40 nuts and lock washers and a regular solder lug under one for the ground connection. RF from the rig goes to a BNC fitting that also mounts in a single hole. The time taken to make a proper "D" shaped hole for the BNC fitting is well worth it; it keeps it from eventually rotating after many uses – this is experience talking! See Photo 2 for a view of the back panel.

The basic SWR circuit is attributed to N7VE as modified by W6JJZ. The use of a 1N34A germanium diode rather than a silicon diode improves sensitivity and sharpness at the high end of the HF ranges (not really important in this application) and also extends the low power detection threshold for someone doing milliwatt operation. The space available for the SWR bridge determined the size of the resistors that could be used, and this selection places a limit on the power handling capacity of the ZM-40. Rather than a single 50 Ohm resistor I used a pair of small 1/4 Watt 100 Ohm resistors in parallel for R1, R3 and R3 (see schematic). A small piece of Vectorboard (3/8 in. × 3/4 in.) was epoxied to the bottom of a sub-miniature DPDT switch (GC 35-002) and all the SWR bridge parts except the coil and the LED were mounted on this board. The coil is wound on a FT-37-61 toroid: 25 turns of #28 wire occupy about half of the form. The #28 5-turn primary is close would and is centered in the remaining space; in other words, the primary and secondary are not inter-wound. The SWR

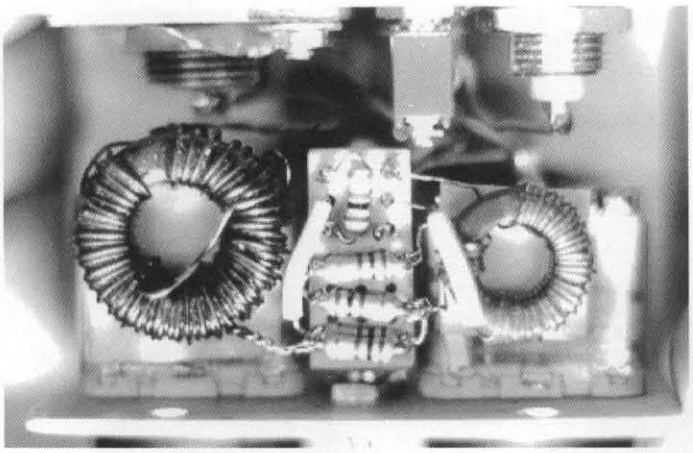


Photo 3. Inside view of the ZM-40. (W6ZH Photo)

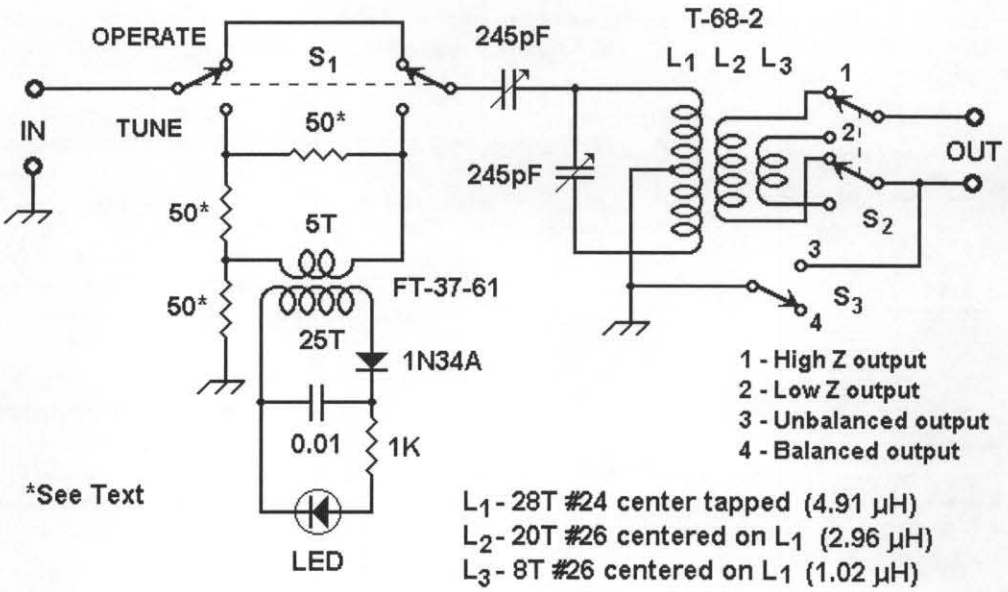
bridge was completely assembled and tested prior to installation. This was a wise move as I initially messed up the connections of the toroid and it would have been a real pain to correct this error after installation! With 3 Watts from the NorCal 40A as input I found that with a short or open at the "antenna" side of the bridge, the LED glowed brightly and the voltage across it measured 1.73 Volts. With a 34 Ohm load, 1.55V and medium bright; with 72 Ohms, 1.64V and medium bright; with a good 50 Ohm load, 0.04V and no visible light. As previously mentioned, the resistors in the SWR bridge limit the power that the ZM-40 can handle in "Tune" mode; probably no more than 2 Watts should be applied, and then for only a very short period of time. To safely handle a full "QRP Gallon", the 50 Ohm resistors should be rated at 2W (two 100 Ohm 1W resistors in parallel, for example). In "Operate" mode, the power that can be handled is limited primarily by the tuning capacitors to about 10W under most match conditions.

The assembly of the ZM-40 was rehearsed several times to determine the correct sequence of component installation. Then all parts were removed and the chassis box was painted and labeled – a tedious task but the results are worth it. Now, assembly time: First, antenna coax fitting, then the back panel switches and wiring those components together. Then the "Ant" cap was put in place with both the sections already paralleled (and shaft extension added afterwards), and then the main coil held to the "Ant" cap with double sided tape and wired to the cap and the back-panel switches. Then the completed SWR unit was put into place, followed by the "Xmtr" cap with the SWR coil placed on it with double sided tape. The BNC input fitting was the last component mounted with its grounding lug used as the common ground point for the unit. Photo 3 shows the bottom view of the finished ZM-40.

Finally – the smoke test: Yes, it worked! The SWR indicator was very sensitive, and I could load my NorCal 40A into practically every antenna I have. Using my Sierra, I found that I could use the ZM-40 on 30 meters as well as on 40, but it did not function on 20 meters or above. Only certain antennas could be matched on 80 meters and even then I couldn't get a "no-glow" condition. The settings of the two capacitors inter-act and the "dips" are very narrow and will be missed if tuning is too quick! Assuming the ATU is tuned first for maximum noise on receive, it should not take long to get a "no-glow" match condition with power applied. If at all possible, use less than 2 Watts for initial tune-up; the bridge is sensitive enough to get good readings at low power levels. You will have to experiment with the High-Z /Low- Z switch positions. It will be very dependent upon the antenna being used. Tuned feeders will probably require the High-Z /Balanced selections while coax fed antennas usually work best with the Low-Z/Unbalanced settings. But don't be surprised at what it takes to get a "no-glow" match. In any event, bear in mind the previous comments about the maximum power that can be handled.

In short, the ZM-40 met my original requirements: It's small, it matches everything that I can throw at it on 40 meters, and the SWR bridge works! Problems? Yep; the ZM-40 is so small and light that anything larger than RG-58 or light twin-lead tends to drag it off the operating position! Maybe some more double-sided tape is indicated!

Edited by W1HUE



ZM-40 SWR Bridge and ATU Schematic

The Rainbow Antenna Analyzer

by ... George Heron (N2APB), Joe Everhart (N2CX), Clark Fishman (WA2UNN)

A low-cost, microcontroller-based measurement instrument for automated SWR analysis, with optional remote PC control and graphical display

Introduction

There are many useful measurement devices to be found in the average ham shack: voltmeters, SWR bridges, frequency counters, oscilloscopes, and more. However when it comes to specifically determining the operating health of your antenna system, nothing can compare to the antenna analyzer.

There are several good antenna analyzers from good suppliers such as MFJ and Autek. These products offer precision measurements and various "bells & whistle" features that are nice - but these units also come with a price tag that is sometimes hard to swallow.

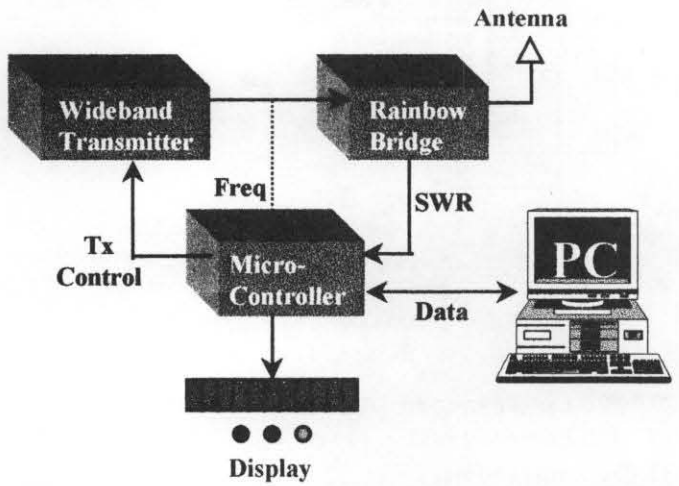
Presented here is an antenna analyzer project that the average homebrewer is able to tackle without providing too much of a dent to the wallet. It has the basic features most needed in the shack and can be constructed in a number of ways.

A major feature of the Rainbow Antenna Analyzer is its completely open design. Both the hardware *and* software are described fully - theory, design considerations, control algorithms and even the source code for the software! This level of explanation and consideration for the homebrewer is not commonly found in today's products.

Another interesting and pretty unique project feature is the Analyzer's ability to connect to a standard PC for remote control, data collection and archival, and graphical display of SWR across all hf ham bands. A VisualBasic program is provided as part of this project, including the source code!

System Overview

The Antenna Analyzer is a small and inexpensive measurement device designed to determine antenna performance across the amateur bands through use of automatically collected SWR readings.



A very low power transmitter is swept across selected frequencies by a microcontroller, and the transmitter's signal is routed through an absorptive SWR bridge to an antenna system (feedline and radiator). These match indications are input to the microcontroller which retains the corresponding frequency and SWR readings throughout the measurement period.

During the measurement period, the microcontroller rapidly displays the individual frequency and SWR values by means of a colorful graphic display of LEDs and bar graph array. When all data are collected, the microcontroller statically displays the relative frequency and its associated SWR reading.

The frequency and SWR data may also be downloaded to a PC attached to the Rainbow Analyzer via a serial cable. A special software program for the PC collects the data pairs and displays a graphic representation of the antenna performance. The plot clearly shows the resonant frequencies of the antenna system under test. The PC may also be used to remotely control the Analyzer for manual selection of frequencies of interest.

Thus with a press of a button the Rainbow Analyzer is able to automatically and quickly determine and display the frequency for which the antenna system is best matched.

Manual operation is also provided to allow the user to control the band/frequency of operation while viewing the display of SWR. In this way the relative bandwidth of the antenna system may be determined.

A unique and exciting aspect to the Rainbow Analyzer project concerns the nature of the software used to control the microcontroller. There are a growing number of computer-controller ham radio construction projects being offered today by clubs, small companies and described in the literature. For the most part, however, they do not provide the source code and design details that are of great interest by a growing number of homebrewing amateurs capable of dealing with software modifications and improvements. The Rainbow Analyzer project supplies fully documented source code and design methodology for the software used to control the microcontroller. Same too for the software used for the companion remote control and display program in the PC.

Feature Summary:

- Automated, microcontrolled antenna analyzer
- Wide band, low power transmitter sweeps across HF ham bands
- Utilizes SWR bridge design and circuitry of the Rainbow Tuner
- Multi-colored LEDs indicate band ... pulsate during scan
- LED bar graph array indicates position in band of lowest SWR
- Bar graph array also indicates SWR at the indicated frequency
- Serial connection to PC for optional display/plot of antenna performance
- All software design & source code provided!!

System Components

The Rainbow Antenna Analyzer is comprised of three functional blocks: the Microcontroller, a broadband Transmitter, and an SWR Bridge. These blocks operate as a control loop driving the signal frequencies to known values throughout the spectrum and recording the associated SWR readings.

Microcontroller

The heart of Analyzer system is the Microcontroller module which sweeps the transmitted signal by presenting a variable voltage to the control input of the Transmitter module. The Microcontroller then measures the frequency of the signal as applied to the bridge, and also measures the SWR of the antenna system connected to the Bridge.

