Ready for new radio thrills and excitement?
You're ready for . . .

QRP NOW!

By Dave Ingram, K4TWJ

Full Details On:

- What's happening in QRP today
- Clubs & On-The-Air Activities
- Secrets to QRP success
- New rigs, kits, and accessories
- Easy brew QRP circuits
- Simple "big signal" antennas
- Clever power supply ideas

QRP *NOW!*

By Dave Ingram, K4TWJ

PREFACE

This book is dedicated to all casual, serious, aspiring, and hopelessly addicted QRPers past, present, and future. As such, it contains a wealth of up-to-date information on all aspects of QRP — from friendly getting started guidance and proven successful operating tips to close-up details of new rigs, accessories and easy-brew antennas. Check our Table of Contents and related topics to get the full impact of that statement. We "cover the whole field" in high style! A large number of QRPers also enjoy building kits and homebrewing miniature projects (one never has too much QRP gear!), so hot new items in both categories are featured in respective chapters. We aim to please — everyone!

Why has QRP become so incredibly popular today, you ask? Because it blends with every lifestyle, situation, limitation, and budget. It is the perfect answer to amateur radio enjoyment in confined quarters, and its ultralight nature is ideal for "personal portable" or "unique mobile" operations of all types. It is affordable, technically understandable, and just plain fun! QRP is also a world of its own, filled with pocket-size rigs, clubs, operating awards, on-the-air activities, and more — all of which are detailed on our following pages. QRP is red hot and cookin! Come on it with us and join the fun!

Preparing a book of this magnitude and timeliness was a very extensive (yet exciting!) venture, and I would like to thank several groups, companies, and individuals for their assistance. Our thanks to Doug Hendricks/and NorCal, Danny Gingell/K3TKS and QRP ARCI, Steve Bornstein/K8IDN and CQrp, and Dan Tayloe/N7VE of the ScQRPion Club. Thanks, also, to Ten-Tec, SGC, Index Labs, MFJ, LDG, Paddlette, and Hamco, Wilderness Radio, HB Electronics, Embedded Research, G4ZPY keys, Ne Kes, FAR Circuits, the American Radio QRP Key Mfg. Co., and other friends recognized along with their goodies featured herein.

Finally, a very special and most deserved thanks go to my XYL Sandy, WB4OEE, for design, layout, and overall production of this book's contents: A mammoth task. Special thanks, also, to Tina Whitenite for word processing and typesetting our text (a major task!). Considering my handwriting and note juggling, she was a magician. All of our efforts will be rewarded when you are inspired by this book's contents and join on-the-air QRP action. I will look forward to QSOing you two-way QRP style soon!

72 and 73,

Dave Ingram, K4TWJ
4941 Scenic View Drive
Birmingham, AL 35210

P.S. Check out our array of discount coupons in the back and save $$$ gearing up for QRP!

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CHAPTER 1

THE WIDE WORLD OF QRP

Amateur Radio is graced with many areas of special appeal and interest, but few of them offer the unlimited (and affordable!) thrills and excitement of QRP. Indeed, it is today's hottest and most rapidly growing pursuit among amateurs of all license classes -- and its popularity is spreading like wildfire. Why so? Simply stated, QRP and low profile hamming blend perfectly with our modern times. QRP gives us newfound freedom and flexibility to set up a small yet quite effective station almost anywhere, its low cost blends with "downsized wallets," and spanning long distances with low power is a treat beyond description!

Times are changing and, with the

Figure 1-1 Welcome to the wide world of QRP! It is a unique area filled with neat low power rigs, kits, projects, all bonded together with newsletters and clubs worldwide. Truly, it is lighthearted and affordable hamming at its best!

exception of all-out contesting and DXing setups, QRP may well be the wave of the future. It is the ideal solution for apartment and condo dwellers facing "big antenna" and TVI restrictions, it is great for outdoor hamming, and dandy for weekend jaunts or mini-vacations. You can set up a really neat QRP rig for less than 200 dollars, or put together a QRP dream station complete with all the trimmings for less than the cost of a basic/plain 100 watt station. Why settle for being just another little fish in a big pond when you can be a kingfish in the world of QRP! Ah, but even this quick-peek preview only scratches the surface of QRP's vast attractions and assets: It is a complete world of its own within amateur radio! It is filled with clubs, newsletters, awards, on-the-air activities, rigs, kits, and projects of all types (Figure 1-1). Yes, and more developments, gear, and even QRP keys are evolving daily (Figure 1-2). QRP is flourishing like never before, it is an absolute blast of fun, and this is your personal invitation to come on in with us and join the excitement!

What is QRP?

If you are a newcomer to amateur radio, you are probably asking what exactly is QRP and what are its special attractions. Simply explained, QRP is pursuing communications with others while using only five watts or less of power. This lower power level and less stringent aire let us use smaller and less expensive rigs, invisible antennas, and even small talkie-type battery packs for

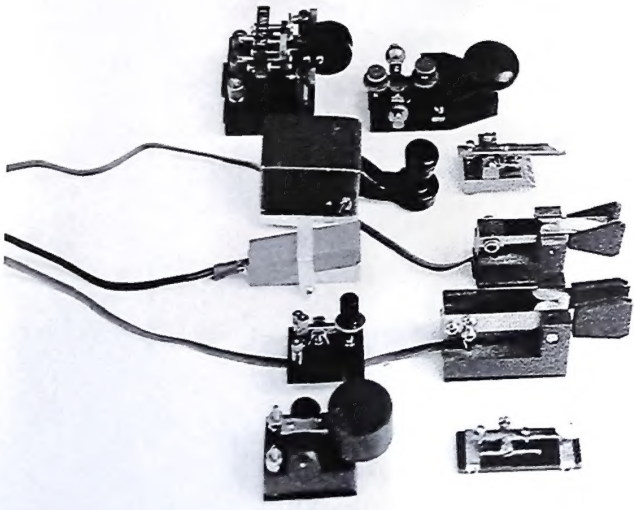


Figure 1-2 Collecting and using miniature keys makes operating CW QRP a special treat, and the variety of "tiny tappers" is endless.

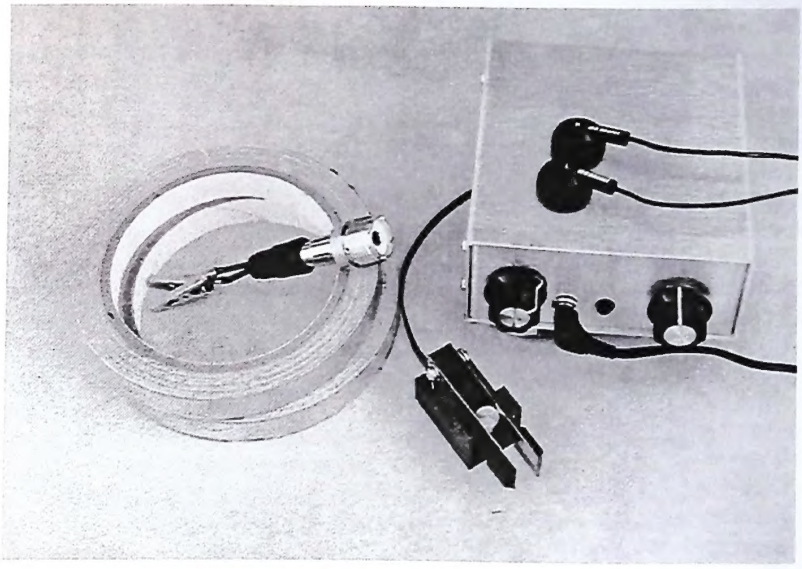


Figure 1-3 This tiny SST transceiver, miniature Paddlette and "stick anywhere" Tape Tenna setup was used to work over 30 countries in one month on 20 meters, and it is still going strong!

power supplies. (See Figure 1-3).

Some operators use QRP exclusively, some only work QRP occasionally, and all of them have a ball using neat little rigs of all types (Figure 1-4 and 1-5). QRPers are also some of the most friendly and congenial folks in amateur radio today. They are enthusiastic, helpful, and very sharp operators able to copy weak signals with amazing accuracy. In many respects, we could thus conclude QRP is more than a mode or an interest within amateur radio: it is a conviction–a lifestyle, or even an informal cult of amateurs dedicated to proving "the operator rather than the rig makes the difference!"

Speaking of modes and interests, incidentally, I should point out that today's QRP activities extend far beyond traditional CW operations around the well-known 7,040 KHz "gathering spot" on 40 meters. Indeed, 30 meters and the 14,050 to 14,060 KHz range of 20 meters is alive with QRP action almost continuously. Hit either band while running two to five watts, and you will start making QRP contacts almost immediately!

Additionally, QRP SSB activities on 20, 17, 12, and 10 meters are growing at a phenomenal rate. Some operators use recently introduced kit transceivers, some use QRP PLUS transceivers produced by Index Labs (until early '97), and some use classic Heathkits or "QRP-type" Ten-Tec Scouts. VHF/UHF FMers are also joining QRP action with new style microminiature talkies (!!). Simultaneously miliwatting and microwatting are also rising in

Figure 1-4 Doug Hauff, KE6RIE, has the world in his hand with this custom-cased 38Special transceiver that goes camping with Doug and works DX like crazy. *Photo via KE6RIE.*

Figure 1-5 Home setup of AB5UA packs maximum enjoyment in minimum space with a trio of Oak Hills kit transceivers and a classic HW-8. *Photo by AB5UA.*

popularity and folks are continuously dreaming up unique rigs and unusual enclosures for this pursuit (Figure 1-6 and 1-7). We have seen transceivers in everything from coke cans to teddy bears!

Do QRPers Really Have More Fun?

Is the fun and excitement of working with low power and small rigs really as captivating as author Dave suggests, you ask? Consider the facts, then judge for yourself, I say. Traditionally, interest in both HF hamming and QRP has directly coincided with 11 year sunspot counts: The higher the number, the greater the interest and activity. Even at the bottom of sunspot cycle 21 during 1996 and 1997, however, interest in QRP boomed like never before. Major manufacturers of "big rigs" were exasperated over declining sales yet at the same time (and often the same city or state), producers of QRP gear were "snowed under" and backlogged with orders. They could not pump out QRP goodies fast enough to meet demands! Some old pros were saying that homebrewing was a lost art and band conditions were poor for DXing while simultaneously QRPers were building kit transceivers and accessories in record numbers and "working out" like crazy – on assumed dead bands, no less! Like many of my friends, I worked stations from Mauritius Island in the Indian Ocean to Japan and Australia while using a little 4 watt transceiver. Many times, I ran a string of 30 minute to one hour QSOs "back to back" as folks called out of curiosity or simply for the novelty of working a QRP station. If QRP is doing this good during the "down times,"

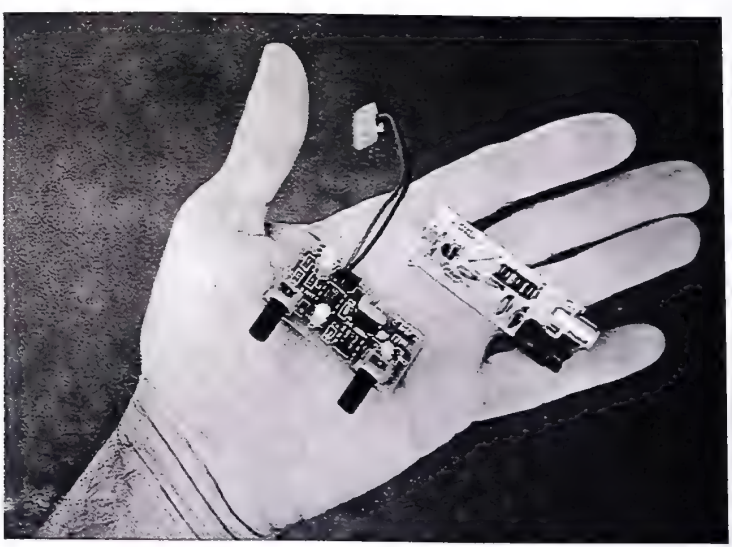


Figure 1-6 This complete HF transmitter and receiver combo for milliwatting and microwatting fit in the palm of your hand! "Micronaut twins" really work, and their full story is in Chapter 5.

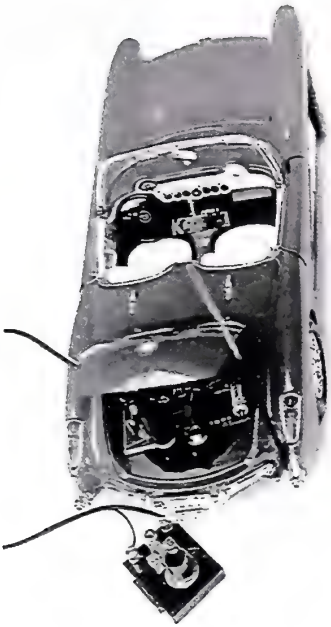


Figure 1-7 K4TWJ's "QRP mobile 'Vette." Small scale model sports car is complete with a one watt transceiver in the trunk, and it really works!

imagine how hot it will be during the "better years" straight ahead!

A Homebrewer's Haven

If you like "being the first kid on the block with a new toy," homebrewing and saving money, you will go bonkers over QRP (Figure 1-8). A fascinating variety of receiver, transmitter and transceiver kits (plus accessories!) are introduced almost continuously by individuals, clubs and commercial manufacturers, and they are all irresistibly tantalizing. Some club-produced kits are sold "bare bones style" at unbelievably low cost, and they are ideal building blocks for personal expansions and customizing. Rigs using variactor-type tuning rather than a variable capacitor-tuned VFO for frequency selection are one example of that fact. By integrating a twenty cent diode with a sixty cent inductor plus a crystal, a respectable operating range is achieved. Using a potentiometer to vary voltage applied to a diode or varicap also yields new flexibilities in panel layouts, and even supports "remoting" the front panel for only pennies! Further, we can add a switch and a second (or third or

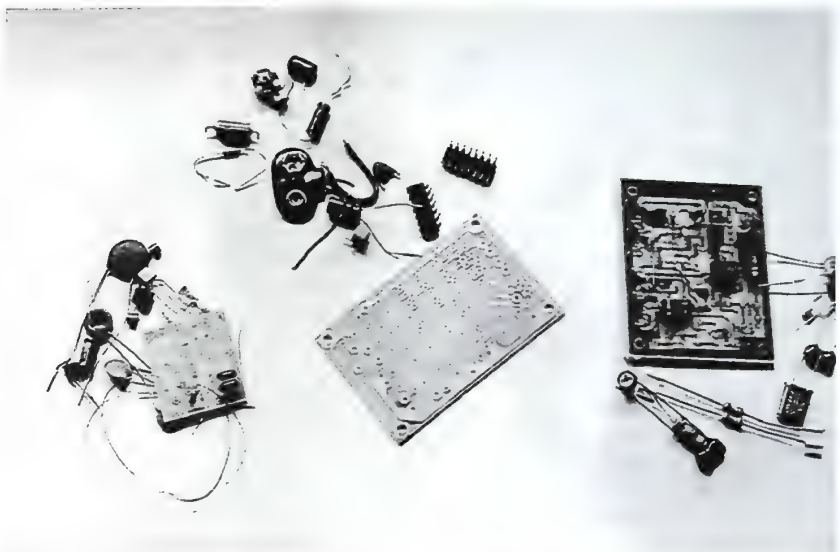


Figure 1-8 Quick-assembling QRP mini-kits is like eating potato chips: It is difficult to stop with just one! Items shown include one-watt transmitter, 250 mw transmitter, and 500 mw transceiver kits ready to build.

fourth) pot for dual, triple or quadruple VFOs! Replace the switch with a diode or logic gate, and we have a split VFO operation. Additional expansions are limited only by one's creativity and available time. How do you learn about presently-available kits? Joining a couple of clubs with large quarterly newsletters (like QRP International and NorCal) will keep you informed on non-commercial goodies. Also check my monthly "World of Ideas" column in CQ magazine. Professionally produced kits are advertised regularly in CQ, QST, 73 and WorldRadio. Amateur radio magazines from other countries like England's RAD COM and Australia's Amateur Radio Action also carry ads and news of kits from their areas -- and many are real heartthrobs. A word of forewarning however: homebrewing QRP goodies can become addictive! Allocate time between construction projects to use them on-the-air and enjoy the fruits of your labor. Additional late breaking news and views on kits and other homebrew goodies are presented in upcoming chapters.

The Magic of QRP

Some amateurs may assume that operating QRP represents an untold magic, and they expect to achieve results comparable to (or better than!) those obtained when using a 100 watt rig and a good antenna. Well, friends, that simply is not the case! The magic of QRP is successfully communicating with low power, a small rig, and an excellent antenna - all complimented by sharp

operating skills. Every QSO holds special significance rather than simply being another entry in the log. Every QSO is also a proud achievement often measured on a miles-per-watt basis -- and the most notable ones are recognized with the QRP International Club's esteemed 1000 Miles per Watt Award (Figure 1-9). QRPers are on the air almost every hour of the day or night, but you must listen closely--often a couple of layers below normal signal levels--to find them (a "mini world down under!"). Not all weak signals are QRPers, however (although good CW proficiency often helps them stand out from the crowd!). Many amateurs use 100 watt transceivers and pump 90 percent of their power into an ineffective or poorly maintained antenna. The magic of QRP thus equates to achieving big-time results with efficiently-used low power.

Putting Power in Perspective

Some folks say running high power ensures solid communications (really?), some say running QRP is a "sport pursuit," and others say a good operator can work anything with five watts anyone can work with 100 watts. What is the unbiased "inside story," you ask? Let's call up some technical standards for reference, and I will explain a simple way to apply them "hands-on style" with an existing receiver or transceiver. Then you can see the actual facts in real-life practice and draw your own conclusions.

First, electronic reference books tell us every 3db change is approximately

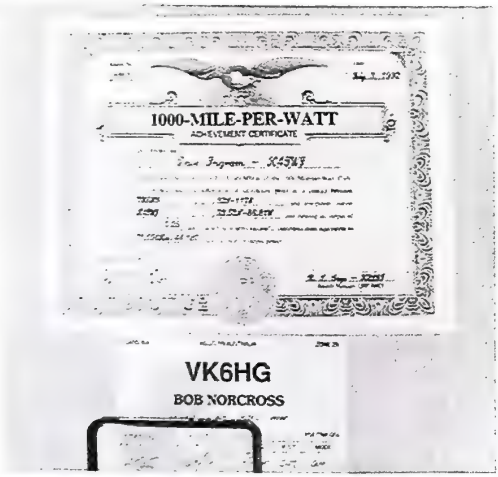


Figure 1-9 Yes friends, you really can span the globe with QRPp! Shown here is the QSL and award documenting our QSO with VK6HG in Western Australia while running only 250 milliwatts of power. As shown on certificate, contact equates to 44,180 Miles-Per-Watt communication.

equivalent to doubling or halving a previous power level. Also, 100 watts increased 10db becomes 1000 watts and/or 100 watts decreased 10db becomes 10 watts. We can quick-check those facts as such: 10 watts increased 10db is 20 watts; increased 20 more db is (20 doubled) 40 watts; increased 10 more db (40 doubled) is 80 watts, and one more db (an approximate third of 80 watts) is approximately 100 watts. Okay, so I "rounded" 3db slightly. The difference is miniscule and "3" is easy to remember. Let's continue. Now check the "attenuator" feature listed in your deluxe home rig's operating manual: some attentuators are 10db, some are 20db, and some are 10/20db-selectable. Next, tune in an average strength signal like you usually copy off-the-air. The signal will probably be in the 100 watt range and read S-7 to 10db over S9. Switch in 10db attenuation and increase the audio gain slightly: You have just "QRPed" the signal. Can you still copy the tuned-in station? Did the S meter level drop as much as expected (surprise!). Note the "QRPed" level (which will probably be between S5 and S8). Switch out the attenuator, then tune in other stations on the band and notice how easy you can copy signals in the S5-S8/"QRPed" level. That is approximately how strong your QRP signal will sound to other stations. Not a drastic drop, eh?

Here's another idea: Tune in a one minute transmission from one of the 10 NCDXF beacon transmitters located in various areas of the world (14,100 MHz). Each beacon's one minute transmission consists of an ID followed by 10 second key down carriers at the 100, 10, 1 and .1 watt/100 milliwatt levels. The beacon then returns to 100 watts, IDs, and the next beacon station follows suit. Notice the S level/readability difference between 100 watts and 10 watts--between 10 watts and one watt-between 100 watts and one watt. Many times, even the 100mw level is quite readable. You must admit our two previous examples put power in perspective--and proved to be real eye openers!