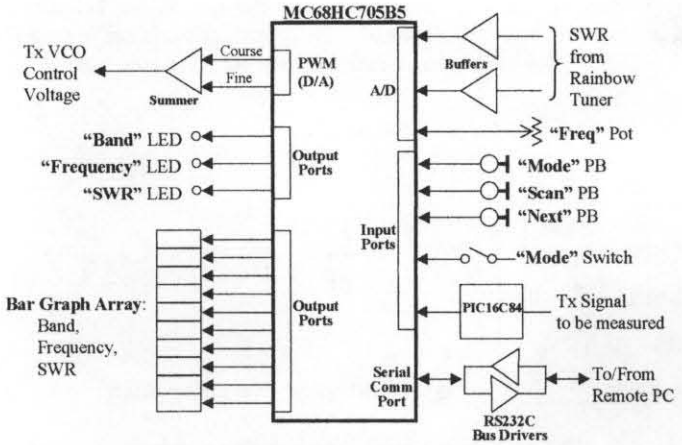


Figure 2: Microcontroller Block Diagram

The single chip microcontroller used in this module is a Motorola M68HC705B5, a high performance CMOS CPU with 6KB of onboard PROM and 128 bytes of RAM. This device is a 52-pin PLCC package providing up to 33 input/output lines for control of the Analyzer functions. Onboard A/D converters and D/A converters provide for a highly-integrated, high-functionality device well suited for this Analyzer project.

The analog control voltage to the Transmitter is generated through use of the two pulse length modulation (PLM) outputs of the HC705. These outputs deliver pulse trains of controllable high-time width which, when filtered, essentially perform the role of an digital-to-analog converter. Each PLM output is derived from an internal 8-bit counter, thus providing 256 discrete voltage levels when the pulse trains are filters. Since we need more than 256 levels of control voltage to span the 30 MHz range our VCO covers, we decided to use two PLMs with one used as a course voltage control (i.e., "bandset"), and the other used as a fine voltage control (i.e., "bandspread"). The two filtered signals are then summed and scaled in an op amp, and then presented to the VCO control voltage input of the Transmitter.

The SWR signals coming from the Bridge module are the forward and reverse voltages in the antenna system. These signals, ranging from 0-1 volt, are each scaled to 0-5V and are presented to the CPU's A/D converter inputs. The software then is able to read those values, calculate the SWR and store the value in memory. Since the 8-bit A/D converter digitizes the analog signals to one of 256 levels, more than enough granularity is provided for the SWR readings.

The other A/D input of the CPU is used to read the value of the *Frequency* potentiometer used in manually controlling the frequency of the Transmitter. The CPU reads the analog voltage presented by the pot and drives the control voltage to the VCO in response. Again, the 256 discrete digitized levels able to be achieved from the pot is enough to control the Transmitter throughout its wide range through use of a clever software algorithm.

The LEDs and bar graph array elements are the way the Analyzer communicates with the operator. These display devices are all driven by the CPU's output ports through buffers and current limiting resistors.

The operator controls the Analyzer by actuating the three pushbuttons and a mode toggle switch. The pushbuttons sequence through the display modes (Band, Frequency and SWR), initiate a scan, and sequence through multiple SWR minimums. The toggle switch allows the operator to set the Analyzer mode to *Manual* or *Automatic*. Use of these controls and display indicators are described later in this section.

Frequency measurement presented an interesting challenge in the design of the Analyzer. A PIC microcontroller was ultimately selected to do the job by counting the buffered RF signal over a precise time period and presenting the 16-bit counter value to the HC705 using a simple serial protocol.

A bus transceiver (MAX232) is used to drive the serial line to the remote PC for optional use of data collection, calibration, display and remote control.

Transmitter

The Transmitter module is designed to output a low power signal based on input of a variable voltage to its VCO. The microcontroller provides this variable dc voltage to set the Analyzer measurement frequency. Ideally it is desirable to use a very simple voltage controlled oscillator that tunes the while HF band of 3 to 30 MHz. Alas, design of a simple oscillator that achieves this goal is not a simple task.

Another approach considered for the Analyzer was to build a band-switched voltage-tuned oscillator. Those of us who grew in the era of general coverage short wave receivers are familiar with this technique. It is indeed quite practical with manually tuned instruments, but quickly becomes difficult to implement with electronically switched tuned circuits and dc voltage tuning.

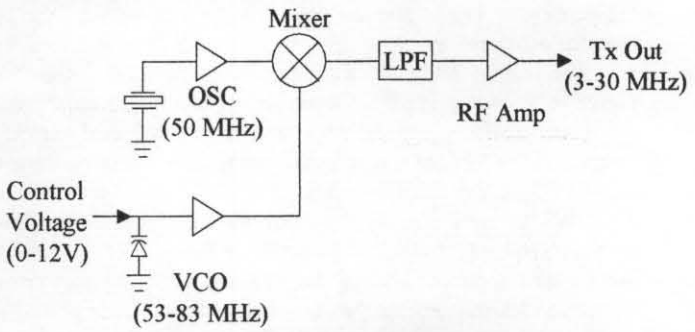


Figure 3: Transmitter Block Diagram

Figure 3 shows the transmitter functional block diagram chosen for the Rainbow Analyzer. Here a 3 to 30 MHz output is achieved by mixing a VHF voltage tuned oscillator with a VHF crystal oscillator. This circuit arrangement provides uncritical reproducible performance. The VCO is tuned over the range of about 53 to 83 MHz and heterodynes with a fixed 50 MHz oscillator in a passive diode ring mixer. The difference between the two input frequencies is in the desired range, 3 to 30 MHz. The mixer output also contains the sum of the two input signals and low amplitude leakage at the input frequencies. But all of these undesired signals are ***above*** the tuning range we want, so an LC low pass filter attenuates them enough to not affect SWR measurements. A buffer amplifier isolates the transmitter output from loading by the bridge circuit and amplifies the signal to a level of about +10 dBm (roughly 1 volt rms).

SWR Bridge

An intriguing aspect of this project is that we are building off and extending a design called the "Rainbow Tuner" originally done by Joe Everhart (N2CX) during 1997. This project was a co-winner of the NorCal Design Contest and was kitted and made available to the QRP community by the NJ-QRP Club throughout 1997.

The Rainbow Analyzer (whose namesake is based also on the original Rainbow Tuner!) uses the forward and reflected voltages derived from the original bridge-portion of the Rainbow Tuner project.

The SWR bridge is a descendant of the classical Wheatstone bridge familiar to those who study basic electronics. Similar configurations have been used for SWR measurement since use of coaxial cable began in the WW-II era.

Identical 51 ohm resistors R1 through R3 form the bridge along with an antenna connected to the Antenna connector. Ideally 50 ohm resistors should be used, but the small error due to using common 51

ohm components is minimal. The RF signal used for SWR measurements is provided by the Analyzer's Transmitter module.

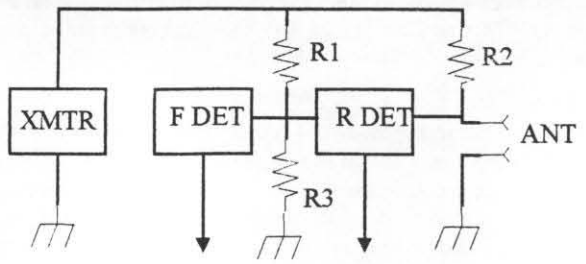


Figure 4: SWR Bridge Block Diagram

The bridge is considered to be *balanced* when the antenna impedance is resistive and exactly equal to 51 ohms. In the condition, the voltages at junctions R1-R2 and R3-Antenna are equal in both magnitude and phase. The net potential between these two points is zero. Any deviation in antenna impedance from this ideal condition unbalances the bridge and the voltage difference between the points becomes non-zero.

The voltage at the R1-R2 junction corresponds to the forward power in a conventional SWR bridge while the unbalance voltage mentioned above varies in proportion to the reflected power. DC samples of the forward and reflected voltage are output by the F DET and R DET RF detectors.

SWR is calculated by the Analyzer MCU using the standard formula SWR = (1 + P)/(1 - P) where P is the ratio of the Reverse to the forward samples. Use of the ratio of these signals for SWR calculation allows accurate measurements without requiring and setup or manual "tweaking." Similarly the resistive bridge circuit features repeatable broadband performance without any critical toroidal inductors or broadband transformers.

Display & Controls

The Analyzer's display mode is controlled by a pushbutton which controls the function of a single bar graph array. Three colored LEDs are illuminated to indicate which of three modes the bar graph array is displaying: Band, Frequency or SWR.

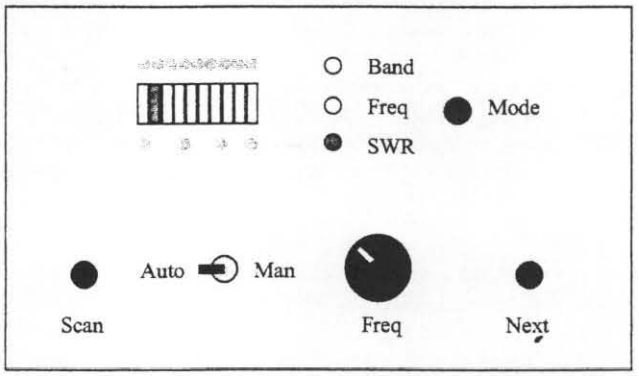


Figure 5: Antenna Analyzer Front Panel

A bar graph array is a group of 10 rectangular LEDs arranged linearly within a small DIP-sized package (approx. 1/2"H x 1"W). These LED display devices are sometimes used to indicate volume levels within audio systems, but here are used as 10 individually controlled LED segments to either indicate the Band and Frequency of the lowest SWR measured during a scan, and the relative SWR measurement for that frequency.

Band Indication

When the Analyzer is first turned on, the red *Band* LED is illuminated to indicate that the bar graph array is functioning as a band indicator. The specific illuminated element of the bar graph array indicates which of the ham bands is being used. In the example below, the display arrangement indicates that the 10 meter band is currently active.

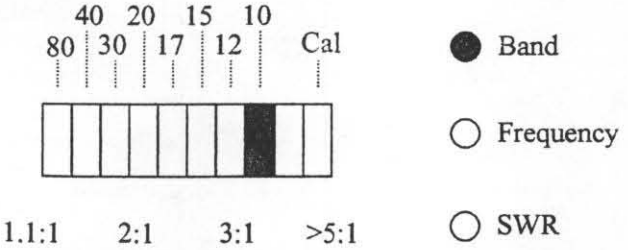


Figure 6: Displays Indicating Band

The bar graph array elements are sequentially illuminated when the automatic scan is in progress, indicating the increasing scan of the transmitter frequency.

In the case of post data collection (i.e., results display), a static display is made to indicate the band of the SWR null found.

Frequency Indication

When the display Mode pushbutton is actuated, the *Band* LED is turned off and the *Freq* LED is illuminated to show that the bar graph array is now indicating relative frequency within the Band previous shown.

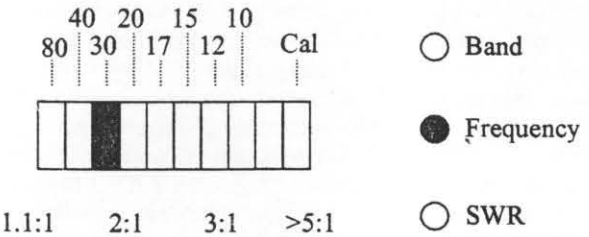


Figure 7: Displays Indicating Frequency Readout

The relative frequency is indicated by means of a single element of the array being illuminated corresponding to the position of the frequency in the band, based on the known default (or user-set) band edges. The left-most element of the bar graph array corresponds to the low band edge, and the right-most element corresponds to the upper band edge. Thus, in the example below, the relative frequency is around 28.050 MHz when coupled with the Band example used above and band edges of 28.000 MHz and 28.150 MHz.

The bar graph array elements are sequentially illuminated when the automatic scan is in progress, indicating the increasing scan of the transmitter frequency.

In the case of post data collection (i.e., results display), a static display is made to indicate the frequency of the SWR null found.

SWR Indication

When the user actuates the display *Mode* pushbutton a third time, the *Freq* LED is turned off and the *SWR* LED is illuminated, showing that the bard graph array now indicates relative SWR readings for the band and frequency settings previously made.

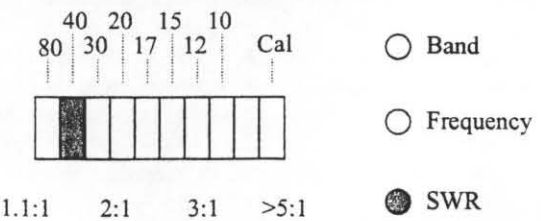


Figure 8: Displays Indicating SWR Readout

The SWR is indicated by a single array element being illuminated along a scale from 1.1:1 to >5:1. As an example, the following illustration shows a low SWR (perhaps about 1.15:1), again indicated for the 10m band of 28.050 MHz.

Circuit Description

For the discussion in this section, refer to Appendix B for schematics for each of the modules: Microcontroller, Transmitter and SWR Bridge.

Microcontroller

Microcontroller U1 has four 8-bit ports which are configurable for various combinations of input and output. All 8 bits of Port A and 5 of the 8 Port B lines are configured as outputs to drive the LEDs (discrete LEDs and those in the bar graph array). These output lines drive 74ACT244 buffers U3 and U4 which sink the LED current, limited to about 13ma by the 330-ohm resistors R8-R20. The ACT drivers were selected because of their output switching characteristics being close to the rails and thus completely turning off the LEDs when "high".

Reading the Control Switches

Four bits of Port C are configured as inputs to sense the three normally-open pushbuttons and the *Auto/Manual* mode toggle switch. Each switch is pulled up to 5V when open or when not actuated. Thus, "negative logic" is used whereby a "zero" read from the input port indicates a "true" or actuated condition.

Controlling and Reading the PIC "Frequency Counter"

We use four bits of port C to control a PIC microcontroller and read data output from its frequency counting algorithm.

The shaped RF signal is presented to an input port of the PIC which is programmed to count positive edge transitions occurring on this input pin. After counting the transitions for 128ms, the two byte counter is sent to the '705 over the serial protocol. Port PC2 is used to supply a clock to the PIC, while data is presented serially by the PIC to input port PC7. The serial data is transferred by using a "handshake protocol" on bits PC5 and PC6 of the '705.

The two bytes of accumulated RF signal transitions thus represent the frequency in kilohertz.

Getting the SWR Readings

The 0-1V forward and reverse analog voltages coming from the SWR Bridge circuit are buffered and amplified by two sections of an LM324 quad op amp. These amps bring the signals up to the 0-5V range and are presented to the fourth input port of the '705 microcontroller, Port D.

Port D of the '705 is an 8-channel A/D multiplexer which is able to direct any pin of Port D to an internal 8-bit A/D converter. Thus the computer is able to look at the forward voltage on pin PD0, then look at the reverse voltage on PD1 and take the ratio of those values to determine the SWR.

Providing for Manual Control from the Operator

A third input to Port D is a simple voltage controlled by a potentiometer coming in on PD2. This control is used to provide the operator a way of easily indicating a control setting between 0 and 255 (using the 8-bit A/D.) The computer can use this variable control in a number of ways, not the least of which is to provide indirect control over voltage being applied to the transmitter VCO, and hence the frequency of the Transmitter. Doing this, the computer reads the analog setting of the pot and correspondingly sets the voltages on its PLM output port "D/A converters". *Voila*, a manually controlled frequency generator!

Generating the VCO Control Voltage

The Pulse Length Modulation outputs PLM A and PLM B are used to generate the control voltage driving the VCO in the Transmitter. These PLM pins provide a digital-to-analog function controlled by software manipulating registers in the '705. This is a unique feature of the microcontroller whereby the waveforms being generated by the '705 PLM output pins have precisely-controlled frequency and "high"-time pulse width. The intention is to provide a low pass filter on the PLM output and integrate the high-time of the waveform, thus giving an effective DC analog voltage on the other side of the LPF.

Both PLM outputs are used in our design in order to provide enough granularity to the control voltage such that we can sweep and transmitter frequency with enough granularity to see frequency detail within our bands of interest.

- One PLM and LPF is used to set the course (or "band set") voltage between 0V and 5V, corresponding to a frequency between 3MHz and 30MHz. Remembering that with 8 bits of control in the PLM registers we are able to generate only 255 distinct voltages to the VCO. When considering the 30MHz range to be covered, 255 steps provides a frequency step size of 177 KHz or so ... far too big a step to collect data within our bands. So we need a fine control as well.
- The other PLM and LPF are used as a fine (or "bandspread") voltage source which gets added to the course voltage in another section of the U2 LM324 op amp. This combined voltage provides another 255 discrete voltage settings on top of the course setting to ultimately allow for finer steps sizes to be used when sweeping the Transmitter. The software algorithm used to sweep the frequency first puts the bandset voltage to the desired band, and then ripples through the PLM B control register setting to effect the sweep of the VCO within the targeted band.

Communicating with the External Host PC

The onboard serial lines of the '705 microcontroller are buffered by the MAX-232 line driver to provide standard RS-232C signals used in communication with the external PC.

The port is normally quiescent. Should the operator remotely command a data gathering and transmission session to begin, the PCLink program running on the PC sends a command byte to the '705 which is polling its serial input port during its idle times. Upon detecting that the PC is commanding a data transmit (for example) from the Analyzer to the PC, the '705 starts sending the data back over the serial link to the PC. Data is collected by the PCLink software and displayed on the PC display.

Transmitter

The Rainbow Analyzer Transmitter consists of both a fixed and a variable oscillator mixed together to provide a 3 to 30 MHz RF output. The practicalities of trying to design a wide tuning range voltage controlled oscillator led to adoption of this technique as discussed in a previous section.

Transistor Q1 is a so-called impedance-inverting overtone crystal oscillator. The oscillation frequency is set by quartz crystal X1. It is an inexpensive 49.XX MHz unit used in portable telephone applications. For purpose of discussion, the operating frequency will be described as 50 MHz, a minor error that "comes out in the wash."

Resistor R1 provides damping of the crystal low frequency parallel resonance so that the circuit operates at the desired third overtone series resonance point.

Q2 is a common-emitter amplifier used to buffer the oscillator from loading effects and to boost the 50 MHz signal to a useable level. Harmonics are removed from its output by a pi type LC filter. Capacitor C7 provides additional second harmonic rejection by resonating with L2 at 100 MHz. L3, the collector load for Q2 is connected at the output of the filter. Both Q1 and Q2 are common 2N2222 NPN silicon bipolar transistors.

Q3, a 2N4416 JFET is a Hartley oscillator tuned over the range of 53 to 83 MHz by two back-to back sections of varicap D5. The back-to back configuration give minimum Q degradation and loading effects caused by possible forward biasing of the diode by the RF voltage

across the oscillator inductor L4. Diode D6 provides bias stabilization of the JFET. Oscillator output is coupled to a mixer trough transformer T3. (All transformers in the Transmitter are bi- or tri-filar wound ferrite core broadband devices).

The mixer is a non-critical diode ring mixer similar to the robust double balanced mixers popular in modern RF transmitter and receiver circuits. A home-brew mixer using common 1N4148 diodes and hand-wound toroidal transformers is a cost-effective means of providing a non-critical, easily-reproduced and high-performance mixer.

The mixer difference output (53-50 = 3 MHz to 80 - 50 = 30 MHz) receives it final filtering by a cascaded pi filter. Since all of the undesired mixer outputs are *above* 30 MHz, this simple filter provides adequate rejection of generated RF signals outside the desired operating range.

2N2222 transistors Q4 and Q5 are a feedback pair that provide broadband amplification to an output level of about + 10 dBm as required for the SWR bridge. A partially bypassed emitter resistance on Q5 provides gain stability with a small "boost" at the high frequency end of the Transmitters operating range. Additional gain and bias stability are provided by feedback resistor R10. Bifilar transformer T4 couples the transmitter output to the SWR bridge.

Integrated circuit U1 is used to provide a regulated 8 volt supply to the Transmitter to ensure frequency stability of the Crystal and variable frequency oscillators. Bypass capacitors on its input and output pins prevent unwanted oscillations or instability.

SWR Bridge

The Rainbow Analyzer SWR bridge is identical to the basic bridge used in the N2CX Rainbow Bridge and Tuner. The bridge has three legs formed by R1 through R3 while the fourth leg is the antenna or external load connected to the Antenna Terminal (this is connected to the Antenna Jack, J1). The operating RF signal is provided from the Analyzer Transmitter connected between the Transmitter terminal and ground. When an antenna connected to the bridge has an impedance of exactly 51 ohms, the bridge is said to be balanced. The net result is that the voltages at the anode of D1 and the anode of D2 are exactly equal to each other in both amplitude and phase. When the antenna impedance is *not* 51 ohms, the bridge becomes unbalanced and there is a voltage difference at the two diode anodes.

Those diodes, D1 and D2 are half-wave detectors that provide DC output voltages equal to the peak value of the sinewave signals on their anodes. Germanium diodes are used since they have the least forward drop of any common diodes so they provide the highest possible dc outputs at low RF levels. This is important to maintain accuracy at low SWR levels.

D1 detects the forward RF signal at the R1-R2 junction with respect to ground since its DC filter capacitor C1 is connected to ground. This voltage is directly proportional to the forward RF power in the bridge. D2 and C2 however are connected across the center of the bridge so it rectifies the difference voltage. This difference voltage across the bridge is affected by both the *magnitude and phase* of the voltage on either side of D2-C2. The importance of this point is that the rectified DC output corresponds to the reflected power of a conventional SWR bridge. Additional filtering of the DC samples is provided by R4 and C3 on the forward sample leg and R5 and C4 on the reverse sample leg. As described in an earlier section, SWR calculations are performed by the Microcontroller using the ratio of the forward and reflected sample voltages.

The bridge is inherently a broadband device since the only reactive components used are the DC filtering capacitors. Accuracy is assured over the entire 3 to 30 MHz operating range by use of metal film resistors with negligible stray inductance and capacitance.

Construction

The Rainbow Analyzer is most easily constructed using circuit boards which will ultimately be provided, although it is certainly possible to build the project using point-to-point or *ugly* construction techniques. The relatively few number of components and modular design lend the project to most construction methods. In point of fact, the early prototypes for this project were constructed on copper clad PCB material using ugly techniques.

The SWR Bridged was prototyped using the PCB of the Rainbow Tuner. Using the Rainbow Tuner LED circuitry allowed visual indication of transmitter operation as it was swept through resonance of the tuned circuit used for test purposes.

The prototype of the Microcontroller module was point-to-point constructed on perf board.

The RF and analog Transmitter module was prototyped (several times!) using various sections of ugly construction on copper clad material, tack soldered together as the sections became alive (i.e., VCO, osc, mixer, LPF, amp).

The Analyzer was designed to fit into a standard 3"Hx5"Wx2"D plastic case from Radio Shack. This size nicely contains the circuit boards, allows room for batteries and is easily held during field use.

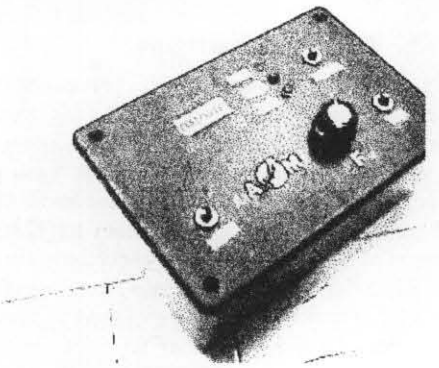


Figure 11: Analyzer Housed in Plastic Case

Alignment

The Analyzer needs no alignment or calibration. The closed loop nature of the system always provides precisely known frequencies to the antenna system: course voltages are presented to the VCO, providing correspondingly course frequencies which are read by the Microcontroller. These frequencies are then driven to the desired band edges and to the interim steps between the edges for data collection purposes.

Operation

The Analyzer has three modes of operation: Automatic, Manual and PCLink.

Automatic

The user enters the Automatic mode by switching the Auto/Manual toggle switch to the Auto position. The Scan pushbutton is then actuated to begin automatic operation of the Analyzer.

The overall algorithm for the Analyzer's operation is actually pretty simple:

a) Starting at the lowest band, the transmit frequency is set to the lower end of that band and the transmit frequency is moved up through the band in discrete steps while the microcontroller collects the SWR readings at each step and stores them for later use;

b) After all bands have been scanned in this way, the unit's microcontroller analyzes the data to determine the minimum

points, or nulls in the SWR data indicating where the best antenna matches were seen;

c) The unit indicates these nulls to the user by displaying the band, frequency and relative SWR in the bar graph array and colored LEDs on the front panel. The user is able to see multiple nulls (e.g., multiple matches due to harmonically-related frequencies within a multiband antenna system) by actuating the Next pushbutton.

Let's now walk through a session using the Analyzer in the Automatic mode.

1) The user initiates the process by actuating the Scan pushbutton. All three LEDs are turned on and remain on to indicate that the Analyzer is busy.
2) The transmitter is set to the lowest frequency in the lowest band and begins its data acquisition process by reading the SWR signal corresponding to that frequency, as presented by the Bridge module.
3) The controller then steps the transmitted frequency up and collects SWR data in the same manner until the upper band edge is reached, at which point the transmitter is set to the next higher band and data acquisition continues.
4) When the transmitter has been scanned through all bands, and all SWR data has been collected, the band of the first (and possibly only) SWR null is displayed in the bar graph array. The user can then actuate the display Mode pushbutton to display the Frequency of the null. The user can again actuate the display Mode pushbutton to display the relative SWR at that null.
5) The user may then actuate the Next pushbutton in order to display the next SWR null. If another null had been found during the scan, the Band/Freq/SWR would be displayed in a manner similar to the first.
6) If no other null had been found, then the same Band/Freq/SWR displays are shown.
7) If no SWR nulls are found during the scan, an error condition is indicated by flashing all three display Mode LEDs (Band, Freq, SWR) simultaneously. Conditions which might cause this to happen might include not having an antenna connected.

Manual

Manual mode allows the user to manually control the transmitter and view the resultant SWR at any point along the spectrum.

A benefit is that the user may see the bandwidth of a given antenna system. Once an SWR null is found in *Auto* mode, the user can place the Analyzer into Manual mode and swing the frequency up and down around the select frequency, monitoring the SWR readout on the bar graph array.

Manual mode also provides the user with a simple signal generator. By being able to set the frequency along any point of the amateur HF spectrum, the Analyzer is able to be used as a rudimentary RF signal source for use in troubleshooting and general signal generation.