True Tales of QRP Success

While writing this chapter, I took a break to relax and chat with XYL, Sandy, WB4OEE, plus bird sit our parrot, Paco, in the den. It is presently 9 p.m. in the evening, I have an earbud 'phone in one ear, and am also tuning 30 meters with a little 4 watt rig on a sidetable. The band sounds quiet and unstable (has it already "closed" for the evening?). Rising above the background noise comes EL2JR in Liberia. He is working a constant string of stations in New England and the midwest. All signals are weak--maybe S2 or S3. I listen to the last station working EL2JR, fine tune to his frequency, then pump out a short and fast call at the next "QRZ." No luck. The next "QRZ," I try again. Still no luck. Drats! Keep this up and I will become "background noise" like many other callers hoping for blind luck to favor them. I listen closer and quick study "who's getting through and why." Another fine frequency shift, another "faster than EL2JR is sending" call, and Bingo! He is returning with "K4TWJ/QRP 459 BK!" As I reply, I look over at my rig: It is small enough to hide in one hand, and its power supply is a wall adapter! Listen again, Dave. Is this really happening? Yes indeed--the chap is now sending "Tnx Dave. Good QRP, QSL via KB3U, 73." Whew! What an adrenalin high! May all our friends, fans, and readers

experience similar QRP thrills and excitement in their own endeavors! My antenna? A full wave Delta Loop mounted only 30 feet above ground to (hopefully) avoid being destroyed by high winds and tornadoes common to our area. The antenna is made of thin hook-up wire with black plastic insulation. You can look right at the antenna and not see it.

Backing up a few months, I remember one Sunday morning when the telephone rang quite early. On the other end was a very excited Fran, KA3WTF. He had just made contact with Paul, AA4XX approximately 400 miles away while running less than 500 microwatts of power on 40 meters. Read that sentence again, friend. Five hundred microwatts is one-half a milliwatt--and one milliwatt is one-thousandth of one watt! A little QRP truly goes a long way! No exotic equipment was utilized at "either end." Both operators used conventional QRP gear and wire antennas! Herein lies yet another world within our world of QRP: Milliwatting and microwatting. It is hot, hot, hot, and yes, more details on gear for both pursuits are presented in our following chapters. Read on!

CHAPTER 2

QRP CLUBS AND ON-THE-AIR ACTIVITIES

A captivating number of special promotions, club events, contests, awards, and on-the-air activities keep life in the QRP lane upbeat and exciting day after day, year after year. Indeed, this "bright lights and glamour" side of QRP is directly responsible for its continuous growth and popularity among newcomers and old pros alike. A shining example of QRP's special promos is the annual "Four Days in May" symposium coinciding with the famous Dayton Hamvention. A few years ago, Dayton forums on QRP became "standing room only" events that overflowed all available time slots. QRP enthusiasts were also generating "gridlock" around show booths, filling motel lobby "chat space," and still growing in number. The logical answer was expanding QRP activities into a "hamfest within a hamfest" encompassing Thursday, Friday, Saturday, and Sunday. Within this time period are a fantastic homebrew contest, a blowout "show and tell" session, a dealer's night for display and demonstration of QRP gear, an extensive technical forum, and an outstanding banquet. Attendees typically emerge with a lavish binder of presented papers, literature galore, and all the kits and goodies they can carry home and enjoy using--until the next year's introduction of more treats. QRP's FDIM is a terrific fun event every low power enthusiast should experience at least once--and while there is still room to "fit everyone in." Details on each year's FDIM, incidentally, usually appear in quarterly newsletters from the QRP International Club and the North California QRP Club. Check them out!

QRP Clubs and Newsletters

When my previous book on QRP was published several years ago, QRP clubs were fairly small in number and members. Today, however, both are almost too numerous to count or accurately document--and more clubs are being formed monthly (Wow!). In fact, QRPers nationwide (and worldwide!) are meeting at hamfests and starting up local area clubs for sharing experiences and exchanging equipment ideas in record number. Listing all QRP clubs on the scene today would obviously require a special task force. I will thus quick-overview some of the larger/more familiar clubs and apologetically invite "unlisted" clubs to share details of their activities with me for inclusion in our new edition.

The QRP Amateur Radio Club International (QRP ARCI) is one of the longest running and most well-known U.S. clubs. Membership is presently around the 10,000 mark. QRP ARCI sponsors/endorses several monthly contests, QSO parties and weekly on-the-air nets plus a very impressive awards program. Club members also enjoy setting up booths and representing QRP ARCI at many hamfests, so step up and say "hello" if you see them. The club's newsletter "QRP Quarterly" is usually 40 to 60 pages, in length and loaded with operating news, contest info, and homebrew projects. Receiving this mini-magazine alone makes joining QRP ARCI

Figure 2-1 Joining several QRP clubs maximizes your enjoyment, and their related newsletters are like a QRP hamfest via mail.

a good deal. Membership is 15 dollars U.S., 18 dollars Canada, and 20 dollars DX. Applications/checks presently go to QRP ARCI secretary, Ken Evans, W4DU, 848 Valbrook Court, Lilburn, GA 30047. Just want an information packet? Send a large Self-Addressed Stamped manila envelope to Publicity Officer, Bruce Muscolino, W6TOY, P. O. Box 9333, Silver Springs, MD 20916. If both of those sources are unproductive, check with a QRP ARCI net control station for names/calls "heading up" the club.

The G-QRP Club of Great Britain is another well-known "biggie" worthy of mention. Membership count is presently unspecified, but rumored to be around 8000. This club also sponsors contests, on-the-air meets, and a superb awards program. The club's newsletter, "Sprat," is a mini-magazine loaded with hot operating notes and homebrew rig descriptions. Almost every issue has become a collectible. U.S. membership to G-QRP and a subscription to "Sprat" is presently 12 dollars, and goes to U.S. agent: Luke Dodds, W5HKA, 2852 Oak Forest, Grapevine, TX 76051.

The Michigan QRP Club (MI QRP) is another time-established group with a large and enthusiastic membership. MI QRP sponsors several popular QRP contests and on-the-air activities, and this club is well-known for helping QRP grow. MI QRP's newsletter/mini-magazine, "The Five Watter," always contains interesting "what's happening" news, plus simple homebrew notes. Contact MI QRP President, Tim Pepper, K8NWD, 654 Georgia, Marysville, MI 48040 for more information and membership rates.

The North California QRP Club (NorCal) started its climb to fame during the early 1990's and presently has 2000 to 3000 members around the U.S. and the world. This club's special interest is homebrewing, and each quarterly issue of its whopper-size mini-magazine "QRPp" is loaded with full details on the very latest homebrew circuits, club-produced kits, and building tips. If you enjoy building and using the hottest rigs of the day, QRPp is a gold mine of information!

U.S. membership/QRPp subscriptions are 15 dollars a year. The club is not incorporated, so checks/money orders should be made payable to Jim Cates, 3241 Eastwood Road, Sacramento, CA 95821.

The Colorado QRP Club (CQC) is small, but rapidly growing. Its membership stood around 150 in early '98, and its 24 page newsletter "Low Down" carried information on club activities plus projects of various types. Considering the newsletter's projected enthusiasm, I would say this club is destined to soon be a "biggie" in QRP. Membership/subscriptions are 10 dollars a year, and go to CQC, Box 460101, Aurora, CO 80046-0101.

Additional QRP clubs with very informative newsletters are quite numerous. Pertinent details on the most well-known follow.

The St. Louis QRP Club, newsletter "The Peanut Whistle." Membership presently limited to Missouri area.

The ScQRPion QRP Club of Arizona, membership/information unavailable at press time.

Columbus (Ohio) QRP Club, small but growing! Sparked by the MRX-40 receiver kit from K8IDN (featured in an upcoming chapter), club enthusiasm is high and activities are hot! Newsletter is presently 2-4 pages, and very informative. Contact Steve Bornstein, K8IDN, 475 East N. Broadway, Columbus, OH 43214 for more information.

NorthWest QRP Club, another hot club with active members in Washington and adjacent states. Their newsletter is shifting from U.S. Mail to Internet access. Club Net meets on 10,123 MHz Monday nights at 2200 EST. Contact NWQRP, P. O. Box 354, Bay Center, WA 98527 for more information.

New Jersey QRP Club, also growing in size. Best known for its QRP "Rainbow Tuner" kit. Newsletter accessible via the Internet. Contact kit manager James Bennett, KA5DVS, 309 Morrison Avenue, Hightstown, NJ 08520 for more information.

Although not a regional club, an **MFJ 90's Newsletter** devoted to operating and "modding" MFJ's popular QRP rigs is published on an eclectic basis. It is quite informative and truly fills a vacancy in this area. Contact David Luscombe, AB5JE, P. O. Box 393, Lake Dallas, TX 75065 for more information.

Finally, I say join a few QRP clubs! It is the best investment you can make in long term QRP enjoyment!

QRP Nets and Awards

Whether you are just getting started in QRP, want to check/confirm the ability of a little homebrew rig to "reach out" or just like to "touch base" with distant clubs, QRP nets/meets are an ideal answer. Unlike conventional traffic nets that pass formal traffic, the purpose of QRP nets is boosting confidence in communicating with low power. Simply listening to a Net Control Station and other QRPers calling the NCS gives you a good perspective on how low power sounds in actual use, plus net activities are an excellent way to perfect your receiving and operating abilities. By calling in to a net, you also realize first hand what to expect when running QRP (I can't believe my earphones! I really did it with only 3 watts! Now that is hamming!).

QRPers have a natural "knack" for understanding each other and also

realizing band conditions constantly change. Typically, you call an NCS and swap signal reports, rig power, and QTH. If you cannot stay on frequency, just say so. They understand. If you can stand by on frequency, however, you will probably be invited to exchange greetings/information with others "checking in" (a great way to meet some of the "biggies" in QRP, too!) There are additional rewards. If you work a station 1000 miles away while using only one watt or a station 500 miles away (or further) while transmitting with only a half watt, you have qualified for QRP's esteemed 1000 miles-per-watt award on-the-spot. Many nets also offer additional awards to operators "checking in" x number of times. Friendships kindled through net communications are

1997 ARCI QRP Net Schedule

Net	Frequency	NCS (Alt. NCS)	Day	Time [1]
TCN [2]	14060	W5LXS (K2LGJ)	Sunday	2300 UTC
SEN [3]	7030 3535	K3TKS (AA1OC)	Wednesday [4]	0100 UTC 0130 UTC
GSN	3560	N9ZZ	Thursday [4]	0200 UTC
GLN	3560	W1CFI (WA1JXR)	Thursday [4]	0200 UTC
NEN	7040-41	K3TKS (KC1DI)	Saturday	1300 UTC
WSN	7040	W6SIY (several)	Saturday	1700 UTC

Notes:

1. Adjust UTC times to one hour earlier when local time switches to daylight savings time unless otherwise noted.
2. TCN remains at 2300 UTC Sunday the year around except on major contest weekends, then it will meet one hour later.
3. If conditions on 7030 kHz are poor, QSY to 3535 kHz at 0130 UTC (0030 UTC Spring/Summer). Please note that 3535 kHz is the Michigan QRP Club net frequency at 0200 UTC (see " Other QRP Nets " listing).
4. Note that in North America, net meets on the evening of the day before local time.

Other QRP Nets

Net	Frequency	NCS (Alt. NCS)	Day	Time [1]
BC (SSB)	3729	---	Daily	0300 UTC
MI-QRP	3535	K8JRO	Wed. [2]	0200 UTC
NE-QRP	3855	WA1JXR	Monday	2100 EST
NEIQS	3560	---	Friday [2]	0200 UTC
OK-QRP	7060 (3560)	---	Sunday	1330 UTC
NW-QRP	10123	W7DFO (N7MFB)	Tuesday [2]	0200 UTC
NW-QRP	3710	N7MFB	Tuesday [2]	0230 UTC
NW-QRP	7035	N7NFB	Saturday	0730 PST
NC-QRP	3686	KQ4RP (club call)	Sunday	2130 EST
VE-QRP	14060	VE6BLY	Sunday	1800 UTC

Notes:

1. Adjust UTC times to one hour earlier when local time switches to daylight savings time.
2. Note that in North America, net meets on the evening of the day before local time.

Figure 2-2 Condensed list of popular QRP nets/groups and time/frequencies of activities as of 1998. Discussionin in text. Thanks to QRP ARC1, K3TKS and NWQRP for data.

additional spinoff rewards. So, why wait? Fine tune your QRP rig, brush up on your operating savvy, and check in with some of the nets/groups listed in Figure 2-2. Our list of nets, incidentally, was compiled from QRP ARCI and NWQRP data plus on-the-air observations--and is surely not 100 percent complete. If your net/group is not listed, drop me a note and I will include it in a future edition. Both of us have the same objective: Helping QRP and QRPers grow! Does the "net idea" work? You bet! I check into nets at every opportunity and every time is an exciting adventure! I am confident you too will find QRP nets terrific enjoyment! Give them a try!

Collecting awards is yet another special treat in the world of QRP, and some very impressive "wallpaper" is available to operators "making the grade." Some of the most popular certificates of achievements are offered to members of QRP ARCI, and shown in Figure 2-3. They include QRP-WAC, QRP DXCC, the 1000 Mile-Per-Watt certificate, and an award for completing 25 two-way QRP QSOs. Precise details on various awards are usually presented in newsletters of associated clubs (another good reason for joining several clubs). Check them out!

QRP Contests and On-The-Air Activities

When the focus turns to on-the-air fun, QRP reigns supreme! Indeed, big-time QRP-only contests, lighthearted QSO parties and brief operating stints are held almost every weekend throughout the year. Prizes and awards are numerous, and they often blow "big contests" (many of which include a "QRP category") out of the water! In addition to certificates and trophies, for example, entrants can also win transceivers, keys, tuners, and more. Whew!

Figure 2-3 QRP ARCI-sponsored awards like shown here add a special touch of excitement to low power communications. Get cracking and collect them all!

CONTEST	APPROXIMATE TIME	SPONSOR
QRP CW Contest	Spring, Summer, Fall, Winter	QRP ARCI
MI QRP CW Contest	January	MI QRP
Milliwatt F D Trophy Competition	June/Field Day	QRP ARCI & MI-QRP
QRP To The Field	May	Radio Adventure Society
FYBO Field Contest	Winter/February	AZ ScQRPions
Flight Of The Bumblebees	Spring	Radio Adventure Society
Homebrew Sprints	Spring, Summer, Fall, Winter	QRP ARCI
Spartan Sprints	Monthly	Radio Adventure Society
Classic Rig Springs	Summer	QRP ARCI & MI-QRP
Hoot Owl Sprints	Summer, Winter	QRP ARCI
Holiday Sprints	Winter	QRP ARCI
Winter Fireside SSB Sprints	Winter	QRP ARCI
Holiday Spirits Sprint	Winter	QRP ARCI
Summer Daze SSB Contest	Summer	QRP ARCI

Figure 2-4 Condensed list of popular QRP contests and on-the-air activities. Discussion in text.

Only a scant number of QRP contests and activities are listed in monthly magazines, mainly because all types of amateur radio activities must be recognized equally in their limited space. Details on the real treats and super-special events are listed in club newsletters like the QRP Quarterly and QRPp. Some of the more well-known (and less known!) activities at the present time are listed in Figure 2-4 to "whet your appetite." As you can see, many of the contests/activities are orientated toward portable operations and having fun in the great outdoors. The Milliwatt Field Day Trophy competition runs concurrent with ARRL's Field Day. A Spring "QRP-To-The-Field" and a mid-winter "FYBO" (Freeze Your B--- Off) contest are similar outdoor events--all independent of ARRL.

Prefer something less strenuous? Try the "flight of the Bumblebees:" A preselected group of "Personal Portables" set up their tiny stations in parks, etc. then pass out QSOs to "bee hunters." Limited time? Try the sprints. They are 2 to 4 hours in length, and a blast of fun. Once "hooked" on contesting, you will love it! Honest! A frequency guide to "finding the action," incidentally, is included in Figure 2-5. Most QRP activity is usually found within 10 KHz of listed frequencies. Test tune them this weekend!

Are you getting the point yet, friends? QRP is blowing wide open with action today, and we want you to join the fun! Now read on for some great tried and proven tips to successfully operating QRP!

QRP CALLING FREQUENCIES

160M—	CW: 1.810/SSB 1.910 (E:1.843)
80M—	CW: 3.560 (N:3.710)/SSB 3.985
40M—	CW: 7.040 (N:7.110, E: 7.030)/SSB 7.285
30M—	CW: 10.106(QRP-L:10.116)
20M—	CW: 14.060/SSB: 14.285
15M—	CW: 21.060 (N:21.110)/SSB: 21.385 (E: 21.285)
12M—	CW: 24.906/SSB: 24.950
10M—	CW: 28.060 (N: 28.110) /SSB: 28.885 (N: 28.385)
6M—	CW: 50.060/SSB: 50.885 (E: 50.285)
2M—	CW: 144.060/SSB: 144.285 (E: 144.585)

N = NOVICE E = EUROPE

Figure 2-5 Popular "gathering spots" for on-the-air QRP activities and QSOs, compiled list courtesy Embedded Research of Rochester, NY.

CHAPTER 3

SECRETS TO QRP SUCCESS

Some folks say QRP success is a matter of skill, some say it is a matter of luck, and others have never really experienced the thrill of big-time QRP success. Personally, I say QRP is genuine amateur radio fun everyone can enjoy in a quite successful manner. The "secret" behind that statement is first ensuring all possible odds are in your favor and then having the mental confidence to know "you can do it" rather than wondering "if it will actually work." Dale Carnegie's "Power of Positive Thinking" works, friends, but you must be a believer and set the stage appropriately. Then, it is akin to sitting down at a poker table in Las Vegas with the cards stacked in your favor! Doth Doctor Dave jest? Nay, nay. My QRP success is 75-90%, and you can enjoy similar results. Read on!

Figure 3-1 Wow - I can work the world with this little rig. My operating tactics must be top notch!

Generally speaking, QRP success depends on three interrelated factors: station equipment, antenna system, and operator expertise. A compromise in one of these three areas can be offset by an advantage in the other two, but the best bet is having all three assets on your side.

Prime factors to consider in QRP equipment are a sensitive and selective receiver, a clean 5 watt-output transmitter, good frequency agility, and full CW break-in operation. Crystal-controlled rigs are okay for experimenting and operating around specific net frequencies, but a transceiver with full range VFO, digital readout, memories, and RIT give you freedom to dodge high power QRM and jump between contacts for a high call/work ratio. Additionally, fewer and fewer operators tune off-frequency for replies to their CQs-and many also use narrow band filters. Unless your signal falls into their "receive slot," they do not hear you. Indeed, shifting your transmit frequency only 200 Hz when a second or third call fails often results in an immediate reply - regardless of your power level. Dual VFOs or RIT with a wide span is almost vital for working split frequency pileups. Some operators assume "working split" is the most challenging way of chasing DX, but a good QRPer can turn that disadvantage into an advantage by noting "who is getting through," and placing a well-timed call on that same frequency for a following or subsequent QSO. Good receiver sensitivity and selectivity give you the ability to hear weak stations

covered by stronger signals. The loud guys usually have several stations answering their CQs, whereas weaker stations listen closer for weak calls. Full CW break-in operation is an additional asset not to be overlooked. The ability to hear "in between" your transmitted dots and dashes allows you to perfectly time your calls--and yield an honest 10db advantage in on-the-air success.

Although a multi-featured 100 watt transceiver can be reduced to five watts for QRP, (and it puts every asset imaginable at your fingertips), there is always the temptation to increase power. Dedicated QRP transceivers are unique in size and undeniably QRP in appearance. They also use less current for field-type operations, and no one can question whether you are actually running QRP when making contacts.

Undeniably, a good antenna system is the QRPer's greatest asset. Ideally, a three-element beam is terrific for 20 meters and higher bands, while Delta Loops and ultra-long wires are superb for 30 meters and lower HF bands. Ah, but few of us live in a perfect world! Verticals are a popular alternate choice for most HF bands, but remember they must have a good ground/radial system beneath them and be mounted at least 1/4 wavelength from obstructions to effectively radiate a signal. Wire antennas like dipoles and Delta Loops do a creditable job for QRP, their cost is low, and they can be homebrewed from fine wire barely visible to untrained eyes. The installation height of wire antennas plays a significant role in their performance, however we prefer to avoid being "the highest object around" for lightning and wind protection. In the case of fine/thin antennas, it also ensures they stay up more than one season! Multiband antennas like doublets and G5RVs are not encouraged for QRP work. They are fine for use with 100-watt rigs (where a 40% loss of radiated power is acceptable), but they can shift a regular QRP setup into the milliwatt category. If you can look up at your antenna and feel a sense of pride (wow, what a big antenna for such a little rig), you are on the right track to QRP success.

Truly, sharp operating tactics make the big difference in QRP success. This is a special skill one develops through trial and error and over a period of time. Defined in general terms, it is a matter of evaluating, timing, and accuracy (knowing when to hold up, fold up, tune away, and when to run--ERR-switch off the rig until later!). Stations experiencing difficulty sending their own call and replying to others are obviously difficult to contact with QRP. Conversely, DX stations "picking off" callers in rapid succession through a group of "fumblers" in a pile-up are often the easiest to contact. That is, assuming your QRP signal is clean, your call is short and perfectly timed, and you have the ability to copy a reply while other (loud!) stations are still calling. Yes! Victory snatched from the jaws of defeat! You are "in and out" before the "big guys" even know what happened! This is also one example where equipment and expertise overlap. If your rig lacks ultra-sharp filters, try tuning a desired station to the lowest discernible tone or pitch and ignoring higher pitched tones (it works--really!). If you cannot hear lower tones, but hear higher tones, reverse the concept. Try different earphones: some are peaked for bass response, some emphasize high notes, and some actually "drop off" desired mid-frequency tones. Use your receiver's RIT for the previous adjustments while ensuring your transmit

frequency is exactly where the other station is listening, or where the last contacted station was transmitting. Think like Luke Skywalker in Star Wars, and the force of QRP will be with you. Really! Perchance you are not using full break-in operation and notice the other station is always replying to someone when you switch back to receive, shorten your call. Keep shortening your call until you can sit back and wait for a reply–just do not miss that reply because you assume you are not being heard. Unless band conditions are "against you" your QRP signal will be heard! Although our previous tactics primarily centered around CW operation, they also apply to SSB (and even FM operations, like via AO-27: the orbiting repeater.). There is one major handicap, however, voice operators usually run heavy-duty power and occasionally ignore weaker callers (that is why you have a tuning knob: use it!).

QRP success demands a positive "I can do it" attitude which, in turn, must be supported or justified by the most well-mated rig and antenna system suitable to your particular installation. Here is where some operators fall short, and even the most positive thinking cannot compensate for an inefficient setup. Begin by checking your QRP rig's signal quality on an auxiliary receiver, and measuring output power on an accurate Wattmeter. Refurbish your antenna system using new wire and low loss coax cable. If you use a vertical or beam, take it apart and clean all connections to "shiny new." Next, tune the antenna(s) for lowest SWR in your preferred operating range. Ensure all connectors are well-soldered. After checking/optimizing SWR, remove the meter/bridge. Ideally, you want a single unbroken length of coax cable connected from the output socket on your rig to your antenna. Assuming the antenna has a reasonably clear "sky view," you are now set for big-time QRP success with both in-country and DX contacts.

DXing and Contesting With QRP

Although some people may analogize "going for the big-time" with QRP to going bear hunting with a hickory stick, such is not the case. Indeed, you can be quite successful with a bit of knowledge and practice! Achieving DXCC is quite feasible, but I must say, it is easier if you have already worked 100 countries "the easy way" with 100 watts. The skill and expertise acquired in that pursuit is a definite advantage for QRP operating. Study signal propagation effects and use that knowledge to your advantage. Daily propagation forecast and sunspot counts are transmitted by WWV on 10 and 15 MHz at 18 minutes after each hour. Use southern hemisphere propagation during ionospheric storms affecting the northern hemisphere, and use the highest frequency band open during a specific time. Pay close attention to when ionospheric storms end. The bands really come alive at that time, and you can have a ball operating QRP while others assume conditions are still poor.

Many DXers use Packet Cluster assistance for finding DX on the air, and it may prove useful if you are running 100 watts or if your present country count is below 100. Remember, however, other amateurs are reading the same information on their computer's screen and will be competing in pileups. As a result, numerous semi-proficient operators often "cover up" the DX station.

You will realize greater success by finding DX before it is listed on a Packet Cluster net.

Strive to get on the air at your least opportune and most overlooked time. Avoid falling into a set routine of operating in specific time slots. I have worked many new countries simply by switching on a rig when I should have been dressing, leaving for work, etc. It is the old story of "they are never on the air when you are looking for them." The solution is looking for QRP success when you don't have time to get on the air! Unfortunately, this technique works great! Remember, also, you cannot work DX if your rig is not switched on. Even if it must "play" while you handle other chores, keep on listening!

Let's assume you spot a DX station working callers at a fairly good pace and consider the best way to contact him or her. Listen closely: Try to assess the DX station's skills and reason for particular tactics. If the operator is efficient, he or she may instinctively react to a well-placed call. If the DX station is sending CW at a fast rate, then call him or her at a faster rate (only one time, with only your call letters followed by "KK"). Be prepared to copy the response immediately and while others are still blasting the frequency with their call. This technique works, but you must be alert and have sharp ears or sharp filters. If you do not "get through" within two calls, shift your transmit frequency approximately 100 Hz and wait until the next time the DX station listens for calls or until you sense when he switches from transmit to receive. Listen for times when U.S. amateurs QRM each other and cover the DX station sending QRZ. During this time, U.S. stations return to receive at exactly the same instant the DX station returns to receive. Turn up your receiver's volume, use good earphones, and you will spot this magic moment. This is the optimum time to transmit your call (only once). If it seems the DX station is returning to a different group than you are hearing, start noting calls to determine if skip is "against you" or if the DX station is replying "two or three behind" in callers. Visualize the DX operator's rig and tactics: place yourself in his spot, then make yourself a "sitting duck" for him to hear you.

Although seldom realized, DX stations operating split frequency are often the easiest to work. Use your rig's second VFO or RIT so you can transmit on the DX station's specified receive frequency while receiving the DX station on the rig's other VFO or with the RIT. Practice fast "button pushing" so you can hear both sides of the pileup. Listen and study until you're able to spot each station making a DX contact. You can also discern if the DX station is listening on one frequency or tuning, then make a successful call precisely where he is listening.

An alternate technique is worth mention. If the DX station indicates he is listening up 10 but making QSOs up 5, call him up 4 to 6. If the DX station signs off the air for 10 or 15 minutes, do not waste time trying to change his mind. Set your timer and start looking for other contacts until nine minutes later. Then return to the exact frequency and listen for that first QRZ. Do not call before you hear it. You do not wish to "give away" the secret and be clobbered by others!

If the station you are trying to contact is not proficient, you can expect to spend a greater length of time pursuing a QRP contact. Again, I emphasize listening close and placing yourself in the

DX station's position. Is he tuning through a pileup? If so, move to the pileup's edge and call him. Listen for a magic moment or hole in the pileup where any station filling in the blank snags a QSO. Do not transmit until you are sure you have spotted that blank space, then insert your perfectly timed call exactly once. You will get only one chance here: Don't blow it!

If you are really serious about DXing, strive to be operational on a selected band slightly before it opens to your area. Search the band diligently, paying close attention to weak stations (the stronger stations usually get all the calls). Write down frequencies or store them in memories for later use. Within a few minutes, you should be familiar with activity and be able to spot new DX stations as they come on the air. Choose your diversions from tuning to contacting stations carefully. Following a few days practice, you should be able to contact stations right as they get on the air, generating pileups others will join after your QSOs. Believe me, gang, it is much easier being a sly fox rather than just another member of the wolf pack!

If you are entering a contest and pursuing a high score, you will want to be operational from the starting moment. Shoot for both contacts and multipliers during the first few hours. This does not mean you should shy away from pileups which seem easy to crack, however, since band conditions may be favoring you at that time. If you can get through a pileup within five or six calls, fine! Hang with it while propagation is in your favor! Remember to avoid becoming boggled down to the point of staying in pileups for a longer period. Stations will be much easier to work near the contest end. If you are entering a large contest in the QRP category, avoid heavily congested band edges--at least until the second day of the contest. DX stations habitually work the strongest stations first, then listen for weaker stations as the going gets rougher. Finally, remember every QRP contact is a reward in itself and persistence to stick with it produces winning results. Never give up!

Using Propagation Effects To Your Advantage

Few top-notch QRPers achieve outstanding results by simple games of chance and sheer luck operating. Instead, they plan on-the-air operations according to schedules and propagation forecasts. These forecasts are listed in monthly amateur radio magazines like CQ, QST, and 73. Additionally, up-to-the-minute propagation forecasts are announced by WWV, the national bureau of standards, on 10 and 15MHz at 18 minutes after each hour. Another useful operating aid is propagation-forecasting software, like illustrated in Figure 3-2. You enter sunspot numbers and solar flux data obtained from WWV (18 minutes after an hour), and the software predicts band openings worldwide with good accuracy - Try it!

Experienced QRPers and DXers are also familiar with propagation on various HF bands. DX openings on 40 meters, for example, usually affect a wide geographical area thus QRPers are competing with many others in trying to establish a successful contact. The only advantage you have in this situation is being close to the DX area. As an example, amateurs striving to work Europe on 40 meters usually compete

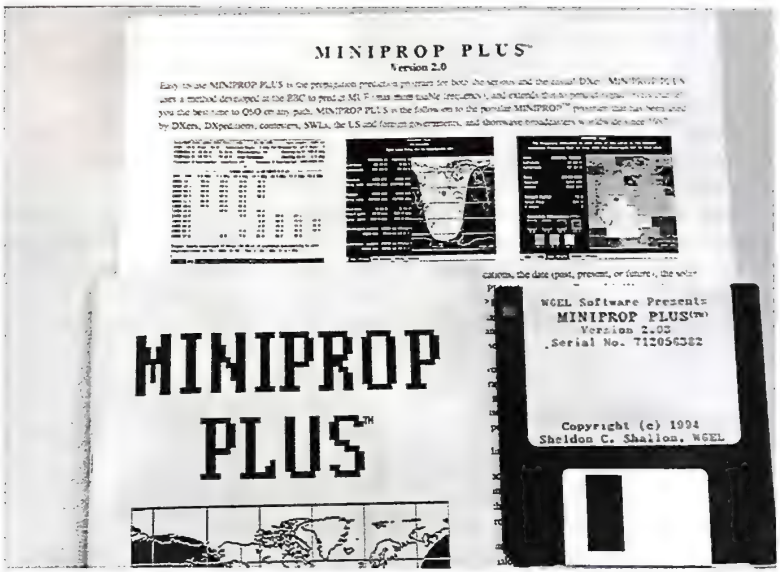


Figure 3-2 Propagation forecasting software like this "Miniprop Plus" program available from W6EL, 11058 Queensland St., Los Angeles, CA 90034 are ideal for determining which bands are open to which areas of the world at what times.

with all U.S. districts, yet New England amateurs have a geographical advantage. Likewise, southern U.S. amateurs would find South American QSOs on 40 meters relatively easy. 30 and 20 meters produce more geographically confined and distinct DX openings than 40 meters, and signal strengths are often higher during these times. The usual openings on 20 meters move across the U.S. in a soft blanket effect: the best conditions being exhibited at the leading edge of this hypothetical blanket. European openings, for example, move from east to west across the U.S. As propagation shifts, Midwest amateurs can communicate better than eastern or northern amateurs. As the hypothetical blanket's leading edge moves toward the west coast, W6s and W7s realize their optimum communications times. Eastern amateurs will notice this specific time period by European signals dropping from 20db over S9 to below S9 levels. 17 and 15 meters DX openings are slightly more confined and pronounced than those on 20 meters, and the "blanket effect's" leading edge is also shorter lasting. 12 and 10 meters are, likewise, quite similar to propagation on 15 meters. This means the "blanket's edge" on both 15 and 10 meters produces extremely good signal propagation and permits successful low power operations right when the band opens and just before it closes. The previous facts are most pronounced during sunspot peak years. Adjustments must naturally be considered during years of declining sunspot activity.

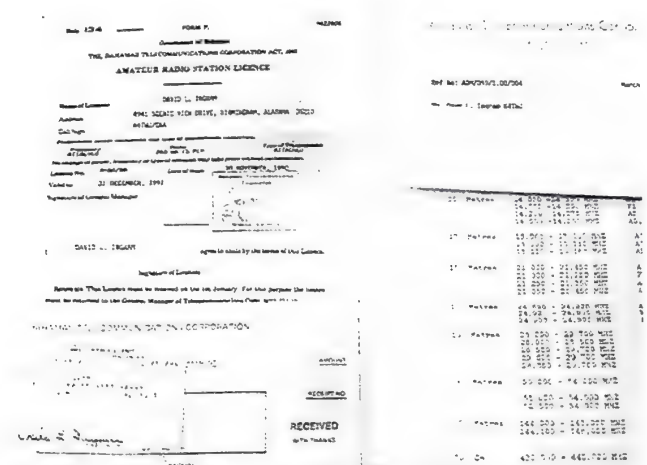
DXpeditioning QRP Style

Are there any disbelievers out there who would like to see what QRP can really do? Well, take a quick jaunt out of the country with your battery powered rigs and wire antennas, and experience "being DX" firsthand. Believe me, friends, you will be surprised at the good results. Yes, and you can earn some prime DX awards in the process. Such dreams today can easily become reality tomorrow. First, maps and country lists are studied and DX requirements are reviewed. The ARRL DX Advisory Committee is consulted regarding licensing. Slowly and surely, the DXpedition begins to formulate into reality. There is only one hitch: once is not enough! After returning home, the QRP DXer starts getting that far-off look and thinking of another and better DXpedition! Essentially, there are two types of DXpeditions: the all-out gusto (and expensive!) endeavor and the casual/vacation type expedition. The travels of Martii Laine, OH2BH, is a typical example of serious DXpedition. A combination vacation and mini DXpedition usually involves visiting some Caribbean Island or making a quick jaunt down to Monterey or Acapulco, Mexico. In the case of big-time expedition, one realizes it is expensive and may not be repeated for some time. Consequently, he or she wants to ensure everything will go as smooth as possible. He obviously does not want to travel a significant distance only to find his license is not valid, his rig has developed problems or antennas cannot be quickly erected. Likewise, the DXpeditioner does not want to lose his gear during transit or have it confiscated by Customs officials (the beauty of small QRP gear: it can be hand-carried when traveling). Fine, you say, but how can one predict such situations. Extenuating circumstances do arise, but their odds of occurrence can be reduced by careful planning and common sense reasoning. Would you purchase a new auto and immediately put it on a long trip before checking out the vehicle around town? By the same token, a "tried and proven" rig is more desirable than an unfamiliar transceiver . . . unless a backup station is also carried along. Would you begin a cross-country trip without a spare tire or basic items like repair tools and extra coolant? Likewise, spare parts for rigs, extra fuses, a volt ohmmeter, and extra wire should be a natural part of your DXpeditioning paraphernalia. The most reliable means of insuring you are not separated from your rig is hand-carrying it in a small flight bag. Remember: without your gear, there is no DXpedition. Another point: some countries require you put up a deposit on your ham gear upon entry. This is another time when an inexpensive QRP rig has the advantage. I understand your deposit is refunded upon departure and showing the gear is still with you rather than being sold in the visited country. This is the "theory": I am not sure what actually happens "in real practice."

A number of basic considerations apply to every DXpedition: where to go, the general status of that area and its licensing requirements, power sources, travel requirements, and extra money for "unforeseen surprises." While planning this endeavor, the "first time" DXpeditioner can acquire a feel for pileup operating by setting up a mobile station in a rare county near his city. The International County Hunters Net

operates on 14.336MHz, and their activities are discussed each month in CQ magazine. There is also a County Hunter's CW net operating on 14.057MHz. If a county DXpeditioner lets his intentions be known to this group, he will find an eager and enthusiastic number of county hunters ready to pounce on his rare county expedition. When activity wanes, moving to another county will start the pileup again. Within a few days after county expeditioning, QSL cards will begin filling the amateur's mailbox and he will also get an idea of that aspect in expeditioning.

The casual DXpedition may necessarily be limited to minimum on-the-air activity and enjoying the vacation most of the time. This should not preclude laying foolproof plans just like it was a serious DXpedition. A license for radio operation from the desired area should be obtained beforehand (Figure 3-3). The American Radio Relay League has information on licensing in many foreign countries available upon request. The majority of casual DXpeditions usually involve nearby countries like the Bahamas, Cayman Islands, Jamaica, Aruba, etc. Few problems with licensing, customs, and power sources are encountered in these areas. As an additional and "backup measure" the expeditioner is urged to contact a native amateur in the country he/she will be visiting. The asset of knowing these people will prove invaluable should unforeseen problems arise. There are many times when travel bureaus are also advantageous, like when making airplane reservations, planning lodging, etc. Remember to secure accurate figures


AMATEUR RADIO STATION LICENCE

RECEIVED

Figure 3-3 Securing a license to operate in another country is a vital "first step" for casual and serious DXpeditioners alike. Remember to renew the license annually, as "starting over from scratch" can be quite challenging.

concerning baggage weight limitations and restrictions concerning carry-on baggage. Whenever possible, publicize your jaunt. Notify DX editors of magazines and DX bulletins of your plans. Be exact and precise as possible, and a group of DX-hungry stations will await your activity. Good luck, and remember to listen for K4TWJ–I will be the weak one running QRP!

IOTA Expeditioning

Say you do not have funds and time for DXpeditioning but still want to enjoy some big-time QRP success? Go IOTA expeditioning to one of the many islands only a few miles off U.S. coastlines. Some of these islands can be reached by bridge. A few examples are Martha's Vineyard out of New England, Dry Tortigas and St. George off the Florida coast, Catalina Island out from the California coast and Orchas Island out from Washington State (Figure 3-4). The Islands On The Air (IOTA) program is sponsored by European magazines, and information on their glamorous DX award is available by sending two dollars to the DX Bulletin, P. O. Box 50, Fulton, CA 95439. The basic IOTA award is available for contacting 100 islands to amateurs worldwide. In addition to details or pursing this award, your information package from the DX Bulletin will include a large list of IOTA-authorized islands. If you like big-time fun, you will go bonkers over IOTA expeditioning. Check it out!

Unique Operations

Still hungry for more shortcuts to QRP success but wish to avoid even weekend travels? No problem - use QRP

Figure 3-4 Lindel Thiesen, AA7DG shows us the grass roots basics of IOTA expeditioning QRP style. He bicycled to Orchas Island off the Washington state coast, quick-erected a wire antenna, and had a ball making contacts galore with a battery-powered rig.

to your advantage in pulling off some one-of-a-kind capers. Bicycle mobile/ QRP, for example, really peaks curiosity and inspires calls. How do you do it? Take a cue from our friend, Dennis Foster, KK5PY (Figure 3-5). Dennis latched onto a MFJ9020 QRP transceiver, made a custom mount to attach it to his bicycle handlebars, then made up a rear carry bag for a 7 amphour gel cell battery. He started out using an inexpensive Ham Stick-type whip for 20 meters, and was amazed at his success. It seemed everyone was captivated by the novelty of working a bicycle mobile. Soon thereafter, Dennis switched to his present (and most unusual) mobile antenna: a little 21-inch "Isotron" radiator mounted on a four foot retracted/8 foot extended aluminum painter's pole (aka "long arm") attached to the bicycle's frame. The results? In less than 2 months of occasional bike mobiling, Dennis worked and confirmed all states plus several DX countries. Expanding on Dennis' activities, an endless number of additional possibilities come to mind: riverboat mobile, hot air balloon/aerostat mobile, and bi-plane/aeronautical QRP mobile are some examples. In the latter cases, 15 or 30 minute rides are often available around beach areas. Finally, your author paused to try a different type of QRP operation while writing this chapter. Using a dualband FM handheld at one watt with a mild gain/36 inch antenna, I contacted stations from New York to Florida, from Oregon to California via the FM repeater/orbiting OSCAR satellite AO-27. Again, the thrill was just like working QRP on HF: stations stacked "end to end" contacting me for six minutes of a typical 10 minute pass. QRP truly knows no bounds, and success of its use is limited only by your imagination!

Figure 3-5 Now here is a setup you do not see every day! Running bicycle mobile/QRP, Dennis Foster, KK5PY, worked all states and several countries in less than two months - on 20 meters - SSB! Whew!

CHAPTER 4

COMMERCIALLY-MADE QRP GEAR

Although not as vast as amateur radio's 100 watt rig market, a good selection of commercially-manufactured QRP gear is readily available to modern low power enthusiasts. Most of these rigs are small sized, reasonably priced, and they make joining on-the-air QRP action quick and easy. This chapter will overview some of the most well-known transceivers from major manufacturers, past and present, plus also discuss some neat accessories like antenna tuners, keys, paddles, electronic keyers, etc. Every item and accessory available on today's market obviously could not be included (that would be impossible!), and items featured or excluded in no way reflect favoritism or non-endorsement of a company or product. I simply invited a cross-section of companies to share details of their products with readers, requested an expedient reply, and compiled the information presented herein. Think of it as a "snapshot view" at the present time and understand new/additional companies are continuously entering the picture.

Which transceiver and/or accessories are best suited to your needs and operating preferences? That depends on a number of factors, and is best determined after a brief on-the-air exposure to QRP action. Some folks find dual VFOs and multiple memories helpful, others prefer the simplicity of a single VFO transceiver. Some operators have the ability to ignore interference to desired stations, others need the assistance of narrow filters and/or passband tuning. Some operators enjoy occasionally SWLing shortwave broadcast bands with their main transceiver. Others prefer straight ham band operation. A rig's weight and size are a prime consideration for backpacking and portable operations, but may not be a main consideration for home use. Reviewing some of those aspects will give you a clearer view of what type QRP equipment you will most enjoy using. A convenient means of visualizing exactly which features best fit your style of operating is by reducing the RF output of your existing transceiver from 100 watts to 5 watts and using it "dedicated QRP style" for a few days time. Most of today's popular 100 watt transceivers are easily reset so their minimum RF output setting is five watts rather than 10 watts. Adjusting an internal trim pot (which is often marked as "MIN PWR") usually does the trick while retaining full power capability by just turning the rigs front panel "PWR" control from minimum to maximum. The location of minimum power adjustments in transceivers varies widely between models and manufacturers, so telephone the service department of your particular rig for specific details.