The Analyzer is placed into Manual mode by switching the toggle switch to *Man*. Then, with the *Display Mode* indicating *Band* on the bar graph array, turning the *Frequency* potentiometer allows the user to change bands. Clockwise rotation of the pot increases the band selection, as indicated on the bar graph array. Counterclockwise rotation of the pot decreases the band selection. The band selection "wraps around", meaning that continued counterclockwise rotation moves the band selection from 40m to 80m to 10m.

Once the band selection is made, the *Display Mode* pushbutton can be actuated to select "Freq". Now in this mode, clockwise rotation of the *Frequency* pot increases the transmitter frequency, as indicated on the bar graph array as a illuminated array element traveling to the right. (Wrap around occurs here too.) Counterclockwise rotation of the pot decreases the transmitter frequency, and the illuminated array element moves to the left.

If the user actuates the *Display Mode* pushbutton to put the bar graph array into SWR display mode, moving the *Frequency* pot clockwise and counterclockwise (hence increasing and decreasing the transmitter frequency) allows the user to see the varying SWR with the varying frequency. This is a very powerful feature.

PCLink

This mode is in effect when the Analyzer is connected to a PC for the purposes of data display, remote control or calibration. The mode is entered by connecting a standard RS-232C serial cable between the Analyzer and a PC which is running the companion PCLink software.

After the Analyzer has completed a manual or automatic data collection scan, the frequency and SWR data are transferred from the unit and the PC displays a graphical plot of that data on the video monitor. This view of the data presents a visually-intuitive representation of the antenna system performance.

The PCLink program was written in Microsoft's Visual Basic VB5. The project source code files are contained on the Jersey QRP website for those interested in modifying the code and experimenting with program modifications.

Shown below is a screen shot of the PCLink application being run on a standard PC. The display indicates the collected SWR readings as a red line on the graph. The antenna system indicates a better (lower) SWR in the 21 MHz region of the spectrum. This data had just been uploaded from the Analyzer.

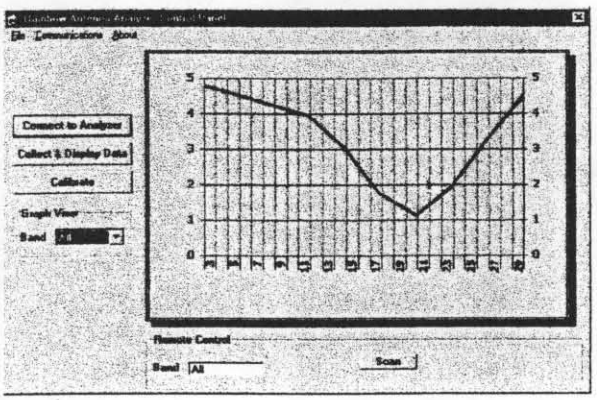
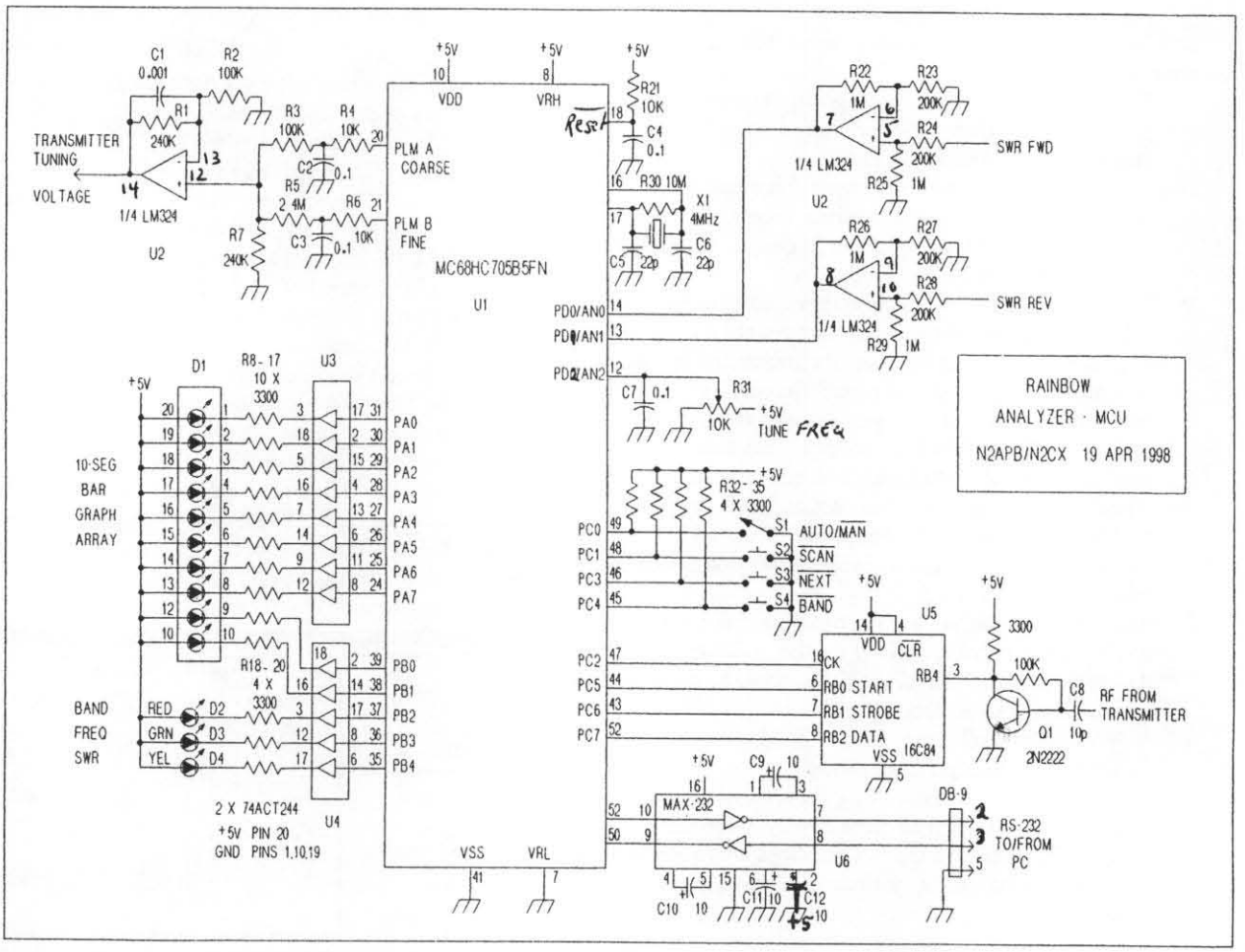


Figure 12: PCLink Screen Save

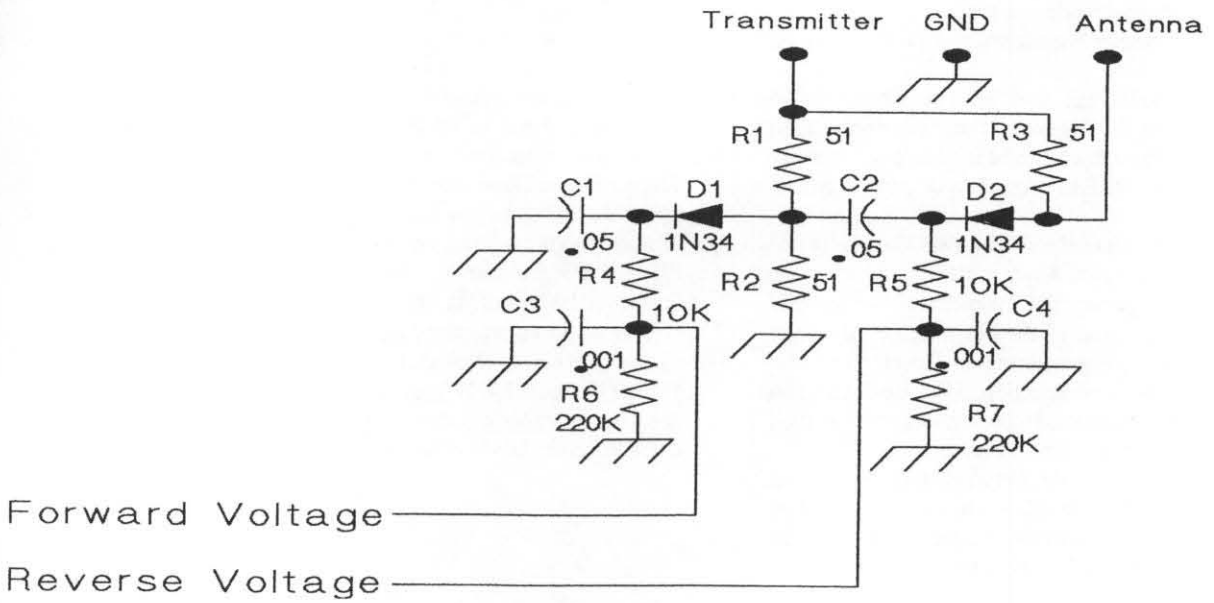
Notes

1) Many thanks are extended to Tim Ahrens, W5FN for providing assistance and special hardware used in the development of this 68HC705 microcontroller project.
2) Thanks also to Dave Benson, NN1G for thoughtful discussion in use of the PIC and signal buffering.
3) A much more complete version of this paper was presented at FDIM 1998 and can be can be found (including all software source code) online at the New Jersey QRP Club website: http://www.njqrp.org/mbrproj/analyzer.html
4) The authors can be reached at:
George Heron, N2APB (g.heron@dialogic.com),
Joe Everhart (n2cx@voicenet.com), and
Clark Fishman, WA2UNN (cfishman@pica.army.mil)

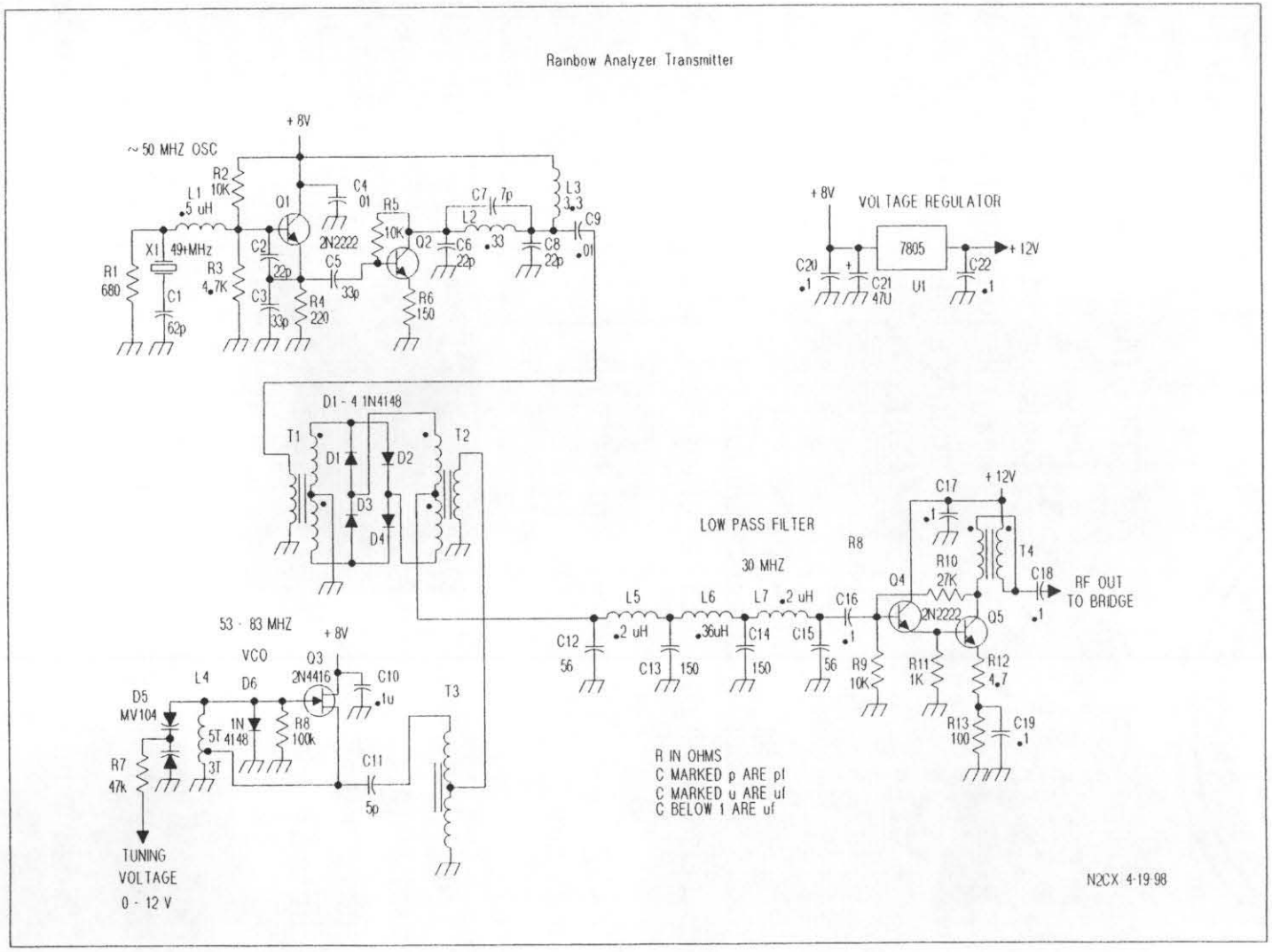
Rainbow Antenna Analyzer: MICROCONTROLLER MODULE



Rainbow Antenna Analyzer: SWR BRIDGE



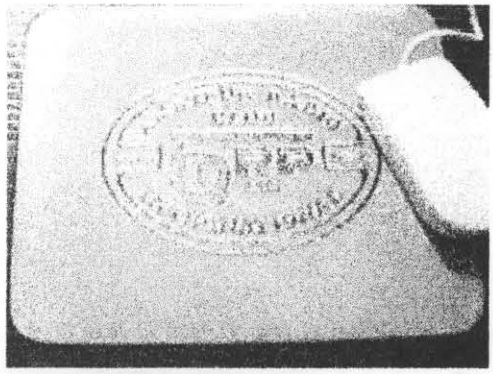
Rainbow Antenna Analyzer: TRANSMITTER MODULE



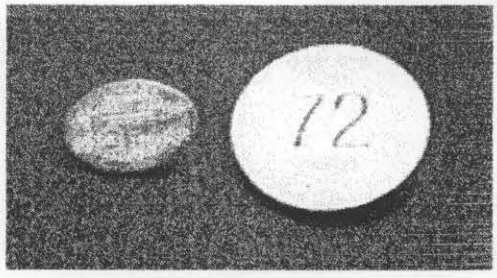
The QRP-ARCI Toy Store

The **Official** QRP-ARCI Coffee Mug. Used by the top QRP Fox Hunters, contesters and casual operators found near the normal QRP freqs. White on midnight blue, Logo on both sides. Coffee, tea or milk not included.