Another technique for "QRPing" modern 100 watt transceivers involves applying a fixed voltage to their ALC input, similar to the way a linear amplifier restricts rig output to prevent overdrive. A

universal and easy to implement external modification filling that purpose is shown in Figure 4-1. Here, a simple voltage divider consisting of a 100K ohm pot

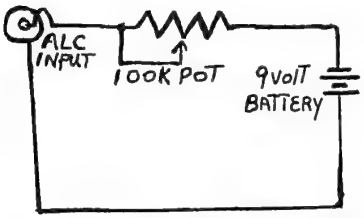


Figure 4-1 Universal "plug-in mod" for QRPizing modern 100 watt-output transceivers. Circuit safely reduces a rig's output to 5 watts or less by applying a small control voltage to its ALC input.

connected in series with a 1.5 or 9 volt battery serves the purpose. This concept applies a negative ALC voltage to the transceiver's rear ALC socket, thus simulating the connection of an external amplifier and reducing transceiver output accordingly.

Check your rig's instruction manual for exact connection/pinout wiring of the rear panel phono and/or DIN socket. Adjust the potentiometer until power output of your rig drops into the 4 or 5 watt range. Typically, this will occur with approximately 1.3 volts applied to the ALC connection. Current drain on the battery is approximately 1 ma, so life expectancy is good. The neat aspect of using this ALC-adjusting technique is convenience. You simply plug it in for QRP, or remove it for full power operations. Remember to check your instructions manual before connecting the circuit and ensure you have the polarities correct. Why not use this QRP technique on a permanent basis rather than purchasing a dedicated QRP transceiver you ask? You can, and you get all the benefits of a modern rig to boot--but you do not realize the full impact of working the world with a tiny rig and proving "the operator rather than the rig makes the big difference!" Additionally, QRP transceivers are unique in size and shape. No one can question if you are truly QRP when using a dedicated low power transceiver! Even if such "QRP fudge" tactics are never discovered, they defeat the purpose and enjoyment of using low power, and overshadow that personal pride synonymous with QRP achievements. Understand I am not "talking down" 100 watt rigs: I am simply emphasizing you remember which setting of the RF power control is minimum and which is maximum! Now let's overview some of today's hot gear!

Classic Ten-Tecs

Early model "power mite" and Argonaut transceivers made by Ten-Tec have become favorite collectibles among serious QRPers, and thus make an ideal starting point for our discussion on low power gear. The power mites or "PM" transceivers were introduced by Ten-Tec as kits or preassembled units during the mid 1960s. They covered 80, 40, and 20 meters with fairly good reception and two watts output. Two of these now-rare and collectible rigs are shown in Figure 4-2. Ten-Tec's "PM" transceivers proved so popular, the company soon replaced them with a more advanced transceiver known as the Argonaut.

The original Argonaut 505 and 509 produced 2.5 watts output, and operated

Figure 4-2 You are looking at a pair of like-new "Power Mite" triband CW transceivers produced by Ten-Tec during the mid 1960s. Little rigs are still fun to use today, if you can find one: They are quite rare. *Photo courtesy David Larsen, N9ZXL.*

SSB and CW on the 80, 40, 20, 15, and 10 meter bands. These tan-cased units featured a slide rule dial with smooth tuning, full CW break-in operation, and proved to be a real treat. During the late 1970s, Ten-Tec replaced the tan-cased 505 and 509 Argonauts with the black-cased Argonaut 515 shown in Figure 4-3. The Argonaut's wide front panel and large dial gave the impression of a full-size transceiver. During operation, the front panel meter and dial were illuminated by a small lamp. Another lamp under the bezel illuminated the tuning knob's pointer and skirt. LEDs on each side of the bezel indicated receiver offset tuning and RF output. Since the unit featured full break-in operation, the LEDs flickered in synchronization with transmitted Morse code...a glamorous display indeed. The Argonauts are neat little rigs. If you ever have the opportunity to try or purchase one, go for it!

Several years after Ten-Tec dropped production of the Argonaut 515,

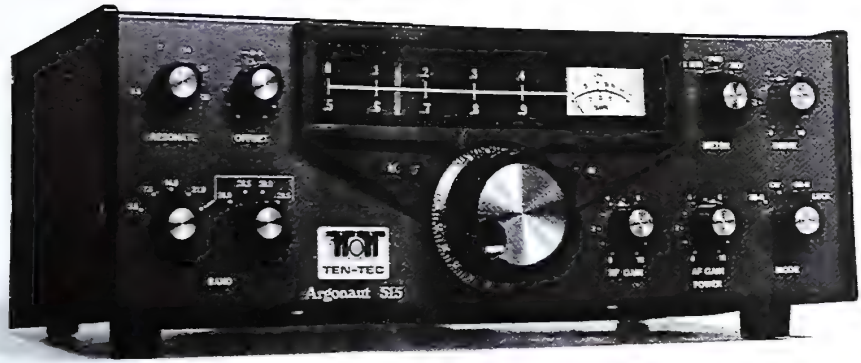


Figure 4-3 Nostalgia supreme! This black-cased model 515 Argonaut is a genuine classic in QRP transceivers, and is highly sought by low power enthusiasts. Unit works 80 through 10 meters, and is easily modified for 30 meters. *Photo courtesy Ten-Tec, Inc.*

a new and completely different Argonaut II was announced (Figure 4-4). This transceiver is modern and quite elaborate. It covers 160 through 10 meters plus receives from 100 KHz to 30 MHZ. Power output is five watts on SSB, CW, AM, and FM. Output can be reduced down to 500mw via the front panel's "PWR" control. Ten-Tec's famous and ultra quiet full break-in is included in the "ARGO II," and it makes QRP operations delightful. The Argonaut II's receiver features passband tuning plus an adjustable notch filter is included for reducing hetrodynes and QRM. The "Argo II" also features dual VFOs, plus 31 memories, VOX, CW sidetone, etc. The "Argo II" was dropped from production a couple of years ago. Ten-Tec now offers a QRP transceiver kit at low cost. Information on the kit is presented in a following chapter. For more information on Ten-Tec gear, contact Ten-Tec, Inc., 1185 Dolly Parton Parkway, Sevierville, TN 37862-3710, telephone 1-800-833-7373 or 423-453-7172.

Classic Heathkits

Although Heathkit "Hot Water" QRP transceivers are no longer produced, used models occasionally surface at hamfest fleamarkets and are still popular among QRP enthusiasts. Bearing those thoughts in mind, let's quick-review these classics.

Heathkit produced three models or versions of the "Hot Water" transceivers: The (direct conversion and limited performance) HW-7, the (superhet and nice) HW-8, and the (quite impressive) HW-9. The HW-8 covers 80, 40, 20, and 15 meters with 2.5 watts output and a front panel selectable audio filter. It is a fun transceiver capable of providing many hours of QRP operating enjoyment.

The HW-9 is a complete rebuild of its ancestors. This unit covers all five popular HF bands plus 30, 17, and 12 meter WARC bands (assuming that option was installed by previous owner). Performance of the HW-9 is quite good--but, like the HW-8, owner modifications

Figure 4-4 Late model Argonaut II is loaded with modern features, and makes an outstanding "plug-and-play" QRP transceiver for the purist. Rig was dropped from production in 1996, but like-new units occasionally surface in hamfest fleamarkets. *Photo courtesy Ten-Tec, Inc.*

and improvements are endless. Heathkit's "HW" series rigs defy fading in the annals of time and they are a terrific way to have fun with QRP on a limited budget. Thanks to our good friend, John, Peregord, Jr., KB8UMD, a photo of the HW-8 and HW-9 are shown in Figure 4-5.

Figure 4-5 QRP and proud of it! Classic Heathkit HW-8 and HW-9 transceivers defy fading in the annals of time. Amateurs worldwide love them! *Photo courtesy John Peregord, Jr., KB8UMD.*

MFJ"90" Series QRP Transceivers

MFJ Enterprises presently manufactures a group of monoband transceivers for QRP called the "90-series." These rigs are available for 40, 30, 20, 17, and 15 meters. They are economically priced, stout little performers, and make convenient toss'n go rigs. Each transceiver covers the CW segment of its specified band, has a superhet receiver with built-in 500 Hz filter, RIT, audio-derived AGC, and semi break-in. Each unit also has a CW sidetone, built-in speaker, and earphone jack. Options include a plug-in keyer (MFJ-412) and narrowband CW filter (MFJ-726).

One of the MFJ transceivers is shown in Figure 4-6, and an inside view of the rig is shown in Figure 4-7. The receiver section is on the right, and the transmitter section is on the left.

Technically speaking, the receiver is single conversion with popular "workhorse" NE-602 ICs used for the mixer, IF amplifier, and product detector. A four-pole crystal filter is included in the IF section, and an LM-386 is used for the audio amplifier stage. The transmitter utilizes another NE-602 mixer for hetrodyne conversion, plus two transistors in driver stages, followed by an MRF-476 for power output. The VFO section is conventional, with a variable capacitor used for tuning. A slight

Figure 4-6 Due to their small size, sensitive "single signal" receiver and stout-hearted 5 watt transmitter, MFJ's "90-Series" monoband CW transceivers are popular among QRPers seeking an economical and ready-to-operate rig. Units are available for 40,30,20,17, and 15 meters. *Photo courtesy MFJ Enterprises, Inc.*

amount of drift is thus noticeable, but not objectionable. Overall, these monoband transceivers exhibit a good price per performance value.

I recently quick-reviewed an MFJ-9020 for 20 meters, and found it to be a rather impressive little rig. Using it during the early morning when 20 meters was just opening, I worked a number of DX stations with it. Output was approximately 4 watts, selectivity was good and the little rig fit comfortably on the corner of my desk! For more information, contact MFJ Enterprises, Inc., P. O. Box 494, Mississippi State, MS 39762, or telephone 1-800-647-1800.

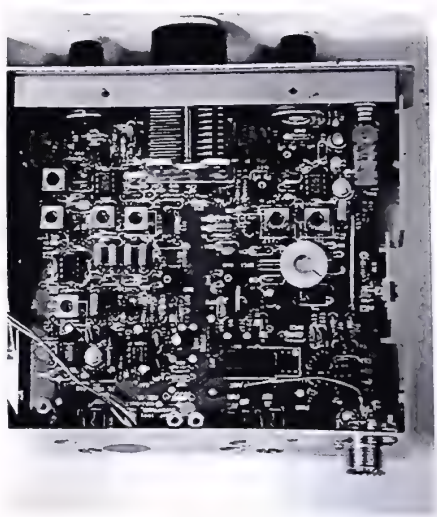


Figure 4-7 Internal view of an MFJ-90 series QRP transceiver. Variable capacitor in middle tunes VFO. Details in text. *Photo courtesy David Branch KB5VKY of MFJ Enterprises, Inc.*

Index Labs' QRP Plus

During 1993, Bruce Franklin/ KG7CR of Index Labs designed an ultra-

compact and quite deluxe CW/SSB transceiver called the "QRP PLUS". The unit proved to be a rollicking success, and orders literally "blew in the doors" at Index Labs. A creditable number of QRP PLUS transceivers were produced before the small company buckled under from the load in late 1996. The QRP PLUS is no longer in production, however, it still enjoys high favoritism among QRPers today. A number of QRP PLUS transceivers are still "in the field," thus the following information is presented for folks fortunate enough to find one.

The QRP PLUS is both small (4 x 5.5 x 6" H,W,D) and uniquely shaped (Figure 4-8 and 4-9). It covers 160 through 10 meters including WARC bands, delivers 5 watts output (adjustable down to a few microwatts), sports full shortwave reception, and has 20 programmable memories. The little transceiver also has a 6 pole crystal filter, RIT, split frequency operation, full CW break-in, and microprocessor controlled circuitry with IF up-conversion. In addition to selecting frequencies, the rig's main tuning knob also selects memories and bands, audio filter bandwidths (from 2400 to 100 Hz) and words-per-minute speed of the built-in electronic keyer. This little rig is loaded for big-time action! Indeed, its high sensitivity, low noise floor, and exceptional stability place it in a class of its own.

Circuit wise, the QRP PLUS is

Figure 4-8 Unique-shaped QRP PLUS SSB/CW transceivers were produced by Index Labs between 1993 and 1996, and many like-new units are still in circulation today. Unit is quite deluxe, with state of the art circuitry, sharp IF filtering, narrow audio filters, programmable memories, built-in keyer, and more.

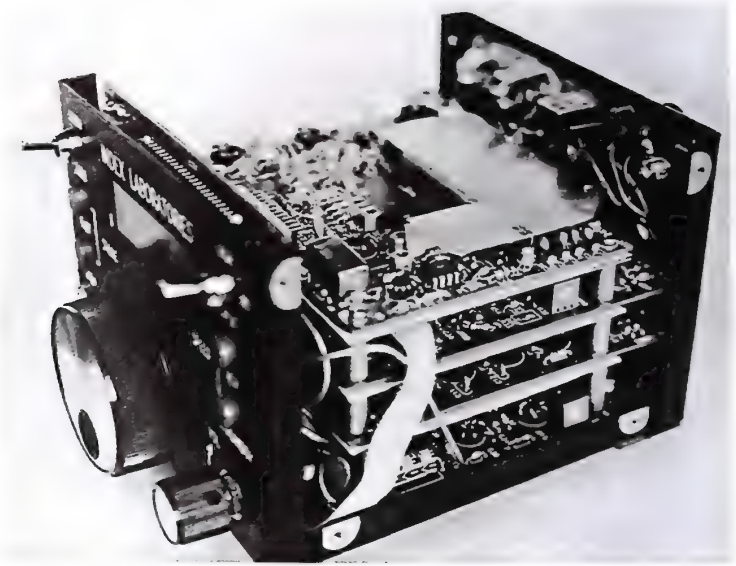


Figure 4-9 Interior view of QRP PLUS reveals cleverly stacked pc boards. A QRP high rise!

single-conversion with an IF frequency of 50 MHz utilized to minimize reception of images or intermod. Bilateral circuitry is used in the IF and filter chain. An SBL-1 IC serves as a double balance mixer in the receiver's "front end." It is followed by a 6-pole crystal filter with a 2.4 KHz bandwidth and an MC1350 IC for the IF amplifier, plus another SBL-1 as a balance mixer/product detector. The following audio section contains two ICs plus a digitally Switch Capacitor Audio Filter section and an LM386. The SCAF filters are selected or "brought on line" by the transceiver's microprocessor which, in turn, is controlled by the main tuning knob. The transmitter section uses another SBL-1 as a hetrodyne mixer. It is followed by several transistor buffer/amplifier stages and a power MOSFET that comfortably produces five watts output. Use of SBL-1 ICs rather than conventional NE602/612 ICs, MOSFET RF amplifier, and microprocessor controlled tuning plus options were clever concepts. Overall, this rig's progressive designs are truly reflected in its outstanding performance. Owners of QRP PLUS transceivers, incidentally, may still be able to acquire service and/or parts from the company. Their address is Index Laboratories, 9318 Randall Drive, N.W., Gig Harbor, WA 98332, telephone 206-851-5725.

The SGC SG-2020 Transceiver

During early 1998, SGC announced production of a new mini SSB/CW transceiver with special ties to the QRP community: The model SG-

Figure 4-10 New SGC SG-2020 all band SSB/CW transceiver is remarkably small in size yet loaded with deluxe features for top-of-the-line QRP action. In many ways, it is akin to a "next generation QRP PLUS." *Photo courtesy SGC, Inc.*

2020 shown in Figure 4-10 and 4-11. The transceiver was designed by Bruce Franklin, KG7CR and SGC's engineers, and thus bears a striking resemblance to a "next generation QRP PLUS." Indeed, many features and functions like memory/band selection, receiver bandwidth and CW keyer speed are accessed by holding a front panel button pressed and rotating the main tuning knob - just like the QRP PLUS. New features integrated in the SG-2020 include passband tuning (depress PBT button and rotate main tuning knob), noise blanker, scanning, backlight for LCD frequency readout and 40 memories. Also unique to the SG-2020 are optional snap-on front and rear covers that transform the unit into a fully portable "manpack"-type system complete with shoulder strap for hands-free carrying. The rear cover accepts 10 "D" cells for stand-alone operation, and the microphone stores in the front cover. An instant portable or mobile station! Impressive!

The SG-2020 measures 2.75 by 6 by 7.25 inches HWD (less front and rear covers), and covers all 9 HF bands plus receives from 1.8 to 30 MHZ. Power output is 20 watts, adjustable down to less than one watt. Whether QRPers will accept a 20 watt-capable transceiver reduced to five watts as "genuine QRP" or classify it as a deluxe small rig for home and portable use is presently unknown. Either way, the SG-2020 is a winner!

Looking closer at the SG-2020, it has a 7 pole crystal filter (2.7KHz

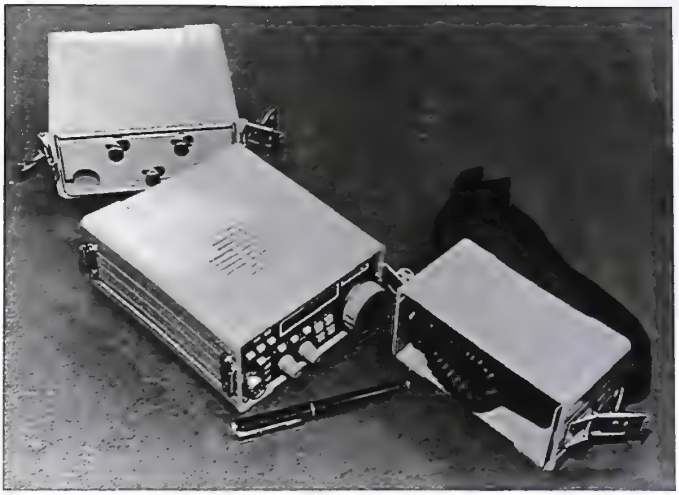


Figure 4-11 Optional front and rear covers for SG-2020 accept batteries (10-D cells), microphone and a small key or paddle, making it a single one piece communication system for use almost anywhere. *Photo courtesy SGC, Inc.*

bandwidth) plus tuning dial-selectable audio filters (2.7 to 100 Hz bandwidths), RIT, XIT, split frequency operations, full QSK, and iambic keyer. Internally, a custom IC with greater dynamic range and lower noise floor is used in lieu of an SBL-1 for the receiver's "front end." It is followed by the crystal lattice filter, FETs in bidirectional IF amplifiers, and the SCAF filters. (The transmitter section includes audio level speech compression, and a pair of 2SC1969 output transistors capable of handling 40 watts. SWR protection "rounds out" the transceiver, making it a "rough and ready" unit capable of surviving any reasonable abuse. Overall, the SG-2020 has a good technical background and a most promising future. Its 20 watt maximum power output may be slightly above QRP, but its small size and low current consumption truly "say QRP" in high style! Additional information is available direct from SGC, Inc., P.O. Box 3526, Bellevue, WA 98009. Telephone 425-746-6310 / orders: 1-800-259-7331.

LDG Automatic Antenna Tuner

Need an antenna tuner to mate with your QRP rig? Want deluxe "big station" convenience plus SWR monitoring to-boot? Check out LDG Electronics new "hands free" tuner shown in Figure 4-12 and 4-13; it is a gem! The tuner is available in preassembled or kit form, covers 1.8 to 30 MHZ, and matches impedances from 6 to 800 ohms. It has an input power range of 100 mw to 20 watts, and can handle up to 30 watts at 50 percent duty cycle. The tuner requires 11 to 14 volts at 75 ma for operation, and auto-tune time is less than one second. Yes, and the only connection required

Figure 4-12 The LDG Automatic Antenna Tuner for QRP is quite small, fully microprocessor controlled, and includes LEDs for SWR metering.

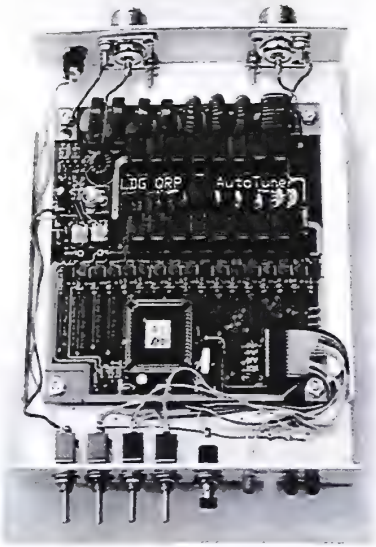


Figure 4-13 Interior view of LDG Automatic Antenna Tuner reveals multiple toroidal coils and fixed capacitors that can be selected in up to 131,000 combinations to tune/resonate any type of coax-fed antenna.

between the tuner and a transceiver is the coaxial antenna cable. The tuner senses impedance and automatically selects up to 131,000 combinations of inductance and capacitance to tune any type of coax-fed antenna. If preferred, you can also select semi-auto or manual tuning and fine-tweak L/C values with front panel switches. LED metering of SWR is included on the front panel, so you actually get two units in one small cabinet (1.2 x 6.1 x 4.7" H,W,D).

The LDG tuner contains approximately 200 parts, which means time for kit assembly will be several hours. Fortunately, however, it can be assembled in a rather repetitive manner of installing similar groups of components. Once "on a roll" building the kit is easy. I test-operated an LDG tuner with several QRP rigs of different power levels, and it worked like a champ. It is also neat for portable and mobile use. Want more information on the tuner? Contact LDG Electronics, 1445 Parran Road, St. Leonard, MD 20685 or telephone 410-586-2177.