The QRP-ARCI mouse pad has been tested under rigorous conditions. Excels at high-speed clicking and browsing. Blue logo on champaigne background. Mouse and browsers not included.



The blue and brass metal pins have a tie-tac pin in the back



The white 72 pins say:
WISHING YOU
72
GOOD QRP

Coffee Mugs	$5 + $3 S&H	Blue Pins	$5 + $2 S&H
Mouse Pads	$5 + $2 S&H	"72" Pins	$1 + $1 S&H

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

Orders to:
QRP-ARCI Toy Store
1640 Henry
Port Huron, MI 48060-2523

Computer Control Korner

by George Heron, N2APB

#1 - Reading Frequency with the PIC Microcontroller

Welcome to what may become a regular *QRP Quarterly* column overviewing the technical aspects of using computers to control our QRP rigs and equipment. PCs and microcontrollers chips are becoming more and more popular as a way to inexpensively control even our simple rigs, test equipment and antenna systems ... we think many people will enjoy and benefit from such a regular section.

We envision a series of short articles discussing how to design in and program the simple embedded microcontrollers we have at our disposal these days (PICs, Intel 8051s, etc.), as well as specific interfaces for the ol' 286/386/486/Pentiums we have on our desktops. We'll overview different aspects each time, covering chip selection, hardware interfacing, software control and basic instruction for the programming of these ubiquitous devices.

Okay, so much for the overview of direction. Let's get down to business on a very popular and interesting topic these days ... "Just how do you measure frequency with the PIC microcontroller?"

The PIC Microcontroller & Frequency Measurement

There are several pretty cool kits available today using PICs to measure frequency: the N6KR-designed KC-1 and KC-2 from Wilderness Radio, and a new kit called Freq-Mite from NN1G, just to name a few. N2CX and I also employ one in our new Antenna Analyzer project introduced this year at the Dayton FDIM.

Each design uses a simple principle of counting the number of RF cycles occurring within a specific time window. Once you know how many cycles came along within 125ms (for example), all you need to do is multiply that number by 8 to get the direct hertz reading. (There are 8 such windows in a one second timeframe, thus cycles/second is the result.) There are a few tricks we can use with the PIC, however, which makes the original count a direct reading of the signal in kilohertz. Let's look closer at the PIC.

The PIC "Externals"

As you might imagine there are many functions able to be performed by a PIC, from basic input/output to pulse train generation. The particular characteristics we'll focus on will be those relating to the Port RB4 input pin, as shown below.

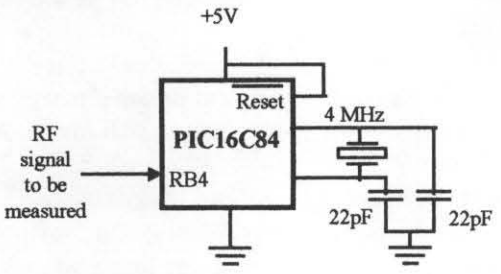


Figure 1: The PIC16C84

The RF signal to be measured is applied to input pin RB4, which has a special characteristic of providing an interrupt onboard the PIC whenever a high/low transition is detected. Thus, with no other circuitry (other than some signal conditioning like a simple transistor) an RF signal can be applied to the PIC and the rest of the frequency measurement algorithm happens in software!

The PIC "Internals"

There are some pretty fancy specialized functions provided inside the PIC microcontroller too. The one we need for our frequency measurement is an 8-bit counter with an 8-bit programmable prescaler, as shown below.

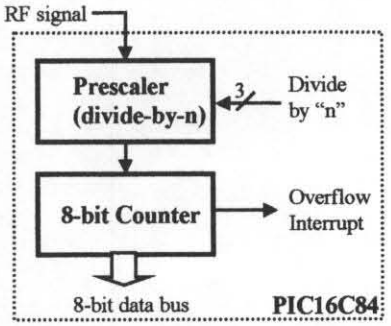


Figure 2: Prescaler & Counter Internals of the PIC

The shaped RF signal present on the RB4 PIC input is internally connected to a programmable prescaler which in turn clocks an 8-bit counter. When this counter overflows (i.e., when the count transitions from 255 to 0), an interrupt is generated and the software can use this event for a number of purposes.

In our case, we set the prescaler to divide by 128 and write a simple program to loop "doing nothing" for a period of 128ms. This is the time during which we will allow the counter to accumulate the number of cycles seen on the RF signal (divided by 128). At the end of the 128ms timing window the internal counter is disabled stopped and the counter can be read.

But there's a little problem: the accumulated count during the 128ms window will be greater than what the 8-bit counter can do. In order to count higher than 256, we use the overflow interrupt to signal the PIC software to increment another counter to keep track of the number of times we overflow. An "interrupt service routine" bumps a variable and returns to the 128ms timing loop. This "high byte counter" is used along with the resultant low byte counter from the PIC to extend the counting range of our system.

We chose the 128ms timing window for a specific reason. When the prescaler is set to divide-by-128, the number of counts accumulated in the 16-bit high+low byte counters is the direct numeric representation of the frequency in kilohertz.

For example, for a 30 MHz signal input to the PIC: 30,000 KHz / 128 prescale = 234,375 counts/sec = 234.375 counts/ms into the counters. Measure this over a 128ms window and you get 30,000 decimal or 7530 hexidecimal in the 16-bit counter. This 16-bit number can then be converted, displayed, or output via Morse code to the operator as an indicator of current frequency setting.

It's a Wrap

That's it for our first column! Please let us know if you'd like to see this continue, and what particular topics you'd like covered in future issues. In the meantime, keep your soldering iron warm ***and*** your assembler or compiler program running!

72,

--George, N2APB g.heron@dialogic.com

From the Membership Chairperson

Dave Johnson, WA4NID

EVERYONE PLEASE READ AND HEED!

I request that everyone refrain from contacting me or other members of the Board about delivery of the QRP Quarterly before the first of the month FOLLOWING the issue month, unless you have a SPECIFIC PROBLEM. It is best if you wait until after the first week of the following month, because sometimes delivery occurs quite late. There is a great variability in delivery date, mainly due to the nature of 3rd class mail from the U.S. Postal Service. For example, for the October issue, don't contact me about a missed issue until at least November 1 (preferably Nov. 7). The reason for this request is that I end up spending WAY too much time answering email about current subscriptions, when delivery eventually occurs through the normal route. And of course I DO want to hear about genuine problems so these can be fixed, but PLEASE be patient with the mail and be understanding about this situation.

Also note that for questions or problems regarding your subscription, contact ME. Other Board members are glad to help, but will often have to relay your message to me, resulting in delays in handling. Ken gets the renewal forms and checks, and mails the forms to me for entry to the database. Please direct questions about subscriptions to me, NOT to Ken.

ANOTHER REMINDER: renewals should be done with a copy of the form provided (this and every issue!), with **COMPLETE** and **LEGIBLE** information. **DON'T JUST SEND A CHECK IN AN ENVELOPE!** Send the form with payment to Ken, keeping in mind that to update your subscription record I must receive the forms from him before the first of the month PRIOR to the issue month. Don't delay renewals because you will be directed to secure back issues by purchasing them from Danny, if you missed any because of renewing late!

CLUB CALLSIGN QRP ARCI NUMBERS! Clubs can now obtain a QRP ARCI membership and receive a lifetime membership number. If a certificate is desired, then the usual $2 charge applies. This does not include a subscription to the QRP Quarterly.

This is not a major change in membership policy, only a way for club callsigns to be assigned a membership number to enable the calls to be used in QRP ARCI contests or other on-the-air activities, as a way of encouraging club QRP operation.

Applications for this should be made by a club trustee using one of our standard membership application forms, and clearly indicating that it is for a club call. Send to the Secretary, Ken, and he will get the data to me.

My email address is WA4NID@amsat.org, and my postal address is on the back cover, as usual. Thanks! Dave Johnson, QRP ARCI Membership Chair

GET YOUR ANNOUNCEMENTS ONTO THE QRP ARCI WEB SITE (www.qrparci.org)!

Just a reminder that I solicit material for inclusion on the web pages. If you have news related to QRP ARCI, or news relating to your local or regional radio club that may be of interest to QRP ARCI members, by all means send it to me! I especially like to post news of upcoming operating events. I just don't have the time to cull through printed sources and compose material myself, but am very happy to "get the word out" about events, plans, announcements or experiences related to QRP, using material submitted by YOU. Note that we have moved the site completely to www.qrparci.org, and that the RTPnet site is now a pointer to this new one. The RTPnet site will eventually be deleted, so "update your bookmarks"! Thanks.

Dave WA4NID, QRP ARCI web site manager. P.S., a big thanks to Jim W4QO with help in obtaining the new "custom" URL, and with producing a much-improved home page.

It is now official. I will be handling the GQRP accounts here in the US. Renewal and updates can come to me at:

Bill Kelsey - N8ET
3521 Spring Lake Dr.
Findlay, OH 45840
kanga@bright.net

419-423-4604 - machine will probably answer!
E-mail is the best way to get in touch with me.
I have a copy of the North American membership database so I should be able to answer inquiries on membership status.

Annual membership is $14. Checks can be made out to GQRP Club.

Do you want to write a Review?

by

Larry East, W1HUE

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 6/7, 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, PhotoCD, PCX or bitmap files). If you want your disks, drawings, etc., returned, please enclose an SASE with sufficient postage.

Remembering "The Good Old Days" of Amateur Radio

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

During the 1930's, most amateur radio equipment was "home-brewed" and this was a matter of pride to most of us. In those days, anyone who bought a factory-built transmitter was usually considered a "sissy." Since that was during the depths of the Great Depression, many of us had little cash to spend on our hobby. But anyone enthusiastic enough to pass the FCC exams could be a ham; lack of funds was no deterrent. Many of us had relatives who had indulged in the popular activity of home broadcast receiver construction. But this activity had, by 1930, largely become passé. Many of us inherited those useful left-over radio parts, and we also had buddies in our hobby with whom we could swap parts.

If we needed, say, a variable capacitor for our latest transmitter, we asked around. Almost always one of our friends had the part, unused, that we needed and would cheerfully "loan" it to us. Thus it often turned out that half the parts in my transmitter came from another ham's stock while half of his receiver was made from my parts. That's the way it was in those days. We didn't mind; in fact, we rather enjoyed such interaction. Money we didn't have, but we made-do anyway. We learned our code and theory the "hard way" – no tapes or snap-courses then *[no multiple choice questions on FCC exams, either! –W1HUE]* – and successfully braved that old ogre, the "RI" (FCC Radio Inspector) in his den.

Each Saturday morning, in our village, the household trash was carried to the street to be picked up by the trash-man. Bright and early those mornings we younger fellows tied our coaster-wagons to the back of our bikes and went cruising. We diligently looked for those Neutrodynes, Superheterodynes, Dynaplexes and other old radios that our neighbors were dumping and replacing with the new "midget" radios just coming into style. On a lucky morning, we might pick up two or three useful old sets. These were then brought home and completely dissected. Variable capacitors, coil forms, tube sockets, fixed capacitors, bakelite panels and even the "bus" wires were salvaged. Needless to say, such items soon were incorporated into our transmitters, receivers or whatever. (With intact old Neutrodynes, etc. now selling for hundreds of dollars at collector's auctions, one wonders what today's collectors would have thought of our escapades in those wild old days!)

But often we needed other parts in our ham gear. Where did we get them in those days? Well, my village was on the Chicago "El" system that ran right down to that dirty old radio parts Mecca of pre-W.W.II Chicago – South State Street. Hop on, and you were there! When I had managed to save a buck or two (usually from my school lunch money) and a Saturday morning came around, I would board the "El" for State Street down in wicked old Chicago.

Fortunately for us, our parents did not know what a sin-splattered environment South State was then! (Alas, not nice and clean, like Cortland Street, New York's radio district.) Lined-up on both sides, from Van Buren to Harrison Street, were raunchy old bars, filled with the social dregs of the city. Alongside those were "Burlesque" theaters openly exhibiting a fantastic array of lissome ladies. There were also dingy shooting galleries where junior-grade Capones viciously practiced their marksmanship. Yes, and there were Lord knows how many other examples of evil and corruption before our innocent young eyes. But avoiding those was no problem for us – all we wanted were radio parts!

Interspersed between and among those sordid scenes were the most fascinating junk radio stores as probably ever existed anywhere. Those fascinating but decrepit establishments sold highly ham-usable radio parts of every sort – and almost for a song! One could, for instance, buy dandy variable capacitors, just right for forty meter receivers or transmitters, for a quarter. Fixed mica capacitors were a nickel. Nice ribbed plastic plug-in coil forms went for a dime apiece, and usable five and six-prong tube sockets went for pennies. One could buy all of the parts necessary for a 350 Volt power supply (the "very nuts" for a push-pull type-45 tube CW transmitter or a hefty receiver) for a couple of bucks! Vernier dials cost about two bits apiece. There were, of course, legitimate radio supply stores in better neighborhoods that sold new parts at standard prices, but we couldn't afford them.

And who could forget those "penny tubes"? Removed from customer's radios as defective, many proved to be useful and sometimes were perfectly good! We would buy a dime's worth, take 'em home to our village's radio repair emporium and test them – much to the irritation of the shop's proprietor!. Out of a dime's worth of tubes, we'd often find four or five fit for ham-station use. (Have you priced any tubes lately?)

Amateur radio was both fun and cheap back then. A really good ham transmitter, 'phone or CW, used a type-10 tube with about fifty Watts input. As for output, that was "by guess and by golly'; most of us had no possible way of measuring it. If we had money, we didn't "waste" it on frills meters but bought a bigger tubes or power transformers. A common CW rig contained a pair of type-45 triodes in a "push-pull TNT oscillator" running about 15 W input and maybe, with a little luck, about 5W out. There were some well-heeled hams on 20 and 75-meter phone (AM, of course) who had exquisite equipment, often running hundreds of Watts, working the world. Occasionally we envied them, but we usually considered them as being "on another planet," as it were. But the financial investment in a typical, and effective, amateur station of that time probably did not exceed $100.

Fifty Watts DC input was all you needed then (and still is, if you know what you're are doing) to work about anything you could hear. With such a rig on 40 or 20 meter CW, European and Australian contacts were quite common. With 15W to a "pair of 45s", coast-to-coast contacts on 40 or 80 meters were the rule – with some DX if you were lucky. We used simple antennas: "Long wires", verticals and "Zepps". "Beams" were being experimented with by a few advanced thinkers but didn't come into general use until after W.W.II.

While bragging of any unusual accomplishments to one's peers is an ongoing normal human activity, there was not the bitter competition between us in the 'thirties that one finds today. Having built all of our gear "from scratch" striven to understand its principles, and kept it working ourselves, we were proud enough. There was a general feeling then that radio was something anyone could understand if they tried.

In those happy days, an Amateur Radio Club was a truly significant institution on our lives. It was a place to share our ham experiences and, with our 100% home-brew rigs, we always had plenty to share. We shared thoughts, parts and schematics. (How many hams today can even read a schematic, let alone draw one?) We listened to talks on theory from our fellow members and argued about radio principles, thereby educating each other. And sure, a ham-club meeting was a pleasant social event also. There was "pop" or coffee, and sometimes cake after adjournment. On occasion our ladies joined us afterwards also. The total mood there was both jovial and humane. (What's a typical ham club like now? You tell me...)

"The age of simplicity has passed," we're told. Maybe that is one of the reasons whey we "old buzzards" look upon the beautifully simple past years of our hobby with such unconcealed joy. Can you younger hams now begin to understand how we feel? If so, this story has done its job.

72/73, "Rock".

Edited by W1HUE

CONTESTS

Cam Hartford, N6GA

Results: Spring QSO Party
Results: Winter Fireside SSB Sprint
Announcing: Summer Homebrew Sprint
Summer Daze SSB Sprint, Fall QSO Party

UPCOMING EVENTS

Michigan July 4 Sprint	July 4
Summer Homebrew Sprint	July 12
Flight of the Bumble Bees	July 25
Summer Daze SSB Sprint	August 2
Colorado	August 23
BUBBA	September 5
Michigan Labor Day Sprint	September 7
ARS Power of One	September 13
QRP Afield	September 19
ARCI Fall QSO Party	October 17-18

1998 QRP ARCI SPRING QSO PARTY

What do K3AS, N3CZB, W3AAX, K8UCL, KØZK and WØPFR have in common? They are tough guys, gritty competitors, and they all use some sort of indoor antenna. When you think the going gets tough at times at your QTH, then think again about these guys running QRP on their attic dipoles and indoor loops. And add WB3GCK to the gang, he does it using a rainspout for his antenna. A gold star to you all for your QRP-style tenacity.

The Spring QSO Party landed on Easter weekend this year. The choice of dates wasn't the best, but moving it either direction on the calendar landed us in some pretty stiff contesting company. Most folk couldn't spend as much time as they wished, and as a result participation was down.

Propagation also took the weekend off, as many reported strange conditions. We will accept this odd behavior from the sun, knowing full well it is in the throes of a rebound from the bottom of its cycle, and the rebound is full of fits and starts.

Soapbox: Thanks to all who came to the party to initiate WQ2RP - WQ2RP; Did not operate very long but activity and bands were good - WA9PWP; A couple hours of rain static Saturday and 30 MPH winds Sunday put an end to contest activity. Caught VK9XE on 10M - W6ZH; Condx could be better, 10M open but nobody home - KØFRP; It took a while to snag 98 contacts from my QTH way down in the hills, but they were all fun - NA3V; Discovered Saturday morning that the G5RV was puny - spent rest of the day putting up the loop - whew! - AE4IC; Band condx were a little on the strange and noisy side - K5HQV; I chuckled when one fellow told me I had a good fist for having such an early QRP number. I felt really old...- N9AG; Crazy conditions. QRN on Lo bands. About half QSOs with solar panel - K3CHP; Great QSO party, lots of interest. Can not wait till next one - WA1QVM; I was surprised when a KH6 came back to me on 10 meters, and an F6 on 15 - WB3AAL; Good fun! - AD4ZE; Lots of nice QRP action! - K8CV; Great contest - good sportsmanship found everywhere! - K9OSC; My computer ate my 80M log! Ain't that a kick in the pants - KJ5MG; Bands seemed to be in good shape but lots of noise at my QTH. 15 meters very active - 10 meters was workable - KA1TQM; Condx were super! Found 10m wide open Saturday night, too bad only one station in California was on - N2VPK; The debut of KC8JIE. I am quite pleased with my first effort. Got my ARCI number (9646) the day after the contest. Sorry everyone - KC8JIE; Nice contest, good activity - AD3O; Lots of fun, but the Easter Bunny took over Sunday - N3IUT; Since it was snowing most of the day Sunday, a contest was the right thing to do!- N7CEE; Tough weekend to find time to operate, but great fun after dusting off keyer - WC1F; Great contest, even ran into some of the QRP-L gang - WA8RXI; First time with new Sierra. What a blast... work a bit, tinker a bit, work some more, do some mods, work some more, tinker some more. Great little rig - KI7MN; Messed around with my 20m verticals the whole contest. Started with 2 phased verticals, ended up with 1 vertical and 12 radials. Worked the whole West Coast with 2 watts, guessed the verticals worked OK - N4UY; Fun time, nice and casual - KE4W; Sure enjoyed the contest - too bad it was a holiday weekend - K3NVI; Thought conditions would be better on 80 - WA3SRE; My first contest. I was surprised how I got wrapped up in the momentum of the event. What fun! - WB5ZJN; Wish I could have found more than 2 hours to operate - K8DD; Pretty good turnout for Easter weekend. I had a great time again - KE4LIA; The band wasn't too good, fading in and out during an exchange - W8TIM; Second time to play in this game. FUN! Goofed around during spring cleaning breaks - WO4O; First contest since Novice Roundup 15 years ago, had a great time - KN4NO; Next year maybe I'll try a 10M only entry, those sunspot numbers are growing every day you know! - W5VBO; Hooray for 15 Meters! - WX7R.

1998 SPRING QSO PARTY

QTH	CALL	SCORE	PTS	S/P/Cs	PWR	BANDS	TIME	RIG	ANTENNA
AB	VE6ZAA	8,918	98	13	5	H-2	4	IC-725	VERTICAL
AK	AL7FS	22,379	139	23	4	A-3	4	TS-450S	YAGI, INV VEE @ 40'
AL	W4DEC	59,724	316	27	5	15M	6	TS-440S	YAGI @ 70'
	K4AGT	12,852	108	17	5	20M	3	OHR-100	DIPOLE
AR	W5ON	522,732	887	84	5	A-5	12	?	?
	KE4W	23,254	151	22	4	A-2	5	OHR QRP CLASSIC	YAGI
AZ	NQ7X	224,315	493	65	5	H-2	15	TS-850	YAGI @ 40'
	W5VBO	119,028	436	39	4.7	15M	9	ARGOSY II	YAGI @ 35'
	KI7MN	36,064	184	28	1.5	A-2	6	SIERRA	ROTATABLE DIPOLE @ 40'
	N7CEE	11,424	96	17	2	A-3	5	?	?
BC	VE7CQK	21,3885	485	62	5	A-6	17	?	?
CA	WE6W	376,320	640	84	5	A-4	23	?	?
	W6ZH	242,424	468	74	5	A-6	5.5	OMNI 6+	10-40 YAGIS, 80/160 VERT
	KN6YD	13,888	124	16	4	A-2	4	HW-7, HW-16, FT890	170' LW, 140' INV VEE
	K6FP	6,300	75	12	5	A-3	3.5	IC-706	INVERTED VEE
	nu6SN	966	46	3	1	40M	2	NC-40A	G5RV
	W6PRI	896	32	4	4	40M	1	?	?
CO	KØFRP	1,062,908	1309	116	5	A-5	20	TS-850S	80 2EL DELTA LOOP, 40 YAGI, TRIBANDER
	NØIBT	192,780	459	60	5	A-5	13	TS-870	DIPOLE
	K1EQA	48,755	199	35	5	A-3	5	ARGO 556	40 M DIPOLE @ 8'
	KIØII	26,880	160	24	5	A-5	5	OMNI V	WINDOM, ANTRON VERTICAL
CT	W1VT	418,446	738	81	4	A-5	19	HW-9	YAGI, DIPOLE, VERTICAL, LOOP
	KA1TQM	35,280	168	30	4	A-4	14	HW-9	DIPOLE, R7 VERTICAL
DE	K3AS	26,887	167	23	5	A-2	7.5	CENTURY 21	60' WIRE IN ATTIC
FL	N4BP	1,425,067	1603	127	5	A-5	22.5	FT-1000MP	YAGI @ 45', DIPOLES
GA	W4ED	735,357	1083	97	5	A-5	20	FT-840	80M LOOP, 40M VERT
HI	WB6FZH	22,022	143	22	5	A-3	4	CENTURY 21	HF6V VERT
IA	WØPFR	34,034	187	26	2	A-2	4	SIERRA	INDOOR MINI LOOP
IL	N9ZXL	183,456	468	56	4.5	A-4	18.5	IC 720	DIPOLE @ 30', YAGI @ 35'
	W9CUN	27,048	161	24	5	A-2	3	TT DELTA 580	GAP CHALLENGER
	NF9X	3,780	54	10	1.5	20M	1.5	TS 130V	VERTICAL
IN	K9PX	160,720	574	40	5	40M	8	TAC-1	80M LOOP
	KB9LGJ	3,990	57	10	2	20M	3	SST-20	HB VERTICAL
JP	JH3XCU	1,428	51	4	5	15M	1.5	QRP+	4 EL YAGI @ 40 METERS
KY	KE4LIA	50,225	287	25	2.5	40M	9	OHR EXPLORER II	DIPOLE
	K4AT	25,368	151	24	4	A-4	3	TS-870S	VERTICAL, KU3X LOADED DIPOLE
MA	WA1QVM	179,242	434	59	4	A-5	19	QRP+	G5RV
	K1GDH	36,750	150	35	3	A-4	4	HW-9	YAGI, G5RV
MD	K3CHP	255,360	570	64	5	A-5	24	QRP+, IC 735	YAGI, VERTICAL
	W3MWY	95,858	334	41	3	A-2	14	ARGO 556	?
	WC1F	3,220	46	10	5	A-3	3	IC 725	R4 VERTICAL
ME	KØZK	44,950	155	29	0.9	A-4	?	QRP+	20M INDOOR ATTIC DIPOLE
MI	K8CV	222,600	530	60	5	A-4	?	?	?
	WA8RXI	191,268	594	46	5	A-2	12	OHR CLASSIC	YAGI, DIPOLE
	KC8JIE	61,320	292	30	5	A-3	13	TRITON IV	40M INVERTED VEE
	K8DD	56,840	290	28	5	40M	2	?	?
	W8TIM	39,270	231	17	0.9	40M	7	NN1G SW-40	DIPOLE
	N8CQA	14,840	106	14	1	40M	3	?	?
	W8SFF	7,392	88	12	2	40M	3	SIERRA	?
MN	NØUR	966,120	996	97	0.95	A-5	14.5	?	?
MO	KØNI	124,600	356	50	5	A-3	4.5	TS-50	YAGI, G5RV
	KCØM	111,202	338	47	5	A-4	18	FT-900	G5RV
MS	K5HQV	344,890	758	65	5	A-5	?	FT-1000	140' DIPOLE
NB	VE9VIC	102,214	298	49	5	A-3	18.5	SB-104A	YAGI, 80 DIPOLE, 40 LOOP
NC	AE4IC	378,504	751	72	4	A-5	15	SIERRA	HORIZONTAL LOOP
	AD4ZE	272,272	572	68	4	A-4	8.5	TS-450	80' RANDOM WIRE
NJ	WQ2RP	64,484	327	28	5	L-2	5	TS-850	100' CF ZEPP
	W2JEK	36,456	186	28	3	A-4	3.5	FT-840	15,40 DIPOLE; 20 GP; 80 HERTZ
	K2JT	10,864	97	16	5	A-4	1	TS 50	80M DOUBLET
NY	W2QYA	15,480	86	18	0.9	A-4	9	HW-8	90M INVERTED VEE
	N2VPK	8,715	83	15	3.5	A-4	1	ARGO 556	BUTTERNUT VERTICAL