G4ZPY QRP Paddle

Gearing up with a palm-size key or paddle always makes QRP operations a special treat, but finding such "miniature manipulators" has always been a formidable challenge. Fortunately, however, Dave has "done the leg work" for you. Yes, and one really "fancy find" is the two-inch square QRP paddle custom-made by G4ZPY and shown in Figure 4-14. This intricately detailed showpiece has dual levers with separate gap/tension adjustments and a superb feel during use. Its highly polished brass mechanism is complemented with chrome screws and sits on a black base fitted with magnets so you can stick it to your rig's case for on-the-spot hamming. G4ZPY also engraves an owner's call letters on the paddle's yoke for a personal touch. Additional information on this paddle and other G4ZPY keys is available direct from Gordon Crowhurst, G4ZPY, 41 Mill Dam Lane, Burscough, Ormskirk, Lancs, L40 -7TG, England. Telephone 011-44-1704-894299. Helpful tip: telephoning between 6:00 am and 7:00 a.m. U.S. time is surprisingly economical and "tea time" in England.

Figure 4-14 Smart looking and terrific handling "3-in-1" QRP paddle handmade by G4ZPY. Key has magnetic base for holding to a rig's case.

"Little Red Key"

Say you prefer a tiny "hand pumper" for QRP? Check out the "Little Red Key" made by Gil Kost, W3MKE, shown in Figure 4-15. Gil calls this 1" x 1.5" gem "the little key with the big

Figure 4-15 Incredibly small "Little Red Key" made by W3MKE of The American Radio QRP Key Mfg. Co. Item is quite popular among "pump-orientated" QRPers. Key is only 1 by 1.5 inches.

personality." Why? In addition to regular gap and tension adjustments, a slightly different degree of arm looseness or tightness is made into each key during production. A variety of similar looking yet different feeling keys are then offered at hamfests so folks can try them and pick the one best suited to their fists. Are "little red keys" thus limited to hamfest sales? Not necessarily: Folks can usually describe a preferred "feel" by telephone. Alternately, you could take "pot luck" and probably emerge fine. The "little red key" has a full-size knob, rear binding post, and some moldable adhesive on the bottom to hold it firmly on a desk, rig, etc. Cute little tyke, isn't it? Want one? Write or "ring up" Gil at the American Radio QRP Key Mfg. Co., 3710 Buckingham Rd., Baltimore, MD 21207-3813. Telephone 410-484-7951. While on the line, ask Gil about his little red paddles, too. He is developing some models to be introduced later in 1998.

NE8KE/KK5PY QRP Keys

Folks occasionally want something different for QRP operations. It may be a pocket knife-type "swing-out" paddle for toss 'n go use, a unique miniature vertical paddle, or a plug-in paddle to use with a handheld HF rig. Answering those requirements are the custom "NeKes" made by Boyd Mason/NE8KE and Dennis Foster, KK5PY and shown in Figure 4-16. All of these NeKes are characterized by spring brass-type fingerpieces that mate with a contact at their far end and a jewel-type button at their fingerpiece end. The keys look unusual, but are surprisingly good to use. Generally speaking, Boyd works on special and unusual designs while Dennis fills orders for miniature QRP keys. Their line is quite extensive and often changes, so check with Boyd or Dennis for specifics regarding "the key of the month." For more details, contact Boyd Mason/NE8KE, 8297 Cleveland, W., Coopersville, MI 49404 or Dennis Foster, KK5PY/QRP, 61700 E. 180 Rd., Fairland, OK 74343.

The QRP Paddlettes

Next up is an exceptionally small and smooth operating dual lever paddle - with an even smaller "twin": The Paddlette and the Paddlette "BP" shown in Figure 4-17. These little marvels sport a dual cantilever-type design. That is, their arms are spring brass that swings from the rear and mates with a common center post. Fine-pitched screws recessed on each side set gaps on each lever, and a tiny adjustment wrench stores in a hidden slot on the base. Gap/travel can be set right down to a feather touch for sensitive fingers. The

Figure 4-16 A wide variety of "Ne Ke" paddles to fit every need are available from NE8KE and/or KK5PY. Items shown include plug-in and vertical Ne Kes.

base on both versions is fitted with a magnetic plate that mates with another adhesive-backed magnetic plate for a desk, rig or optional knee mount. Extra magnetic plates are readily available, and make moving the paddle from one spot to another a cinch. The full-size Paddlette's base is 1.75 x 1 inch, and the "BP" or BackPacker base is 1.25 x .75 inches. The Paddlette's leg mount is really clever: It has a small metal bracket for the paddle, an adjustable buckle and a one-touch quick-release clip. Once adjusted to fit, you can snap it on/off in a second. Additionally, a small carry case for the Paddlette BP and its mating leg mount permits storing and carrying the paddle in a pocket a cinch. The Paddlettes are made by Bob Hammond, KI7VY and available by writing or "ringing up" Bob at Paddlette Company, P. O. Box 6036, Edmonds, WA 98026. Telephone 425-743-1429. Check them out, gang!

MFJ's QRP-Boosting Speaker

Before concluding this chapter, yet one more item needs to be recognized: The MFJ-283 Amplified Speaker shown in Figure 4-18. This self-contained unit is perfect for little rigs with only earphone output. It will boost the audio to one watt level, and its internal 3 x 3 inch speaker provides room-filling volume. Internally, the unit has a TDA 7053A audio power amplifier. It is powered by an internal 9 volt battery (not included) or via an external 12 volt DC source. The amplified

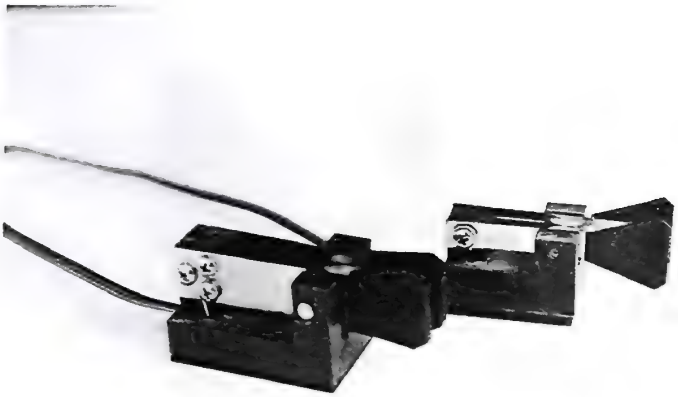


Figure 4-17 Bob Hammond, KI7VY, makes two versions of miniature "Paddlettes," and both are real winners. Left item is full-size (1 by 1.75 inches) Paddlette. Right item is tiny "BP" version Paddlette, and is only .75 by 1.25 inches.

Figure 4-18 Want big rig volume from your little QRP rig? Cable its audio output to this MFJ-283 Amplified Speaker and enjoy room-filling sound. *Photo courtesy MFJ enterprieses, Inc.*

speaker is equipped with a 3.5 mm socket for audio input, and it has a volume control on the front. Barely noticeable in the photo are side holes for audio to be emitted. This MFJ item is available at dealers nationwide.

Conclusion

Now answer truthfully, friends - with all the neat gear and goodies available at reasonable costs right now, who could resist joining QRP action! Need we make it even more enticing? Okay: discount coupons for several items featured in this chapter are included in the back of this book. Use some of the coupons to gear-up with goodies at low cost and enjoy fun all the way!

CHAPTER 5

KITS GALORE! FUN UNLIMITED!

QRPers are unique in the respect many of them enjoy building kits almost as much as getting on the air with their little treats. Yes, and assembling the hottest new rig or accessory of the day can become a pleasantly addictive pursuit. Somehow there is always one more transceiver, antenna tuner, keyer, etc. we simply must include in our radio paraphernalia. And why not: even several kit rigs cost less than a basic or "bare bones" 100 watt transceiver. Try kit building for yourself and see: it is a blast of fun, and using a rig you personally assembled is a most exhilarating experience!

Kits are particularly attractive for QRP, as they are low in cost and you get all the parts in one package (which sure beats "chasing down" elusive components!). You also get the assurance a finished product will work properly with minimum dinking or fumbling (assuming proper assembly!). One possible factor to consider, however, is whether the kit is produced commercially or as a club project. In the latter case, items like off-board connectors, controls, and a mating enclosure may be left to the builders discretion rather than included in the kit (which also explains how club kits can be ultra low priced).

Many QRPers describe kit building as a relaxing "hobby within a hobby," and even analogize it to putting together jigsaw puzzles (you do not get step-by-step instructions with the latter, however!). Some folks "jump right in" and build a complete transceiver within two or three days after it is received. Some folks order new kits as fast as they are announced and plan assembly sessions for cold winter nights. Others with very limited time (like your author!) assemble kits by installing a half dozen parts a day during lunch breaks and then soldering components plus checking each day's work briefly at night. Any of these tactics can be used. They all produce the desired results of acquiring a terrific little gem you can enjoy for many moons hence. Go for it!

How challenging is building gear from a kit and how can you estimate assembly time or complexity of various kits? A very good question, particularly if you are not an avid kit builder! There are no set guidelines here, but the technique that "works for me" is referencing on parts count. A general "getting started" rule of thumb (which can be altered according to your experience with kits) follows. Items in the 10 to 40 parts category are what I consider fun projects that can be casually assembled in an hour's time. These items also make great first projects and are ideal for newcomers. Items in the 50 to 75 or 80 parts category are in the middle of what I call the "easy brew" category. Assembly time is approximately 6-8 hours. Items in the 80 to 125 parts category are in the top end of the easy brew category and probably require 10-14 hours for assembly and checkout. Items in the 125-225 parts range are in what I call the "big time" category, and assembly probably equates to 7 or 8 days of "on and off" building. Get the idea? Remember to check

components before and after installation, use a fine-tipped and low wattage iron, quality 2% silver solder, and enjoy kit building!

TEN-TEC 1300-SERIES TRANSCEIVERS

Say you are ready to go big-time QRP with your own kit-assembled transceiver? Reluctant to pursue such a project due to visions of "no work upon completion?" We know the feeling! Rest assured, many of us have been in that same position and understand your plight. Maybe Ten-Tec has a viable answer for you in their "1300-Series" monoband CW transceiver kits. Assembly is simplified by building the kit in seven small steps or "phases" rather than as one large project. Each step or "phase" is checked and proofed "as you go" and each step is akin to building one small project (25 to 35 components). Yes, and these kits are packaged right for your success in assembly. The kit is supplied complete with all the bits and pieces, a quite elaborate instruction manual, and a professionally-finished enclosure (Figure 5-1). It even has an internal subchassis you can slide out of the enclosure for testing or modifying the finished unit as desired. Although quite small in size (2.7 by 6 by 6 inches H,W,D), there is extra room inside to add an electronic keyer and small battery pack for stand-alone/portable operations. The kit makes a very nice transceiver you can enjoy for many years hence.

Ten-Tec's 1300-series QRP transceivers are available for 20, 30, 40 or 80 meters. Their receiver section is both sensitive and selective, their transmitter pumps out a solid 3 to 4 watt

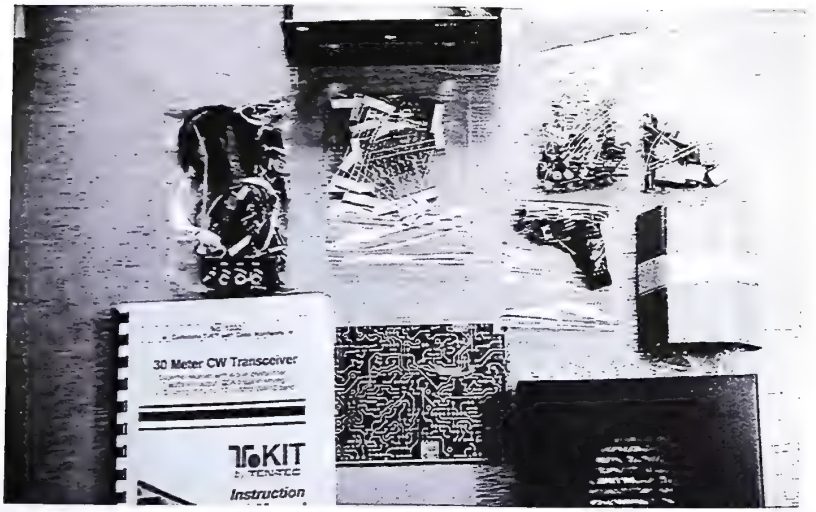


Figure 5-1 A Ten-Tec 1330 transceiver kit as received and laid out ready for assembly. Everything is included; knobs, screws, nuts, wire to wind toroids, etc. Assembly time is 7-8 days of on/off building.

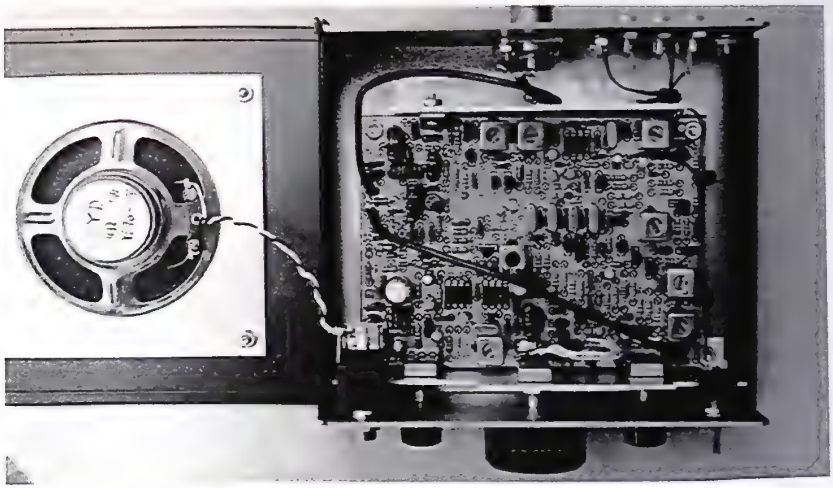


Figure 5-2 Inside view of the Ten-Tec 1330 after assembly. All components are mounted on a single pc board with front and rear subchassis.

Figure 5-3 The Ten-Tec 1330 ready for action. Rig is quite small (2.7 by 6 by 6 inches, H,W,D) and delivers a clean three to four watt signal.

signal, and their break-in operation is classic Ten-Tec -- quiet and smooth as silk. The rigs have a variactor-tuned VFO which covers any desired 50KHz range in a CW subband. Stability is exceptionally good. Each kit consists of approximately

220 parts which places it in the "big-time" category. Assembly time depends on your dedication: I would estimate six to seven days of "on and off" building to complete the unit. As mentioned previously, assembly is simplified by building the unit in steps. An inside view of the transceiver completed and fitted into its enclosure is shown in Figure 5-2, and an outside view of the little rig ready to operate is shown in Figure 5-3. I have the 30 meter version of this kit, and it is a real joy to operate. In fact, I can work any station I can hear with it -- and that includes goodies like 3B8CF in the Indian Ocean, PY7ZZ in Brazil, and much more.

Circuit-wise, the receiver section uses a JFET transistor as an amplifying mixer which drives a four pole crystal IF filter. Following amplification by another transistor, a popular NE612 is used as a product detector. A pair of LM-386 ICs are then used for additional signal filtering and bandwidth reduction plus driving a speaker or earphone. Audio derived from the ICs output is also routed to an AGC circuit for controlling gain of the IF amplifier. The transmitter section consists of an NE-612 mixer driving a three stage transistor amplifier buffer, which in turn drives a 2SC2166 power transistor to an output of three to five watts, depending on power supply voltage and current. An interesting trick is performed for sidetone monitoring: A small amount of the transmit oscillator's signal is allowed to "leak" back into the receive IF and hetrodyne with the receive oscillator. When the resulting tone is equal to a tuned in signal, the transceiver will be transmitting on the same frequency it is receiving. Both the CW

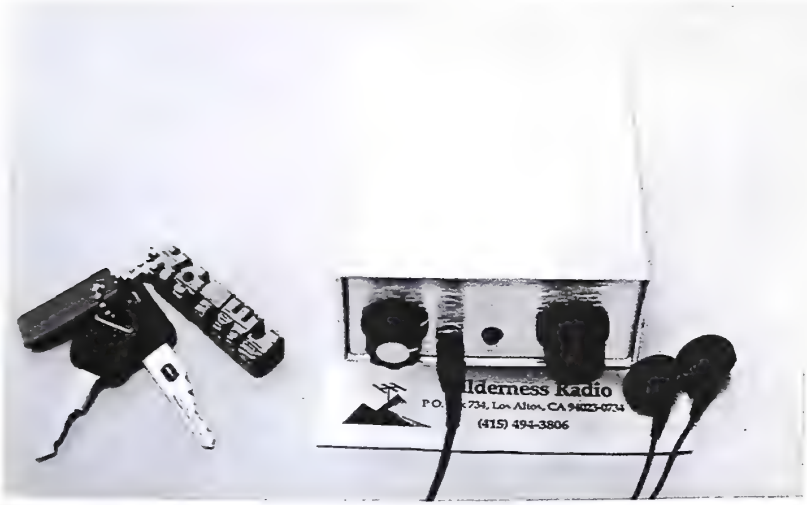


Figure 5-4 The ultra-small and smooth performing SST kit transceiver from Wilderness Radio makes a great travel rig. Unit features sharp IF filter, LED receive/transmit monitor, PIN diode QSK, off-air sidetone, and one to three watts output, depending on power source.

Figure 5-5 The SST kit as received and "15 minutes into assembly." Pausing to shoot photo was the most difficult step! Note fine-tipped iron and ultra-thin solder used to ensure accuracy without solder bridges between close pc board connections.

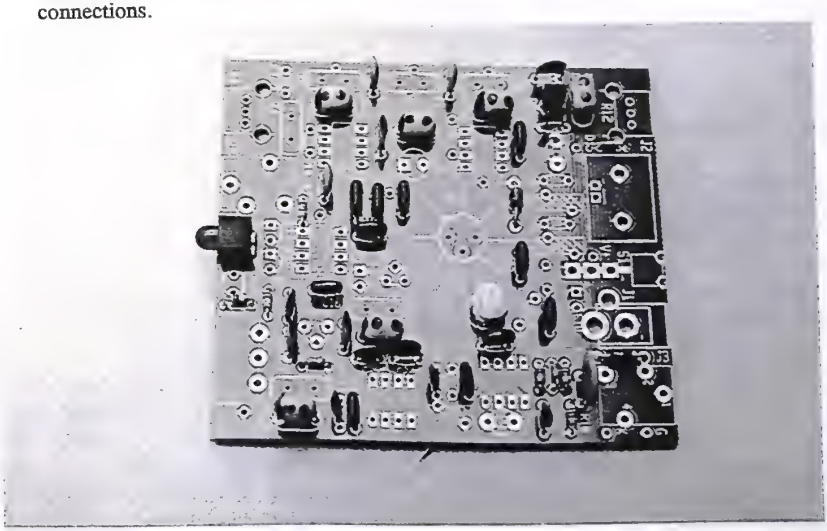


Figure 5-6 Approximately "three hours into assembly," the SST kit begins taking shape, LED on left will be signal monitor on front panel. Volume and tuning pots will be mounted on each side of LED.

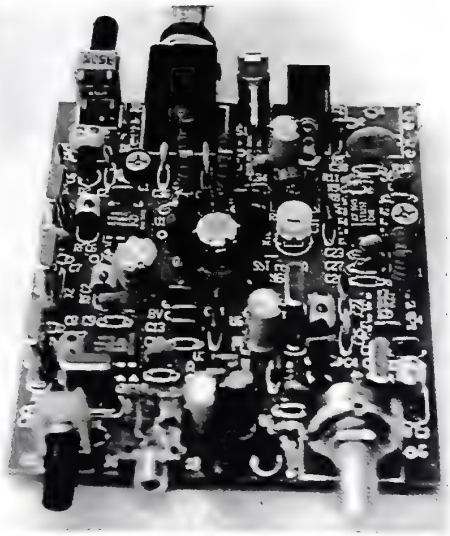


Figure 5-7 Completed SST ready to accept front and rear panels and slide into "clamshell" enclosure. Visible in front/lower area is volume control, earphone socket, LED and tuning pot. Crystal filter is on left. RF gain, antenna connector, on/off switch, and power socket are on rear. Homebrewed with pride!

sidetone and audio-derived AGC concepts may raise a few brows, it works exceptionally good in the Ten-Tec transceivers. Performance of the little rigs is outstanding. For more information on Ten-Tec's QRP transceivers, contact the T-Kit Division of Ten-Tec, Inc., 1185 Dolly Parton Parkway, Sevierville, TN 37862. Telephone 423-453-7162.

THE WILDERNESS RADIO SST

If easy to assemble and pocket-size transceivers capture your fancy (naturally: They are the hottest thing going in QRP today!), take a close look at the neat little "SST" available from Wilderness Radio and shown in Figure 5-4. This Simple Superhet Transceiver is exceptionally small (1.5 by 3.2 by 3.5 inches, H,W,D), yet optimized for big-time operation and high performance. Further, you can add a 9 volt lithium battery inside its case to make a completely self-contained rig. When combined with a small wall adapter-type supply for home use, you have a complete HF station that will fit in a coat pocket!

The SST is unique in several ways. First, all parts including front and rear panel controls, sockets, etc. mount directly on the pc board. No external wiring is necessary to complete the kit, thus simplifying assembly and making the SST a real fun project. Second, its design is versatile to permit operation with

battery voltages from 9 to 16 volts. Finally, an optional electronic keyer and CW-announcing frequency readout can be added inside the little SST's case. Talk about a lot of radio in a small package -- Wow!

The SST is a monoband transceiver available in a 40, 30 or 20 meter version. It has a quite sensitive receiver with both AF and RF gain controls plus a three-crystal IF filter with 400Hz bandwidth for single signal reception amidst QRM. The SST also sports smooth-as-silk full break-in operation with PIN diode switching, audio derived AGC with LED indicator, and true off-the-air signal monitoring for sidetone. Frequency coverage on 40 meters is approximately 10KHz around 7,040KHz, 15KHz around 10.112KHz on 30 meters, and approximately 20KHz around 14.050KHz on 20 meters. Naturally, an owner-secured crystal could be substituted on the rig's pc board for coverage of other in-band frequency ranges. Typical output of the little rig when powered from a 13.8 volt source is 2.5 watts, and 1.0 watts when power from an internal 9 volt/1200 mah lithium battery. The SST kit consists of a single 3 by 3.4 inch pc board and 77 parts. This places it midway of the "easy brew" category, and equates to an approximate total assembly time of 6 to 7 hours. After completion, alignment takes only a couple of minutes -- and can be accomplished with little more than your ears and a wattmeter. You then fit front and rear panels to the pc board, slip the unit in its case and you are ready for action. Some photos of my own SST "going together" are shown in Figures 5-5, 5-6, and 5-7. Following well-detailed instructions in the SST manual, building the little rig was actually a pleasure!

Can a transceiver barely larger than a deck of playing cards actually turn good on-the-air QSOs you ask? Yes indeed! I built the 20 meter version and worked both in-country and DX stations with it like crazy. After each session, I still look at the little rig in amazement. Everyone needs a "take it with you" mini transceiver like this!

Technically speaking, the SST's circuitry (shown in Figure 5-8) gives us good insight to modern design concepts and possible future evolutions in QRP circuits. Let's thus take a "whiplash" tour of the circuit. Starting in the upper left hand corner of the schematic, incoming signals are applied to an NE-602 mixer and downconverted to an IF frequency for a selected band. In this case, 7040MHz beats with 11.040MHz, from the VXO, to produce an IF of 4.0MHz. After passing through a three-crystal filter it is then directed to a second NE-602 for product detection. The resultant audio signal is then amplified by an LM-386, and directed to an earphone. Looking at the left bottom section, the transmitter has a separate NE-602 mixer which accepts a signal from the VXO, hetrodynes same, and outputs to an LT-1252 wideband video amplifier IC. The LT-1252's output is then used to drive a 2SC799 transistor, which is capable of more than five watts output. Now let's bring in some fine points. First, closing the key for transmit connects D1 to ground and unbalances the mixer while cutting off the received signal and forward biasing D2 to remove remnants of the transmit signal at Pin 1 of U1. This permits direct monitoring of the transmit signal with no change in volume or quality. Next, notice crystal X4 in the product detector's support circuitry. This crystal is tuned approximately 600Hz above the IF frequency to provide

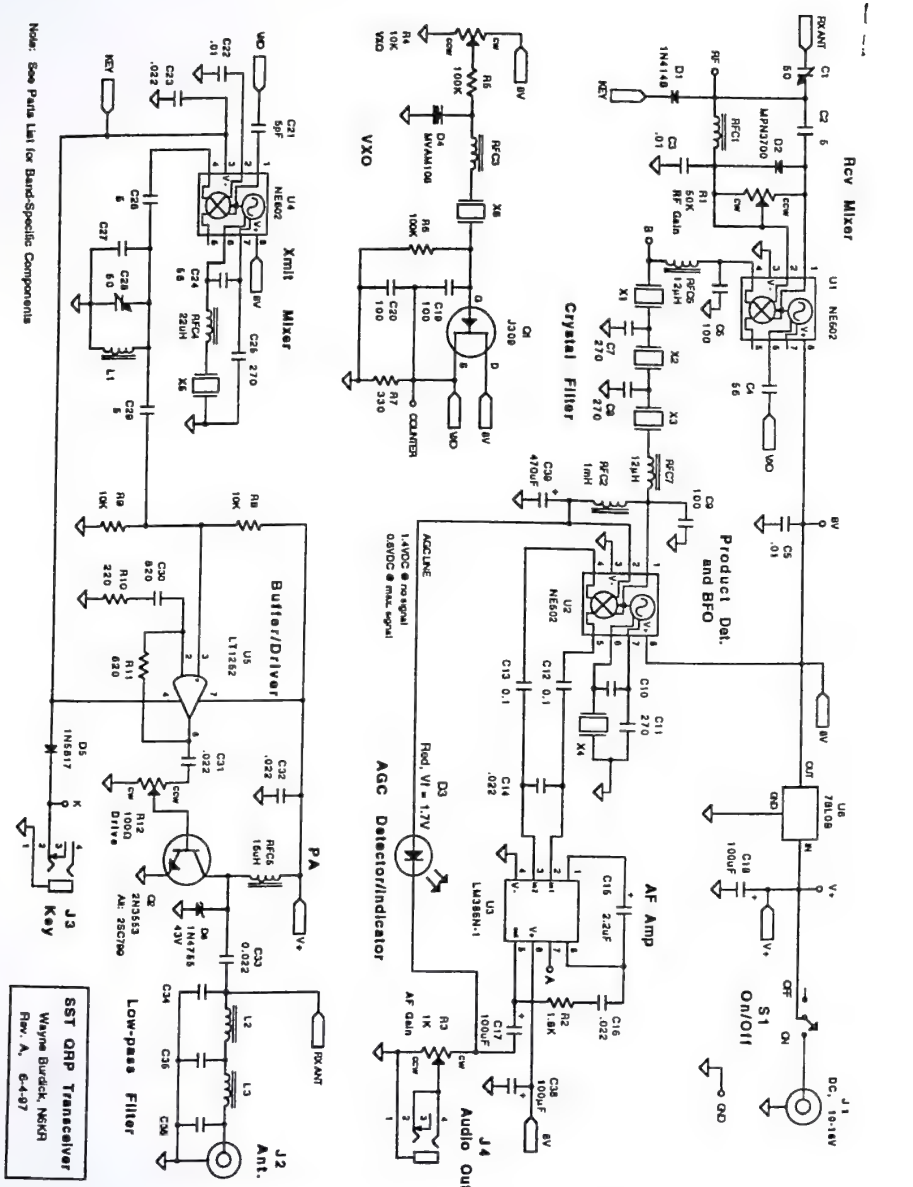


Figure 5-8 SST's circuitry diagram compliments of Wayne Burdick, N6KR. Discussion in text.

Figure 5-9 Another popular QRP transceiver from Wilderness Radio is this well-known "Sierra," which can be built in "basic" or "deluxe" style. Unit works 160 through 10 meters, according to its plug-in band module.

hetrodyning action for an audio output signal. Now look at the AGC detector: One end of D3 connects to DC ground via R3, and the other end is 1.4 volts above ground due to the internal bias circuitry of U2. D3 requires approximately 1.7 volts to become forward biased, so it has no effect when small signals are present. When AF output approaches .6 volts, D-3 begins conducting on negative half cycles and reduces the bias on U2. This provides good AGC range with minimal components plus gives a visual indication of signal strength on both receive and transmit.

Now look at the VXO circuitry. The exact frequency of crystal X6 is controlled by capacitance of variactor diode D4 which, in turn, depends on voltage applied from R4. This arrangement provides superb stability under all types of temperature variations, and also yields a respectable tuning range. As discussed in the SST's manual, additional values can be substituted for RFC3 and/or other "more warpable" crystals tried for X6, as desired for a wider tuning range. Additionally, a second variactor diode with much greater capacitance is included in the kit for folks wishing to experiment with wider tuning ranges. Finally, notice zener diode D6 connected to the collector of output transistor Q2. This zener serves as SWR protection. Assuming a 12 to 14 volt DC supply and approximately two watts output, the zener will act as shunt protection when the antenna's SWR rises above approximately 2.0 to 1. Clever! Notice the overall concept of this transceiver, friends: NE-602/NE-612 ICs truly prove meritous for frequency conversions and signal detection, while a wideband amplifier IC and power transistor work perfectly in transmitter stages. Will SBL-1 ICs eventually supersede workhorse NE-602s? Will variactor-tuned oscillators with voltage readout ICs and multiple switched potentiometers replace VFOs and conventional memory systems? Quite possibly so, but let's not forfeit a minute of time enjoying QRP operations in the meantime!

The SST and its mating/optional KC-1 CW frequency announcer and electronic keyer plus "buzz not" noise blanker are available from Bob Dyer, KD6VIO, at Wilderness Radio, P. O. Box 734, Los Altos, CA 94023-0734. Telephone 415-494-3806. Price of kit is less than one hundred dollars. Also available is the well-known "Sierra" transceiver (Figure 5-9), NorCal 40A, plus other accessories.

THE 38 SPECIAL & 44 MAGNUM

Unquestionably, the hottest mini-transceiver kit of 1997 was the "38 Special" designed by Ori Mizrahi-Shalom, AC6AN, and produced by NorCal, the North California QRP Club.

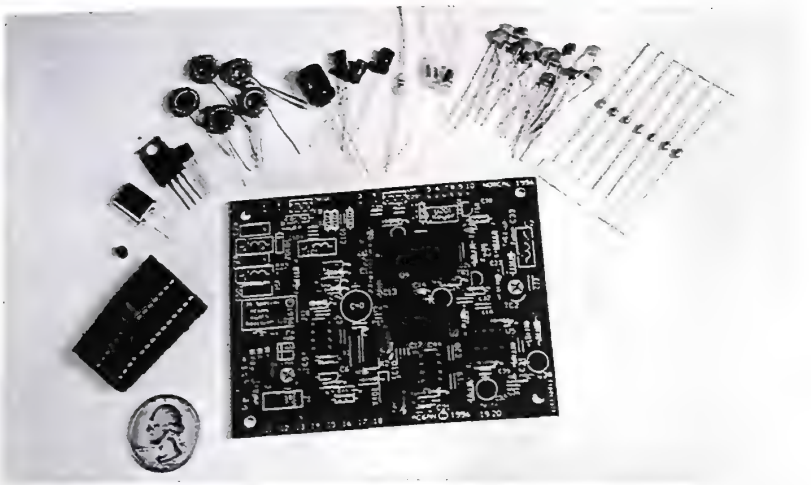


Figure 5-10 My first 38 Special approximately two hours into construction. Resistors, IC sockets and a few capacitors have been installed on the pc board.

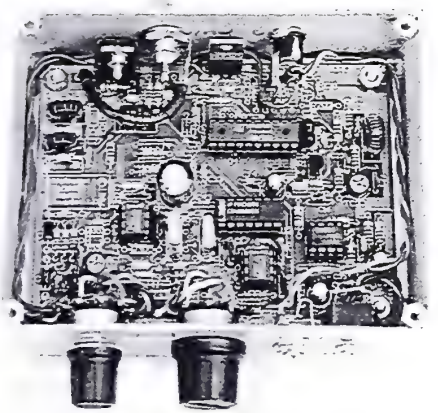


Figure 5-11 Completed 38 Special mounted in a homebrew enclosure made from copper clad pc board material. Front controls are volume and tuning. Transmitter amplifier section is in left rear.

The 38 Special was an ultra small-sized and hot performing rig covering the main (lower) 20KHz range of 30 meters. It sported a 4 IC Superhet receiver with IF filter, a narrowband audio filter, clever CW sidetone arrangement, VXO frequency control, and full CW break-in operation. On-board pc "runs" were included for an optional power MOSFET to boost output of the basic one transistor and one IC transmitter from 400mw to 5 watts output, a Tick electronic keyer, RIT and several "experimental mods." Most amazing of all was the kit's price of 25 dollars (you added controls, sockets, MOSFET, keyer, and enclosure). Time lapsed views of my own 38 Special during and after construction plus my second 38 Special mounted in a custom case made by Doug Hauff, KE6RIE, are shown in Figures 5-10, 5-11, 5-12, & 5-13. This kit was an approximate 99 parts project, which placed it at the high end of the "easy brew" category, and equated to an approximate assembly time of 9 to 10 hours. Despite a minor inconvenience of clicks or "thumps" with break-in operation, the 38 Special proved delightful to use. Indeed, I contacted stations worldwide with it during the first couple of months -- and continue enjoying using it for both in-country and international QSOs today. It is a real "romper" on 30 meters! The 38 Special "turned the corner" from direct conversion to superhetrodyne in evolution of homebrewed rigs for QRP, however, NorCal discontinued production of the kits during late 1997 (being a club project, it was time to move on to another project and keep club members homebrewing). Ah, but the good news is this highly popular transceiver kit is coming back --

Figure 5-12 My 38 Special mounted in a custom case produced by Doug Hauff, KE6RIE of the San Luis Machine Co. Rig, Paddlette and earbuds all slip in a coat pocket. This little gem has worked over 30 countries in strictly spare moments, and it is still going like crazy.

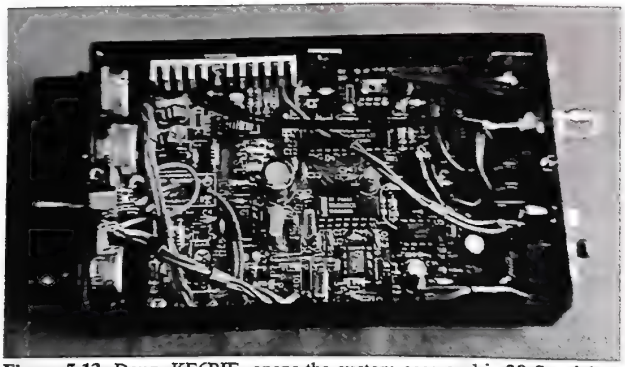


Figure 5-13 Doug, KE6RIE, opens the custom case on his 38 Special to show us how everything fits perfectly in place. Doug continues making custom enclosures for newly announced kits as time permits.

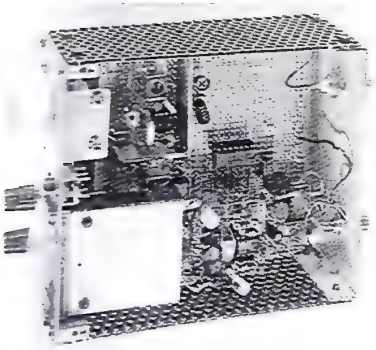


Figure 5-14 Interior view of the experimental/prototype 44 Magnum built (on perfboard, no less!) by HB design coordinator Paul Harden, NA5N, and used to refine/improve original 38 Special design. After "working out all the flaws," pc boards for kits were made. *Photo courtesy NA5N.*

and even better than before. A new company, H. B. Electronics, is presently working on a refined and improved version designated the "44 Magnum" which should be unveiled around mid 1998 (see Figure 5-14 and 5-15).

Since the 44 Magnum was under development at press time, only a

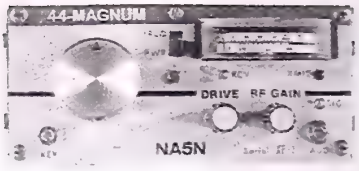


Figure 5-15 Front view of NA5N's prototype 44 Magnum gives us a general idea of how a finished unit might look. An enclosure is not included in the basic kit, however, so few 44 Magnums will look identical - unless someone produces custom cases. *Photo courtesy NA5N.*

conceptual diagram was available for study and sharing. That diagram is shown in Figure 5-16. Let's take a quick tour of its design. Beginning at the left top, the level of incoming signals is adjusted by an RF Gain control and then directed through a toroidal transformer to the input of receive mixer U1: A popular NE-602. This IC's local oscillator is crystal controlled by X1 at 22.1MHz. The difference between a selected incoming frequency (10.110MHz, approximate) and the local oscillator (22.1MHz) thus produces an IF of 12MHz. This signal proceeds through X2, on through one of four bi-lateral switch sections in U2 (CD4066) and into the product detector/transmit mixer U3. Here, the signal hetrodynes with another 12.0MHz signal generated by X3 and the mixer in U3, and audio output is available at Pin 4 of U3. A diode-switched capacitor shifts the frequency of X3 approximately 650Hz during receive to produce a zero-beat audible tone. During transmit, the diode shorts the capacitor so the transmitter's output is on exactly the same frequency as an incoming signal. Audio from U3 then proceeds through the 2N3904 and on to bilateral switch U2b. During receive, the "second bilateral switch" connects output from the 2N3904 to the TL082 dual op amp. The two sections of TL082 serve as a combination CW filter and audio amplifier: Their overall bandwidth is 200Hz at -6db and 1500Hz at -30db. Output from the op amp is applied to the earphones. Now, let's trace the transmit path. Returning to U1, its 22.1MHz signal routes to the lower bilateral switch in U2A. During transmit, U2's upper switch is open and its lower switch is closed. This applies the 22MHz signal to U3. The signal hetrodynes with 12MHz from crystal X3, and produces an approximate 10.100MHz output. At this time, the upper switch in U2b is open while the lower switch is closed. This allows the transmit signal to proceed on to the transmit drivers, on to the 5 watt PA, and to the antenna output. As we look closer at the 44 Magnum's diagram, some very interesting points come to view. First, the overall purpose of U2 is routing receive signals in and out of U3 during receive mode and routing a local oscillator signal in and out of U3 during transmit. As such, it eliminates the need for a separate NE-602 as a transmit mixer. Next, notice how the VXCO is tuned: Voltage from the tuning potentiometer causes a varicap to shift capacitance and thus change the frequency of X1. Finally, we should point out the simplicity of aligning a completed transceiver. One merely peaks the receiver's input coil for strongest signals and peaks the transmit driver for the cleanest (spectrally pure output signal). The full alignment procedure can thus be done by hand and with an auxiliary receiver. Will future QRP transceiver

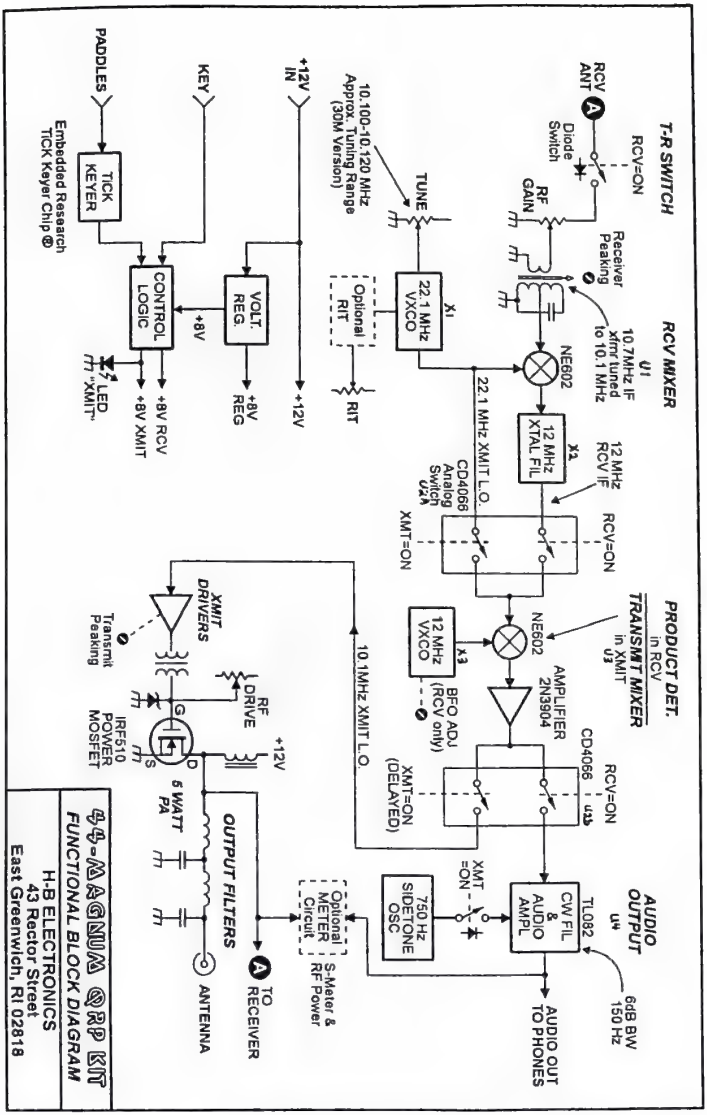


Figure 5-16 Conceptual diagram of the new 44 Magnum from HB Electronics. Discussion in text.

designs follow these ideas of signal switching with analog ICs or continue using separate transmit/receive mixers? Will CMOS buss drivers or video amplifier ICs gain popularity as drivers of low power amplifiers? Even more interesting is the question will NE5532s give way to the TL082. A completed circuit diagram of the new 44 Magnum was not available when this chapter was being written, primarily because H. B. Electronics was busy redesigning problem areas and developing prototypes of the new 44 Magnum. By the time you read this, the new transceiver and its circuit diagram should be available and can be compared with the original 38 Special for greater understanding of technical theory of operation. In talking with H. B. Electronics, I understand their main focus is on improved IF filtering, reduction of T/R switching "thumps," and a solid output of five watts without heat. With those goals accomplished, and considering a target kit price of under 50 dollars, the new kit promises to be very popular. For more information, contact Bob Berlyn, N1PWU, H. B. Electronics, #43 Rector St., East Greenwich, RI 02818, telephone 401-885-2497.