QTH	CALL	SCORE	PTS	S/P/Cs	PWR	BANDS	TIME	RIG	ANTENNA
OH	N9AG	270,970	553	70	5	A-5	5.5	?	?
	WBØIQK	95,718	318	43	4	A-4	16	ARGO 556	R7000 VERTICAL
	K8UCL	82,600	295	40	2	A-3	12	HW-8	ATTIC DIPOLE
	WB5ZJN	58,212	308	27	5	40M	10.5	OHR SPIRIT II	G5RV
	K8UPR	41,160	196	30	5	A-2	4	IC 756	WINDOM
OK	AB5UA	121,212	468	37	4	20M	8	OHR 400	YAGI @ 50', VERTICAL
	KJ5MG	93,632	304	44	4	A-4	15	HB XCVR	DIPOLE
OR	AA7QU	88,704	352	36	5	15M	4	?	TREE-MOUNTED STACKED YAGIS
	WX7R	85,701	371	33	5	15M	9	IC 735	VEE BEAM, YAGI
PA	W3TS	333,450	390	57	0.25	A-4	?	HB SUPERHET TCVR	80/40 INV VEE, YAGIS @ 52'
	WB3AAL	301,950	495	61	1	A-4	15.5	TS-450S	YAGI, VERTICAL
	NA3V	124,012	412	43	4	L-2	19	OHR 100, TS-570	HF-2V VERT
	W3AXX	74,880	288	26	0.8	40M	5	?	INDOOR ANTENNA
	AD3O	56,168	236	34	4	A-3	6	OMNI A	YAGI, DIPOLE
	W3DP	56,056	308	26	5	40M	?	OHR 100A	G5RV
	N3IUT	46,480	166	28	0.9	A-3	9	QRP+	YAGI
	WA3SRE	18,480	132	14	0.95	80M	7	ARGO 515	40M LOOP AS LW ON 80
	K3NVI	17,640	120	21	5	A-2	4	TS-130V	VERTICAL AND INV VEE
	WB3GCK	14,840	106	14	0.95	40M	4	SW-40	RAINSPOUT
	N3CZB	9,345	89	15	5	H-2	6	CENTURY 21, MFJ 9020	INDOOR HB LOOPS
	KX3X	4,025	175	23	90	A-2	5	TS-520	INVERTED VEE
	N2BSC	98	7	2	5	20M	3	NW8020	20M QUARTER WAVE VERTICAL
PAN	HP1AC	13,300	100	19	5	H-2	3	K9AY, K1BQT	YAGI
RI	WA1OFT	70,525	325	31	5	A-5	10.5	IC 706	250' CF ZEPP, VERTICAL
	K8ZFJ	49,742	209	34	5	A-3	10	IC 706	G5RV
	KW3U	45,269	223	29	5	A-4	5	IC 725	R5 VERTICAL, LONG WIRE
SC	K4NK	107,016	312	49	4	A-5	?	TS-440S	YAGI, DIPOLES
	KN4NO	20,160	144	20	5	20M	15	MFJ 9020	INVERTED VEE @ 25'
TN	WO4O	35,350	202	25	5	40M	2	TS-450S	40M DIPOLE @ 80'
TX	WA8GHZ	28,539	151	27	5	A-3	4	?	?
VA	K4JM	185,220	490	54	5	A-4	5	PARAGON	135' END FED, 20M DIPOLE
	K4GEL	97,580	410	34	4	A-3	6	HB TRANSCEIVER	QUAD, LOOPS
	N4UY	27,048	184	21	5	A-2	6	20M SST, 40M SCOUT	20M VERTICALS, 40M DIPOLE
	WD3P	5,060	46	11	0.7	20M	1	SIERRA	HB VERTICAL
WA	W7DRA	14	7	2	100	20M	1	GLOBE CHIEF, HRO 60	LONG WIRE
WI	W9MSE	234,171	567	59	5	A-4	6	TS-440S	VERTICAL, 80/40 DIPOLE
	K9OSC	166,208	448	53	5	A-4	6.5	IC 756	80/40 TRAP DIPOLE, 20M DIPOLE
	WA9PWP	25,200	150	24	5	H-2	2	IC 725	CAROLINA WINDOM 80
	AF9J	7,200	72	10	0.5	A-4	7	QRP+	90' RANDOM WIRE

TOP TEN

N4BP	1,425,067	W1VT	418,446
KØFRP	1,062,908	AE4IC	378,504
NØUR	966,120	WE6W	376,320
W4ED	735,357	K5HQV	344,890
W5ON	522,732	W3TS	333,450

SINGLE BAND

80M	WA3SRE	18,480	LO-BAND	NA3V	124,012
40M	K9PX	160,72	HI-BAND	NQ7X	224,315
20M	AB5UA	121,21			
15M	W5VBO	119,02			

TEAMS	FOUR CORNERS	N4BP, AE4IC, VE7CQK, AL7FS, W4ED	2,775,192

Adventure Radio Society announces new "POWER OF ONE" Contest

This is a four hour event during the second Sunday of September, running from 10:00 PDT/11:00 MDT/12:00 CDT/1:00 EDT to 2:00 PDT/3:00 MDT/4:00 CDT/5:00 EDT. Thus, the hours of operation accommodate all four time zones.

No matter where you live, there is time to for Oners who chose to reach their sites with human power to travel to their sites, set up their stations, operate the contest, and travel back to their cars.

Both home-based and portable operations are encouraged. Portable Oners must use human power to reach their sites (walking, biking or boating). The distance traveled to the site is at the Oner's discretion.

The power for all participants is one watt. We operate CW on 40, 20, 15 and 10 meters, on the standard QRP frequencies. We want this to be a national contest, so we encourage long-range contacts by giving double points for 20, 15 and 10 meters. 40 meter contacts will receive one point. The same station can be worked on different bands for additional QSO points and multipliers. The exchange is RST, state/province/country, and your status ("HB" for home-based and "PQ" for portable.

Separate but equal prizes are awarded to the home-based and portable winners.

Details of this and all other ARS events can be found on the Adventure Radio Society web page, http://www.natworld.com/ars.

1998 WINTER FIRESIDE SSB SPRINT

QTH	CALL	SCORE	PTS	S/P/C	PWR	BANDS	TIME	RIG	ANTENNA
PA	W3TS	32,090	31	26	500mW	A-5	3.5	HB TCVR, CLIP-LEAD	INV VEES, YAGI @ 52"
OH	N8ET	16,653	61	39	5	A-5	4	TR-7	MANY LARGE, TALL ARRAYS
FL	WU2J	7,080	16	13	1W	20M	2	HB TCVR, SPRAT 80 & 81	HB MINI BEAM @ 23'
PA	KM3D	6,078	14	11	8W	A-2	2	NORCAL CASCADE	YAGI @ 55', 75M HALFWAVE
VA	N7RI	5,049	7	1	3W	75M	0.08	HB CENTENNIAL TCVR	DIPOLE @ 40'
OR	AA7QU	4,900	35	20	5	20M	2	TS-870	STACKED YAGIS @ 50' AND 80'
AZ	NQ7X	4,032	32	18	5	H-2	2	TS 850	YAGI
TX	N5JWL	560	10	8	5	20M	0.75	ARGO 556	R-5 VERTICAL
KY	KA4FMD	252	6	6	5	40M	2	FT-840	G5RV @ 30'
VA	N4EUK	210	6	5	5	A-2	2	FT-840	100' LONG WIRE
GW	GW0VSW	210	6	5	10W	40M	1.5	IC 737	G5RV
AR	KE6DKH	210	6	5	5	H-2	1.5	TS-130V	40M DOUBLE ZEPP @ 30'
KY	N4HLU	175	5	5	4	20M	1	ARGO 515	LONGWIRE
MA	WA1QVM	175	5	5	4	A-2	4	QRP+	G5RV
ME	K1DRV	112	4	4	5	A-2	1	TS-520	DIPOLE
OH	WB0IQK	28	2	2	3	20M	0.5	ARGO 556	R7000 VERTICAL

This running of the Fireside SSb Sprint was the first test for our new format, in which we divided the operations into two time segments. The first time sefment favored the higher bands, while the second time segment favored the low bands. By shortening up the time slots and channeling people into fewer frequencies, it was my hope that we'd get more of the SSB gang together at the same time and same place.

Activity on the appointed day was much brisker than in previous SSB tests, but it appears many participants were shy about submitting logs. Be Brave! Send in those logs, however short they may be. Some of the folk in the above listing had as few as three contacts, but sent in the results anyway.

For the next SSB Sprint, I'm going to make two changes. The first will be to make 40 Meters available to both time slots. Thanks to Mike, W3TS for this suggestion. 40 can play both ways, and late in the afternoon is good for some medium distance hops that would otherwise be missed.

The second change has to do with the scoring. I deleted QSO Points as a multiplier last time, adding the operators Name to the exchange to make the exchange more personal. This brought the scores down by a fair magnitude from previous contests, but in doing so I neglected to reduce the bonus points available for Homebrew rigs. This gave the HB rig bonus a much greater significance. Hopefully this change will level out the playing field somewhat.

Soapbox: Ran out of stations to work on 20, so turned the beam east and worked several ZS6 stations - **N8ET**; Could have run another hour as there were many stations heard but pile-ups everywhere - **WU2J**; I really enjoyed the contest, but ended up ragchewing with most of my contacts - **KM3D**; After breaking into a round-table on 75, I worked furiously to finish receive circuitry on 40m 2n2222 rig. No luck by 9 PM - **N7RI**; Nice to exchange names and comments - **NQ7X**; High static levels made for less contacts - **N5JWL**; Surprised to make any contacts on 40m at that time of night. Didn't hear anyone call CQ on 80 meters - **KA4FMD**: Very bad QRN on 40 and 20 - **N4EUK**; Enjoyed my first ever contest, with SSB - GW0VSW; Enjoyed the contest, but too much QRM & QRN, too much Fire-In-The-Sky here - **KE6DKH/5**; Very much enjoyed the contacts and short chats on SSB - **N4HLU**.

1998 NOVICE/TECH+ SPRINT

QTH	CALL	SCORE	PTS	PWR	BANDS	RIG	ANTENNA
GA	W4ED	525	75	5	80, 40, 15	FT-840	80M LOOP, 40M VERT
AZ	N7CEE	70	10	2	40, 15	SIERRA	40M HORIZONTAL LOOP
VA	K3SS	70	10	5	80, 40, 15	FT-757GX	DIPOLE @ 35'
NJ	W2MBY	1,435	205	5	40	TS-850S	VERTICAL 40M LOOP
CT	W1KKF	700	100	5	80, 40, 15	TS-850	G5RV @ 70'

The first outing of our Novice/Tech+ Sprint turned out to be a very slow affair. We'll try again next year, hoping to get the word out to more N/T+ types. Our congratulations to John, W2MBY/T, who ran off with the best score.