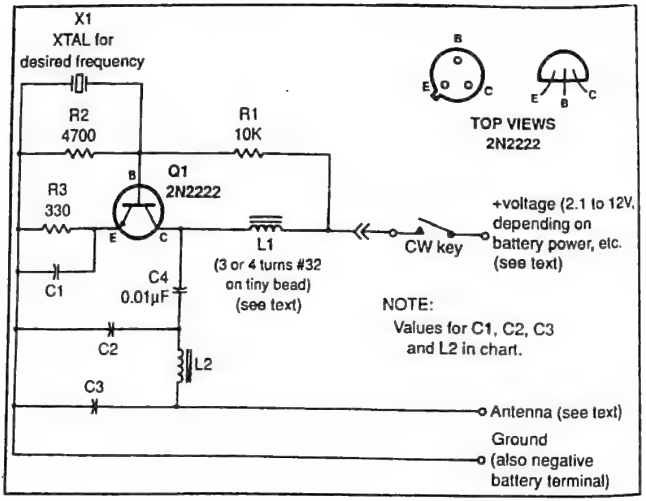
THE MICRONAUT QRPp TRANSMITTER

Shifting into the mini-kit and "quick brew" category, our spotlight now falls on a simple fun project for milliwatting and microwatting, in-shack demos of keys and rigs, a reference signal for checking fleamarket gear and more: The Micronaut transmitter kit shown in Figure 5-17. The Micronaut was originally featured in my April and May, 1996 CQ "World of Ideas" column, re-featured by request in my August, 1997 and August, 1998 CQ columns, and folks continue ordering the kits today. Although quite simple, this little gem has actually "reached out" to Australia, Brazil, and several Caribbean islands. Further, it makes an ideal "first project" for introducing newcomers to

Figure 5-17 The easy-brew Micronaut transmitter kit shown in various stages of assembly. Little tyke can be powered by Tabasco sauce, grapefruits or watch batteries - a real fun project. Kits available from K4TWJ.

QRP and/or homebrewing. Particularly unique is the Micronaut's ability to operate on extremely low power sources like Tabasco sauce, tomatoes, and grapefruits. That's right: Just pour some hot sauce into a small glass, place a zinc-coated screw on one side and a nail on the other side, connect wires, measure voltage, and use it to power a Micronaut! 1.2 or 1.25 volts will yield an output of approximately 500 microwatts. Using a common 9 volt battery, power output will be increased to 300 or 400 milliwatts. As you will recall from our opening chapters, this low power is quite sufficient for spanning long distances and/or having fun making local contacts.

The Micronaut is a true pocket-size rig, with a pc board measuring 1.5 x .75 inches, and consisting of approximately a dozen components. Its circuit diagram shown in Figure 5-18 is a basic oscillator using a PN-2222 which, with proper biasing, operates at voltages



Band	C1	C2	C3	L2	Inductance (uHy)
20 m	270 pFd	270 pFd	270 pFd	12 turns #28 or #30 on T-50-2 core	.720
30 m	330 pFd	330 pFd	330 pFd	13 turns #28 or #30 on T-50-2 core	.980
40 m	470 pFd	470 pFd	470 pFd	16 turns #28 or #30 on T-50-2 core	1.280
80 m	750 pFd	750 pFd	750 pFd	34 turns #30 or #32 on T-50-2 core	5.780

Figure 5-18 Circuit diagram of the Micronaut transmitter. Emitter resistor can be decreased in value to increase output power. Warping circuit can also be added to crystal for variable frequency control. Prewound molded inductor is now included in kit to eliminate winding a toroid coil.

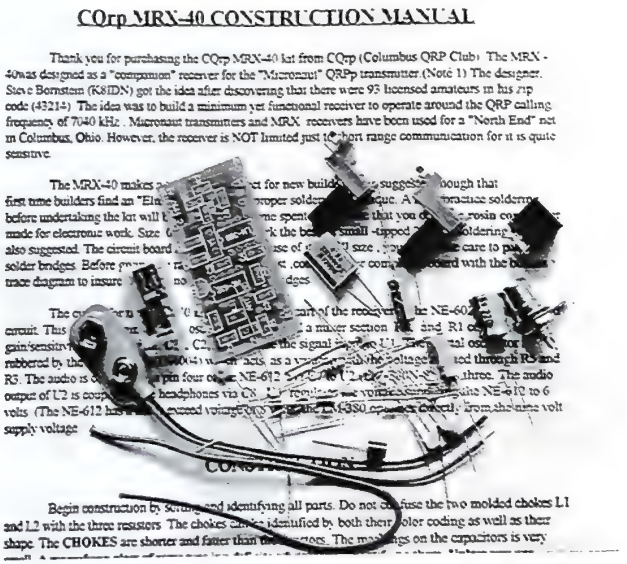
too low for other basic oscillators to work. All components and connectors mount directly on the Micronaut's pc board and the little transmitter can be assembled for 80, 40 or 30 meter operation. Although not a "big-time" project like an SST or 44 Magnum, the Micronaut continues faithfully serving its intended purpose in high style: Convincing folks they can build something that actually works at first "fire up," and inspiring creative fun. One chap, for example, used a small slot car motor connected to the shaft of a hamster's running wheel to power a Micronaut. When the little animal exercised by running at night, the ham Micronauted like crazy! Another chap installed his Micronaut inside a center insulator for a dipole and routed key voltage up to it via coax cable for low-loss microwatting experiments. Personally, I like sneaking up on someone tuning a receiver at a hamfest or dealer showroom and ask if they hear the DX station calling them on (my Micronaut's) frequency. It often results in a real show-stopping gag! Expansions to the Micronaut like an additional RF amplifier stage for more power and/or a warping circuit for the crystal, etc. are endless and, yes, friends "Mark II or Mark III" versions are possible in the future--if I can only find time to produce them. Micronaut kits are available for 15 dollars plus 2 dollars S & H from Dave Ingram, K4TWJ, 4941 Scenic View Drive, Birmingham, AL 35210.

THE MRX-40 Micronaut Receiver

Lighthearted hamming and micronauting with tiny rigs received a real boost in popularity when Steve Bornstein, K8IDN, accepted our invitation/challenge to design and build a mating receiver for the previously highlighted Micronaut Transmitter. Working with only one NE-602/612 IC and a popular LM-380, Steve produced the "MRX-40" Micronaut Receiver Kit for 40 meters shown in Figure 5-19 and 5-20. The little "Micronaut Twins" quickly proved their merit in local area communications among members of the Columbus, Ohio QRP Club, and "kitting" the MRX-40 became a club project. Like the Micronaut Transmitter, the MRX-40 is an ideal first project for new homebrewers. It consists of approximately 23 parts, placing it in the one hour or quick-brew category. Although originally designed for 40 meters, it can also be modified for 80 or 30 meter operation by changing its crystal and input coil/capacitor. The receiver's pc board measures 1 x 2 inches, and is ideal for ultralight portable operating or general band monitoring. The receiver and transmitter combo make a complete HF station you can hold in the palm of your hand -- what a treat! Being direct-conversion, you can also listen two or three KiloHertz each side of a tuned frequency without continuous readjustments. Neat!

Technically speaking, the MRX-40's circuit diagram is beautifully basic and easy to understand (Figure 5-21). An NE-612 functions as both an oscillator and mixer, converting incoming signals from tuned circuit C1/C2 and L1 directly to audio, which is then coupled from Pin 4 of the NE-612 to Pin 3 of the amplifier chip LM-380. The audio is then boosted to a high level for driving an earphone or even a small speaker and that output is available at Pin 6. The oscillator's frequency is controlled by crystal Y1, which is a standard HC-6 type and

supplied with the kit. The crystal's frequency can be warped several KiloHertz each side of center by D1 which acts like a varicap in series with L2. Potentiometer R5 controls the voltage applied to the varicap for tuning, while R4 controls overall gain of the receiver. The 78L06 is a simple three-terminal regulator used to ensure six volts is applied to the NE-612 while full input voltage is applied to the LM-380. Although surely not optimum, I converted my MRX Receiver


COrp MRX-40 CONSTRUCTION MANUAL

Thank you for purchasing the COrp MRX-40 kit from COrp (Columbus QRP Club). The MRX-40was designed as a "companion" receiver for the "Micronaut" QRPp transmitter (Note 1) The designer, Steve Bornstein (K8IDN) got the idea after discovering that there were 93 licensed amateurs in his zip code (43214). The idea was to build a minimum yet functional receiver to operate around the QRP calling frequency of 7040 kHz . Micronaut transmitters and MRX receivers have been used for a "North End" net in Columbus, Ohio. However, the receiver is NOT limited just to short range communication for it is quite sensitive.

Begin construction by sorting and identifying all parts. Do not confuse the two molded chokes L1 and L2 with the three resistors. The chokes are identified by both their color coding as well as their shape. The **CHOKES** are shorter and fatter than the resistors. The markings on the capacitors is very

Figure 5-19 The MRX-40 Micronaut Receiver kit laid out and ready for assembly. Unit is powered by a 9 volt battery, and works like a champ. Kits available from K8IDN.

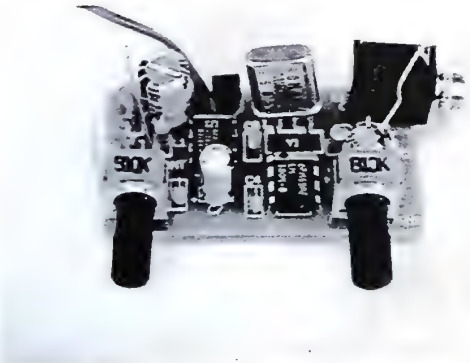


Figure 5-20 The MRX-40 assembled, modified for 30 meters like discussed in text, and ready for action.

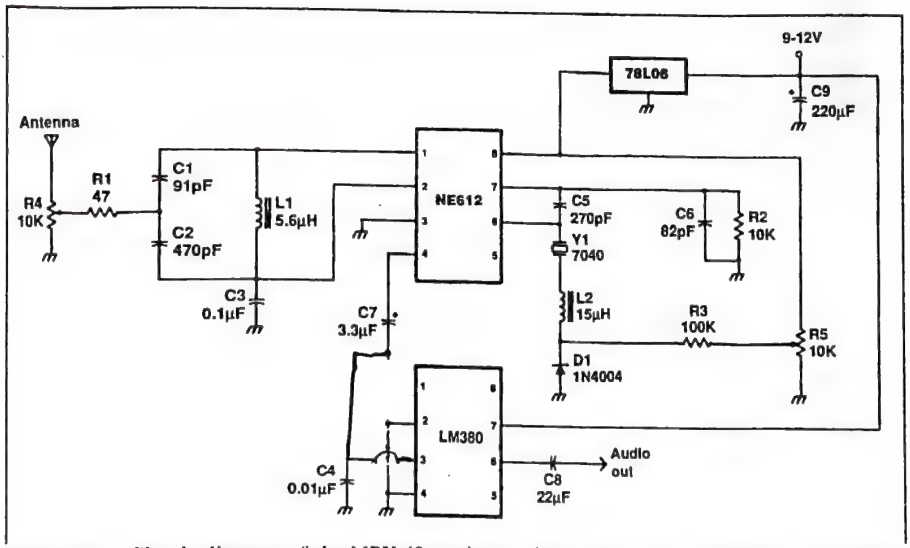


Figure 5-21 Circuit diagram of the MRX-40 receiver. Little gem is Direct Conversion with varicap tuning. Discussion in text.

for 30 meters by changing C1 from 91pfd to 68pfd, C2 from 470pfd to 330pfd and L1 from 5.6UHy to 4.7UHy. Being in a hurry, my logic was simply scaling inductance and capacitance down for a higher frequency -- and the results worked fine. A similar arrangement should be applicable to other bands. In many ways, this little receiver seems like a modern solid state equivalent to those classic Two-Stepper/two tube receivers of yesteryear--and, yes, just as much fun to use! As this book was being written, MRX Receiver kits were 18 dollars postpaid and available from Steve Bornstein, K8IDN, 475 East North Broadway, Columbus, OH 43214.

Those Terrific Tick Keyers

Are you still using a hand key with your QRP transceiver(s)? Do not feel despaired; until recently, they were the logical choice because electronic keyers were larger and more expensive then mini QRP rigs. Ah, but the introduction of several tiny IC keyers from Embedded Research Company is favorably changing that situation. These new electronic keyer kits are true QRP in both size and cost. They are available in four versions, and all are absolutely terrific! Ticks are unique in the respect they use a single pushbutton for speed adjustment, tune/key down function, right or left hand paddle selection, sidetone on/off, iambic A or B operation and manual key mode. During selection, keyed output is disabled while letters corresponding to selections are emitted from the keyer's pizo buzzer. Alternately, you can connect a Tick so its sidetone and/or selection telemetry is routed through audio stages of your rig. Tick-2s are identical except they include

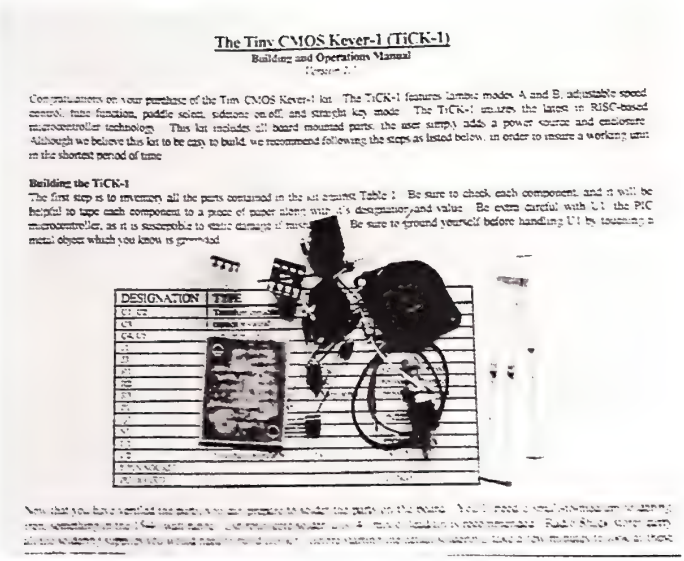


Figure 5-22 A small Tick-1 electronic keyer kit from Embedded Research ready for assembly. With less than a dozen parts, it will be completed and operational in less than an hour's time.

a 20 character memory you can program with a desired message. A new Tick-2B adds a beacon mode in its functions, plus it accepts a lithium cell for memory retention. Another version, the Tick-2EMB, supports extreme RF immunity and stand-alone operation with all parts directly board-mounted. If preferred, you can also purchase Ticks in tiny surface mount kits or buy only the keyer chip and "embed" it in your rig. Now that is versatility plus!

All Ticks operate from a 5 volt, 9 volt or 12 volt DC supply. During use, they draw less than one milliamp of current. When not in use, they immediately go into sleep mode and draw less than one microamp of current. When powered by a conventional 9 volt battery (90ma), typical battery life is close to a year!

A Tick kit laid out and ready for assembly is shown in Figure 5-22. It consists of less than a dozen parts, placing it in the one hour/quick-brew category. The keyer's pc board is only one inch-square. The kit is also supplied with a socket for the IC so upgrading or changing versions of Ticks during the future is no problem. The manual is laid out very well and makes assembly a snap. A completed Tick ready to install in a case or rig is shown in Figure 5-23. The item in the upper right corner marked "AT-12" is the pizo buzzer.

The Tick's basic circuit diagram is shown in Figure 5-24. Notice everything except the keyer transistor and a few support components are built into the little IC! Notice, also, the user has a choice of applying three to five volts directly or using 9 or 12 volts and adding the three

Figure 5-23 Completed Tick keyer photographed after assembly and check out. All functions like speed adjust, key/tune mode, sidetone on/off, etc., are controlled by that single pushbutton. Unit is small enough to embed in a rig, or mount in a tiny enclosure.

pin-5 volt regulator circuit. Using the completed Tick Keyer is a sheer delight: You simply press the pushbutton to select various functions which are announced in Morse. You then choose the desired function with a tap on the dot or dash paddle for on/off, etc. For speed adjustment, you select "S," then hold the dot paddle to increase wpm or the dash paddle to reduce wpm. These little critters are fantastic: You simply must try one to appreciate it! As this information is being written, Tick chips (only) are priced between 5 and 12 dollars, depending on a desired version and full kits are priced between 16 and 24 dollars postpaid (although strictly a personal opinion, I suspect prices will be necessarily increased slightly during the months ahead. Actually, I do not understand how they can produce Ticks at such low cost!). Ready to "get ticking?" Contact Embedded Research, P. O. Box 92492, Rochester, NY 14692. Telephone 716-359-3941.

The Embedded Research Tixie Transceiver

Embedded Research continues to pump out the goodies! As this chapter is being written, they are announcing a new mini-transceiver kit called the "Tixie." It combines an increasingly popular Pixie 2 circuit and a Tick-2B keyer on a 3 by 3 inch pc board, resulting in an easy to build pocket rig for 80, 40 or 30 meters (Figure 5-25, 5-26, and 5-27). The kit consists of the pc board, Tick keyer chip,

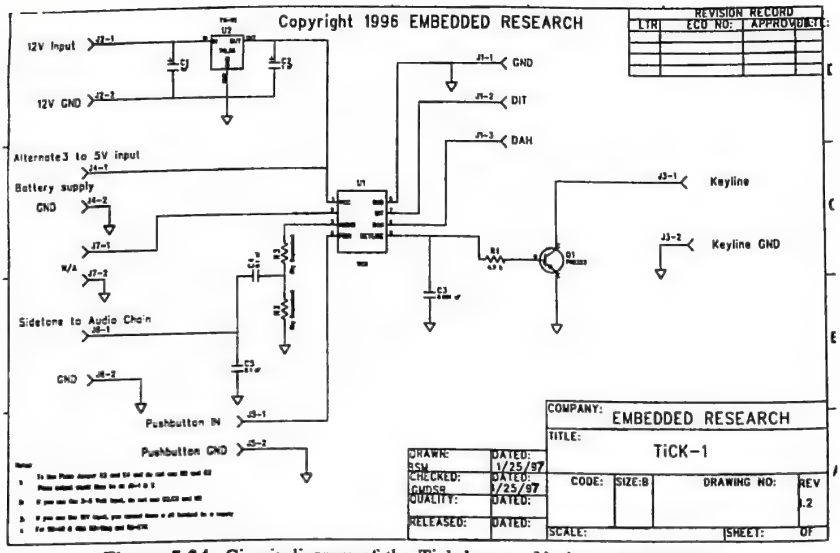


Figure 5-24 Circuit diagram of the Tick keyer. Variety of Tick chips can be interchanged in socket to make the most personally-attractive keyer desired. Kits and chips available from Embedded Research.

circuit diagram, data sheets and construction notes, but less (easily obtained) parts to minimize kit cost. Neat idea.

Several versions of the Pixie and Pixie 2 circuit (all similar in basic concept) are presently in circulation, and I am not sure who receives credit for their original design. I recall first seeing its concept of using a transmitter's output transistor to serve "double duty" as a receive detector/mixer several years ago in the "FOXX" transceiver designed by GM3OXX. Then, a variation of the circuit surfaced as the Micro-80 from RV3GM and an article on adding mods to the somehow-renamed Pixie 2 circuit appeared in the winter '97 issue of QRPp Magazine. Regardless of its background/history, the Pixie 2 is a dandy "weekend project" or "first project" guaranteed to turn a high "QSO per investment" ratio! It is originally intended as a simple Direct Conversion transceiver for 80 meters with 250 to 500 milliwatts output. By changing its crystal and output capacitors/coil, however, it will work 40 or 30 meters with equal performance. Remember W1FB's Tuna Tin 2 transmitter? It pumped out 300mw, and folks worked thousands of miles with them. You can do equally well with this rig! Point accepted, but still prefer more "oomph?" Okay, since IRF-510 MOSFETs are "transparent" or bilateral, you can add a homebrewed 5 watt amplifier to a Pixie, Pixie 2 or Tixie for a big-time signal without any T/R switching. That's right" your rig can "hear through" an IRF-510 and it will boost your transmit signal -- without switching. Pixies are indeed versatile little circuits that can be

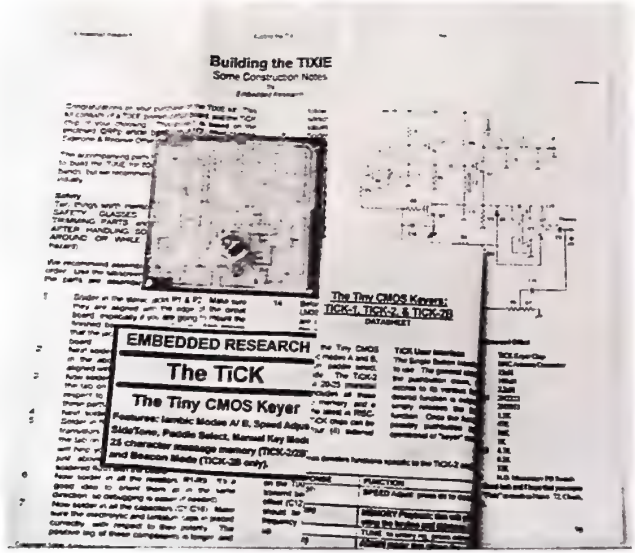


Figure 5-25 A scrounger and skinflint's delight! New "Tixie" mini-transceiver kit from Embedded Research is supplied with pc board, Tick keyer chip, circuit diagram and assembly notes. You add easily-obtained parts to build the rig, and pocket the savings.

expanded in dozens of ways. There's more! An on-the-air Pixie/Tixie contest has just been announced. Order up a Tixie kit from Embedded Research and join the fun!