Soapbox: If only the N/T+ ops knew how open 15 Meters was gonna be - **W4ED**; Conditions seemed to be poor with lots of QRN. I could occasionally hear stations in the contest way down in the noise. I did have several enjoyable general QSOs as a result of my contest CQs! - **N7CEE**; Listened on 15, 40 and 80 but only worked one station on 40. Hope for more activity next year - **K3SS**;

FALL QSO PARTY

Date/Time:
Oct. 17, 1998, 1200Z through Oct. 18, 2400Z. Work a maximum of 24 hours of the 36 hour period. CW only.
Exchange:
Member - RST, State/Province/Country, ARCI Number
Non-Member - RST, State/Province/Country, Power Out
QSO Points:
Member = 5 Points
Non-Member, Different Continent = 4 Points
Non-Member, Same Continent = 2 Points
Multiplier:
SPC (State/Province/Country) total for all bands.
The same station may be worked on more than one band for QSO points and SPC credit.
Power Multiplier:
0 - 250 MW = X 15; 250 MW - 1 Watt = X 10
1 W - 5 W = X 7; Over 5 W = X 1.
Suggested Frequencies:

	GENERAL	NOVICE
160 Meters	1810 KHz	
80 Meters	3560 KHz	3710 KHz
40 Meters	7040 KHz	7110 KHz
20 Meter	14060 KHz	
15 Meters	21060 KHz	21110 KHz
10 Meters	28060 KHz	28110 KHz
6 Meters	50128 KHz	

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

Team Competition: Competition between teams consisting of 2 to 5 members will be a separate category apart from individual entries. Team members will be listed as individuals and the team score will be the total of the members' scores. The team captain must send a list of team members to the contest manager postmarked at least one day prior to the QSO Party.

Multi-Op Class: Submit list of operators and number of transmitters in simultaneous operation.

Portable Operation: Submit information on location of operation, list of operators and number of transmitters in simultaneous operation.

Entry may be an All-Band, Single Band, Hi-Band (20M, 15M, 10M and 6M) or Lo-Band (160M, 80M and 40M). Certificates to the top 10 scores, to the top score in each Single-band, Lo-band and Hi-band class, and to the top score in each class in each SPC. The contest manager reserves the right to recognize special significant entries with a certificate award.

Entry includes a copy of the logs and a separate summary sheet. Include duplicate check sheets with entries of 100 QSOs or more. Indicate total time-on-the-air, and include a legible name, call, QRP ARCI Number (if any) and address.

All entries must be received within 30 days of the contest date. Late entries will be counted as check logs. Members and non-members indicate their output power for each band. The highest power used will determine the power multiplier. Output power is considered as 1/2 of input power.

Include a description of homebrew equipment, commercial equipment, and antennas used with each entry.

Send an SASE for a summary and sample log sheets. Include an SASE with your entry for a copy of the results. Results will be published in the next available issue of the QRP ARCI Quarterly.

The final decision on all maters concerning the contests rests with the contest manager.

Entries are welcome via E-Mail to CamQRP@cyberg8t.com, or by mail to:

Cam Hartford, N6GA
1959 Bridgeport Ave.
Claremont, CA 91711

SUMMER DAZE SSB SPRINT

Date/Time:
January 11, 1998; Hi Bands - 1900 to 2100 UTC; (40, 20, 15 and 10 Meters)
Lo Bands - 7 PM to 9 PM Local Time. (160, 80 and 40 Meters). Operation is permitted on 40 Meters in both time slots.
Exchange: RS, State/Province/Country, Name
QSO Points: All QSOs are worth one QSO point
Multiplier: SPC (State/Province/Country) total for all bands.
S/P/Cs may be worked on more than one band for credit.
Bonus Points: Points awarded for using Homebrew equipment,apply for each band on which Homebrew equipment was used:
+500 HB Transmitter used
+500 HB Receiver used
+1,000 HB Transceiver used
Homebrew Definition: If you built it, it is considered Homebrew.
Power Multiplier: (Power Output)
< 250 mW (< 500 mW PEP SSB) = X 15; 250 mW - 1 Watt (500 mW - 2 W PEP SSB) = X 10; 1 W - 5 W (2 - 10 Watts PEP SSB) = X 7; Over 5 W (Over 10 Watts PEP SSB) = X 1.
Suggested Frequencies:

	GENERAL		
160 Meters	1860 KHz	15 Meters	21385 KHz
80 Meters	3865 KHz	10 Meters	28385 KHz
40 Meters	7285 KHz	6 Meters	50128 KHz
20 Meter	14285 KHz		

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

Entry may be an All-Band, Single Band, Hi-Band (20M, 15M, 10M and 6M) or Lo-Band (160M, 80M and 40M). Certificates to the top three scores, to the top score in each Single-band, Lo-band and Hi-band class, and to the top score in each SPC. The contest manager reserves the right to recognize special significant entries with a certificate award.

Entry includes a copy of the logs and a separate summary sheet. Include duplicate check sheets with entries of 100 QSOs or more. Indicate total time-on-the-air, and include a legible name, call, QRP ARCI Number (if any) and address.

All entries must be received within 30 days of the contest date. Late entries will be counted as check logs. Members and non-members indicate their output power for each band. The highest power used will determine the power multiplier. Output power is considered as 1/2 of input power.

Include a description of homebrew equipment, commercial equipment, and antennas used with each entry. Homebrew bonus points may not be claimed if a description is not included with the entry.

Send an SASE for a summary and sample log sheets. Include an SASE with your entry for a copy of the results. Results will be published in the next available issue of the QRP ARCI Quarterly.

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

Entries are welcome via E-Mail to CamQRP@cyberg8t.com, or by mail to:

Cam Hartford, N6GA
1959 Bridgeport Ave.
Claremont, CA 91711

1998 SUMMER HOMEBREW SPRINT

Date/Time:
July 12, 1998; 2000 - 2400 Z. CW only.
Exchange: Member - RST, State/Province/Country, ARCI Number
Non-Member - RST, State/Province/Country, Power Out
QSO Points: Member = 5 Points; Non-Member, Different Continent = 4 Points; Non-Member, Same Continent = 2 Points
Multiplier: SPC (State/Province/Country) total for all bands.
S/P/Cs may be worked on more than one band for credit.

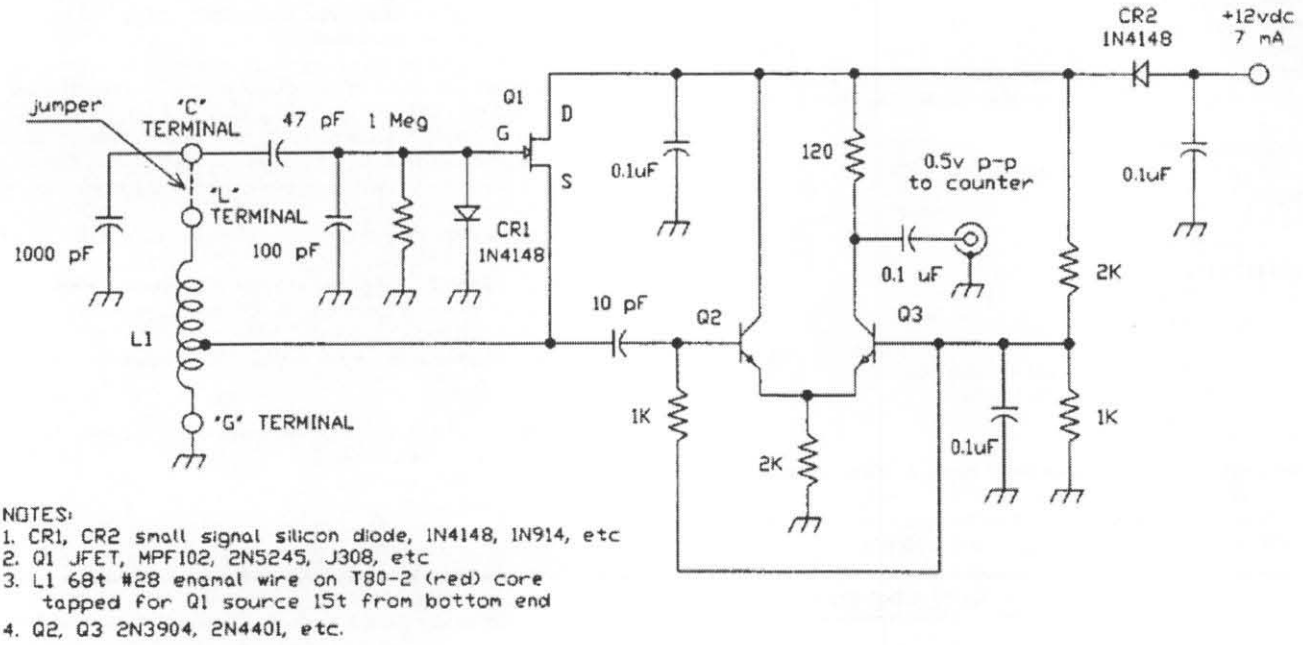
Bonus Points: Points awarded for using Homebrew equipment,apply for each band on which Homebrew equipment was used: +2,000 HB Transmitter used; +3,000 HB Receiver used; +5,000 HB Transceiver used
Homebrew Definition: If you built it, it is considered Homebrew.
Power Multiplier: (Power Output)
0 - 250 MW = X 15; 250 MW - 1 Watt = X 10;
1 W - 5 W = X 7; Over 5 W = X 1.

For complete rules, see the April 1998 issue of the QRP Quarterly, page 79.

Errata

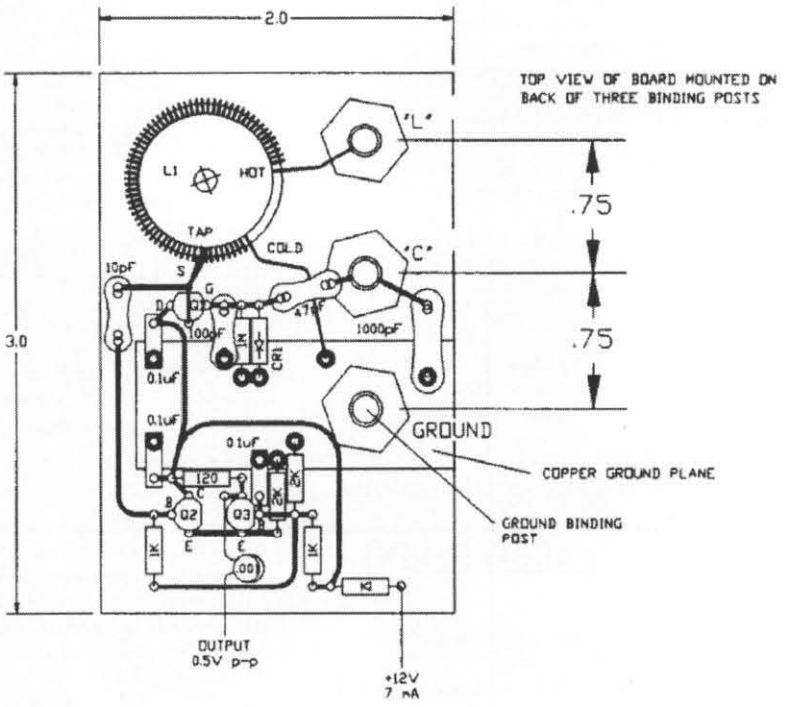
Two figures were inadvertently left out of Bill Carver's article "Measuring Capacitors and Inductors" that appeared in the January 1998 issue of the **QRP Quarterly** (page 37). The missing figures are shown below.

FIGURE 1 : SCHEMATIC



NOTES:
1. CR1, CR2 small signal silicon diode, 1N4148, 1N914, etc
2. Q1 JFET, MPF102, 2N5245, J308, etc
3. L1 68t #28 enamel wire on T80-2 (red) core
   tapped for Q1 source 15t from bottom end
4. Q2, Q3 2N3904, 2N4401, etc.

FIGURE 2 : PART LAYOUT



W7AAZ - 5/13/97

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.

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(With thanks to **L.B. Cebik** for all his help)

de **Ron, KU7Y**

New Member / Renewal Application Form

Full Name:_____ **Call**_____ **QRP ARCI #** _____

Mailing Address _____

City _____ **State / Country** _____ **Zip+4 Code** _____

(Please use your full 9 digit zip code)

New Address? **(List ALL old calls)** _____ **New Membership or Renewal?** _____

Packet Radio Address _____ **E-Mail Address** _____

Home Phone Number ( ) _____ **Work Phone Number ( )** _____

USA $15	CANADA $18	DX $20

Change of Address, and membership status questions go to:
Dave Johnson, WA4NID 2522 Alpine Rd, Durham, NC 27707

Mail completed application to either:

Check or Money Order in U.S. Funds

Make checks payable to: "QRP-ARCI"
All applications MUST BE RECEIVED at least 30 days prior to the cover date to receive that issue.

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848 Valbrook Court
Lilburn, GA 30047

For a Club Information Pack, write to:
G. Danny Gingell, K3TKS
3052 Fairland Road
Silver Spring, MD 20904
K3TKS@abs.net

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