The KnightSMiTe Pixie 2 Transceiver

After squeezing in the previous last minute addition about the new Tixie kit from Embedded Research, yet another version of Pixie 2 kit was unveiled by The Knightlites QRP Club of North Carolina. Wow--QRP is blowing wide open with action! The two kits are similar in the respect one "generic theory of operation" is applicable to both (assuming you "fill in the blanks" on minor variations), but differ in their size and method of assembly. The Embedded Research Tixie is a regular "leaded components"-type kit, whereas the KnightSMiTe Pixie 2 is a miniature surface mount kit with microchip-type components. Let's thus begin with an overview of Tixie/Pixie circuitry, then bring in details of the KnightSMiTe kit.

Refer to Figure 5-28 for our following discussion, then relate facts back to Figure 5-27.

Two transistors Q1 and Q2 form the heart of the transceiver. Q1 operates as a Colpitts Crystal Oscillator which produces a carrier at the transmit operating frequency. It also serves as a local oscillator during receive, permitting detection of signals appearing within a

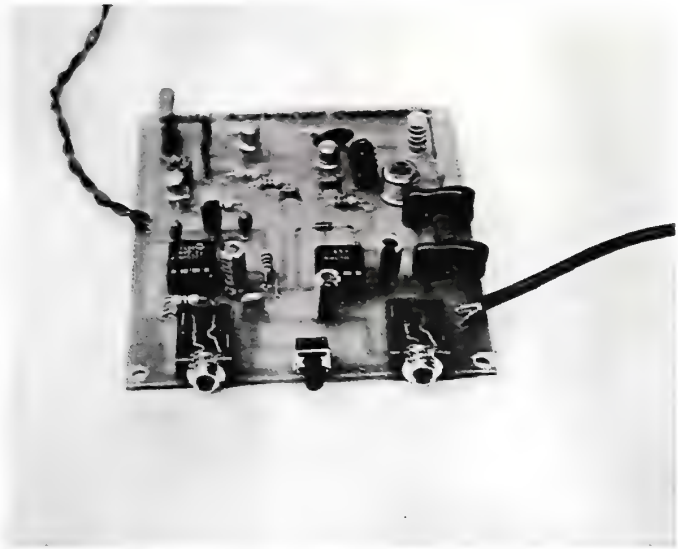


Figure 5-26 Fully assembled and ready for operation Tixie transceiver. Front sockets accept plugs from paddle and earphones, and pushbutton between them selects Tick functions. Easy brew rig produces 500mw signal on 80 meters, and is easily modified for other bands.

few hundred Hz to several KHz either side of the operating frequency.

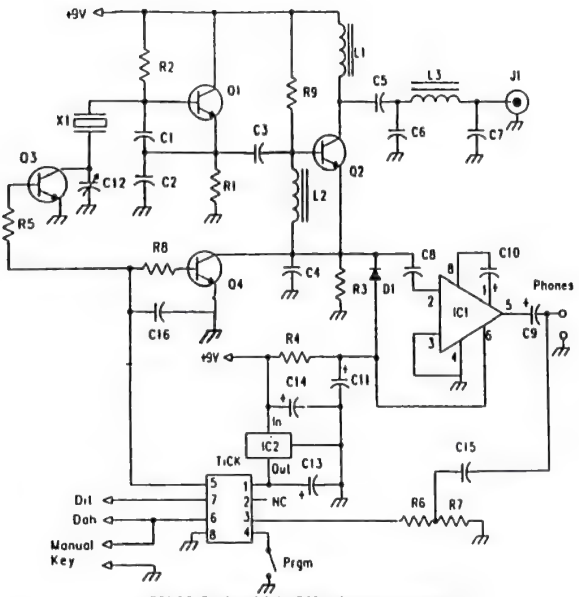
C1 offers a limited adjustment to the nominal operating frequency of a KHz or so to provide sufficient offsetting of KnightSMiTe pairs and enable intercommunications while permitting a pleasing receive tone.

An attribute of typical CW communications protocol is that responding stations tend to zero the transmit carrier of the station being called. This produces a zero beat (no receive tone) in direct conversion receivers which receive on precisely the same frequency which the transmitter transmits.

An attempt to remedy this is provided in the KnightSMiTe design and with careful adjustment, a difference of a few hundred Hz between transmit and receive frequencies can be realized. There is significant interaction between transmit and receive offsets, however, and this is due to the finite capacitance of the switching diode D2 which switches between a high reverse bias and zero bias during receive and transmit respectively while keying. This arrangement is not ideal, but it works.

A more elegant approach would replace C1 with a variactor with separate bias set points for transmit and receive. The transmit frequency could be fixed at mid range and an RIT to either sideband could be realized.

R7 (a zero ohm resistor) provides a return path to ground to keep the oscillator running continuously during both transmit and receive. It can be removed and the oscillator keyed in



K1CL Pixie with TICK Sidetone and Offset

sion of the Pixie should help even more. However, all of these additions do increase the complexity of what was originally meant to be the ultimately simple transceiver.

Parts List:

C1,2	100pF
C3	82pF
C4	.05uF
C5,15	.01uF
C6,7	820pF
C8	.1uF
C9,10,11	10uF/16V
C12	5-50pF Variable Cap
C13,14	1uF/16V
C16	.001uF
D1	1N914
IC1	LM386
IC2	78L05
IC3	TiCK Keyer Chip
J1	BNC Antenna Connector
L1	15uH
L2	100uH
L3	2.2uH
Q1,3,4	2N2222
Q2	2N3053
R1	1.5K
R2	47K
R3	10K
R4	1K
R5,6,8	4.7K
R7	8.2K
R9	33K
SW1	N.O. Momentary PB Switch

Good luck and I hope that you enjoy your "Pixie" as much as I have. 72, Chuck, K1CL

Figure 5-27 Tixie circuit is a combination of Pixie 2 transceiver and Tick keyer chip, with switching transistor Q3 used for receiver offsetting and Q4 used for keying transmitter. IC2 is regulator for Tick. R6 and R7 set level of sidetone from Tick. Figure compliments Embedded Research, K1CL, and NorCal/QRPp.

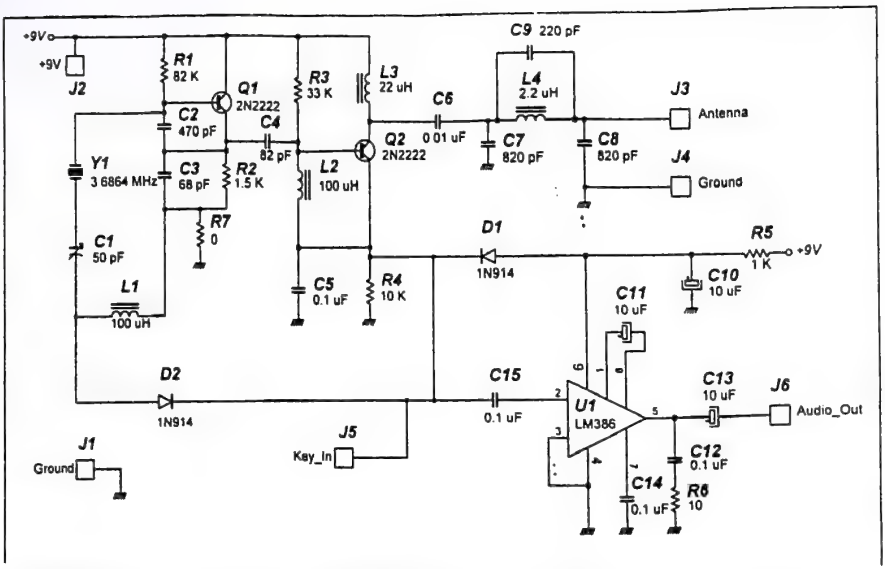


Figure 5-28 Circuit diagram of the KnightSMite Pixie 2 transceiver kit produced as a surface mount project by the Knightlites QRP Club. Only two transistors and one IC comprise the complete rig, which include receiver offset and VXO tuning. Discussion in text.

concert with the final (Q2) to serve as a QRPp transmitter with an independent receiver should you tire of using the KnightSMiTe as a transceiver.

Q2 serves as a class C power amplifier during transmit and delivers approximately 250 milliwatts to an antenna. Q2 is only lightly forward biased (a few microamps) during receive and it serves as an active mixer. Q1 serves as the local oscillator driving the base of Q2 and RF is coupled from the antenna into Q2's collector.

C5 and R4 serve as an audio low pass filter (LPF) and remove the radio frequency components appearing at the mixer output (the emitter of Q2). The resultant signals (those which appear within a few KHz either side of the oscillator carrier frequency) are thus extracted as baseband signals (the audio range in this design) resulting from the algebraic difference between the local oscillator (running at the crystal frequency) and the received signal. This process is what is termed direct conversion which, in this case, means that the desired signal is converted directly to an audible tone. The actual tone that is heard represents the distance in frequency that the received signal is displaced from the frequency of the crystal oscillator serving as the local oscillator. It should be clear now why it's not desirable to have the oscillator operate at the same frequency during both transmit and receive when in practice, most stations attempt to match

your transmit frequency when responding.

The audio from the output of the LPF consisting of C5 and R4 is coupled to the audio amplifier U1 via capacitor C15 which removes the DC bias (emitter voltage) component and audio frequencies below 150 Hz. The tone at which the audio gain peaks is set by the RC time constant of C5 and R4 which is approximately 1000Hz.

Finally, U1 amplifies the detected signals approximately 46db and presents them to the speaker or headphones connected to J6 via capacitor C13.

Keying is achieved by grounding J5 which shorts the audio input of amplifier U1 and reduces the power supplying the audio amplifier to approximately 0.7 volts via the voltage drop across diode D1. This effectively disables the receive function while transmitting and only a small click is heard in the headphones or speaker during keying due to the making and breaking of this connection.

The receive audio LPF composed of C5 and R4 is also shorted to ground placing the emitter of Q2 at ground potential and thus setting its gain to maximum. Q2 then operates as a class-C RF power amplifier boosting the oscillator output to nearly 250 milliwatts as measured at the output connector J3.

The RF output is taken from the collector of Q2 and coupled via C6 to a LPF designed to reduce the harmonic content of the transceiver to well below FCC limits. The LPF also suppresses signals around 80 meters from creating interference to the KnightSMiTe during receive. Our special thanks to the Knightlites QRP Club for providing the

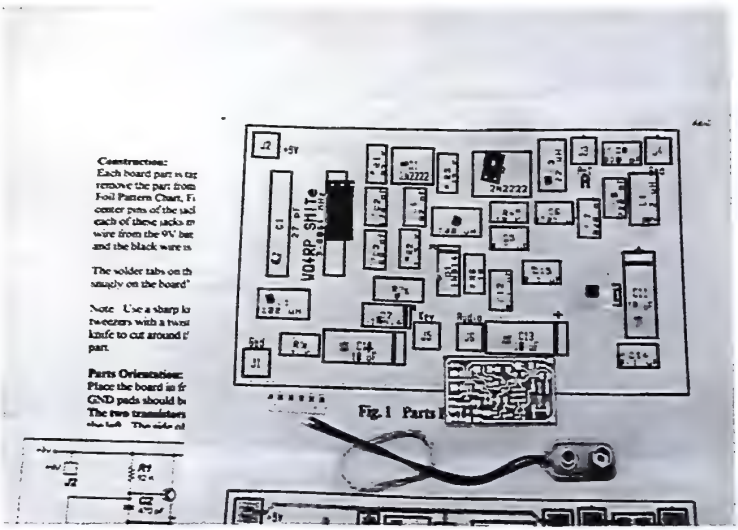


Figure 5-29 The KnightSMiTe kit is laid out for easy assembly, with each component taped to a guidesheet indicating its point of installation on pc board. You just lift components and solder them one at a time.

previous information.

Now looking closer at the KnightSMiTe kit, it is an all-surface mount transceiver you assemble on a pc board 1 by 1.75 inches in size. Each component is taped to, and identified on, a parts placement chart included with the kit (Figure 5-29). Using fine eyebrow tweezers, you remove one part at a time, and solder it on the pc board. Working with parts the size of a pin head is easy if (and only if!) you have the right tools. Use a pair of 10X magnifying goggles (YLs use them to sew needlepoint), tiny tweezers, ultra-fine solder, and a 10 watt iron with a pinpoint-size tip. Then, assembly becomes a proud accomplishment. Hearty congratulations to the Knightlites QRP Club for producing this unique kit. One word of advice: jump quick if you want one. Kits will probably be available until December, 1998. Beyond that time, availability is unknown. Kits are available from Bob Kellogg, AE4IC, 4708 Charlottesville Rd., Greensboro, NC 27410.

Important Notice!

Please understand this area of QRP kits is extremely vast and including all presently-available gear is simply impossible. Likewise, there are surely many more new companies preparing gear to announce after this book is printed. Inclusion/exclusion of products from any companies know or unknown is not intentional: It was necessary to achieve publication in proper time! Remember, I am only your "tour guide," and questions regarding various kits are best and quickly answered by talking directly with their manufacturer. Hopefully, you will build some of the kits and we can QSO on 30 meters one week night soon! Good luck building the kits -- and remember to allow time to enjoy using them on the air!

CHAPTER 6

HOMEBREW QRP: A LOW COST TREAT!

Sometime within every QRPer's life, the need or drive to homebrew a particular item "right from scratch" becomes an irresistible urge. Such admiral endeavors are the focus of this chapter: it highlights a variety of tried and proven circuits you can assemble "perfboard style," use in a lighthearted manner, and modify or expand to your heart's content. Enjoy!

KY8I's Michigan Mighty Mite

A good friend and fellow QRPer, Tom Jurgens, KY8I, recently described a neat little QRP transmitter he built in only a couple of hours time. Tom snapped the circuit together using available parts, and contacted several states "right off the bat." Obviously, a rig of that nature is too good to keep secret! A picture of Tom's Mighty Mite is shown in Figure 6-1, and its circuit diagram is shown in Figure 6-2. The transistor is a popular 2N3053, or Radio Shack equivalent. Resistors are one-quarter or one-half watt, and almost any type of crystal will work fine in this circuit. A small 365pfd trimmer capacitor salvaged from a defunct AM pocket radio is used for tuning. The transmitter's coil is wound on a 35mm plastic film container (approximately 1.25 inches in diameter). Tom glued the film container to the perfboard for easy assembly. For 40 meter operation, the coil consists of 21 turns of No. 22 or 24 wire tapped at 7 turns. For 30 meters, wind 15 turns of the same size wire tapped at 4 turns. For 20 meters, wind 11 turns of the same size wire tapped at 4 turns. For 80 meter

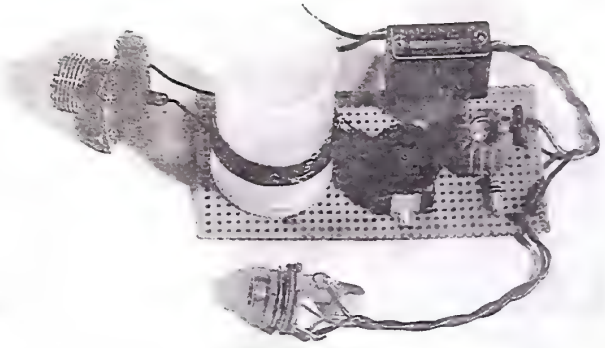


Figure 6-1 The KY8I Michigan Mighty Mite. Little rig uses only a handful of parts and goes together in a snap. Do not underestimate its ability, however; Tom worked over a dozen states with the little rig in only a few days after assembly. *Photo courtesy KY8I.*

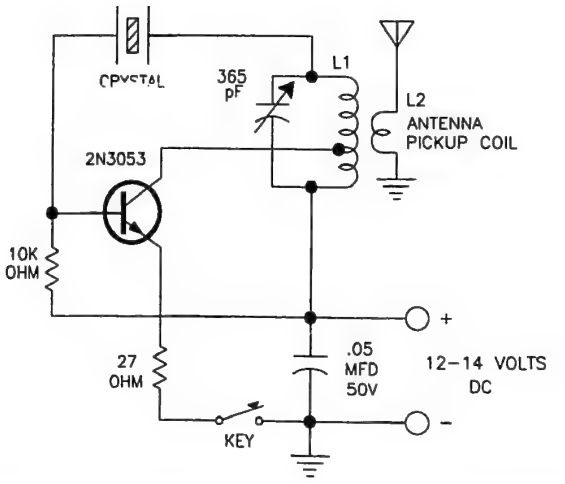


Figure 6-2 Circuit diagram of the Michigan Mighty Mite, compliments of Tom Jurgens, KY8I.

operation wind 46 turns and tap at 16 turns. For 160 meter operation, wind 64 turns and tap at 20 turns. The antenna pickup coil (L2) is 4 turns for 40, 30, or 20 meters, and 8 turns for 160 or 80 meters. Output of the transmitter is approximately one to 1.5 watts when powered from a 12 or 13 volt DC source. KY8I's "MMM" shown here is yet to receive its attractive casing. Maybe some of our readers have clever ideas in mind for making it look like a real unique item. Who knows . . . maybe we will see a QRP-equipped stuffed toy, a ladies egg-shaped hose container QRP transmitter, or a giant "MMM" peanut" that transmits with a one-watt signal. Use your imagination!

N7VE'S One LED SWR Indicator

Looking for a quick-brew SWR indicator to use when operating portable? Want ultra small size and low cost to-boot? Dan Taylor, N7VE has a dandy answer with his ScQRPion Visual SWR Indicator (Dan is a member of the Arizona ScQRPion QRP Club, hence the unique designation). Details herein are condensed, but complete enough to homebrew one pronto. The item's full story appeared in the North California (NorCal) "QRPp" newsletter/magazine for Spring 1997.

The SWR indicator's circuit diagram is shown in Figure 6-3 and technical details plus assembly notes follow. Notice this is a resistive wheatstone bridge with an antenna (or tuner) comprising one leg of the bridge. A toroidal step-up transformer samples voltage due to an impedance mismatch (the antenna's SWR), and uses it to drive/illuminate an LED. When the bridge is balanced (when the antenna or load is

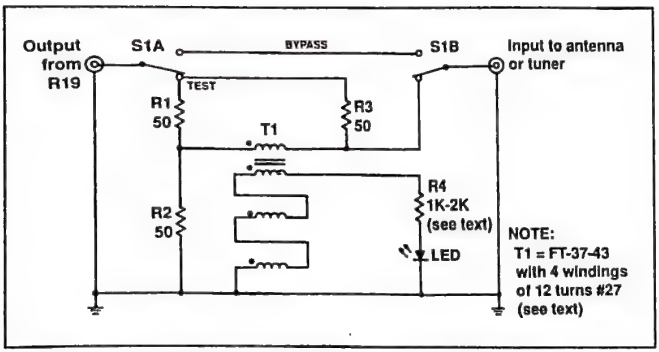


Figure 6-3 Circuit diagram of N7VE's one LED SWR indicator. Item operates on principle of a Wheatstone bridge, with "unbalance voltage" illuminating an LED. Details in text.

50 ohms and the SWR is 1:1), voltage across the transformer is zero and the LED does not light. If, and when, SWR rises, the LED's brightness increases accordingly. As a typical in-use example, the LED "fully extinguished" or "off" range is 45 to 55 ohms for 5 watts of power, 42 to 58 ohms for 2 watts of applied power, and 40 to 63 ohms for one watt of power. This concept may seem unusual or crude, but once you reference LED brightness to readings on a known-dependable SWR meter, it is very easy to use. Further, this Visual SWR Indicator is a super-handy pocket aid for tweaking a tuner or verifying used-daily antennas still exhibit a low SWR. There are a couple of minor drawbacks, however. First, the bridge absorbs approximately half of a rig's output and must be switched out of the line or disconnected after checking the SWR. Second, it works only at QRP levels of 1 to 5 watts. Lower power will not produce enough voltage to light the LED until the SWR is high (exactly how bright depends on power and SWR), and higher power will overload the LED plus burn out the bridge's resistors.

R1, R2 and R3 are each 50 ohm carbon resistors capable of handling half of your rig's output power (in watts). The resistors must be non-inductive (carbon-composition; not wirewound or metal film types) and precisely 50 ohms. Dan wired four 200 ohm 1/4-watt resistors in parallel to "make" each of the 50 ohm resistors (R1, R2 and R3) and get one watt of power dissipation. Since resistor wattage can be "pushed" to double normal rating, Dan's bridge can handle 2 watts of power continuously or 4 watts intermittently. I wired two 100 ohm 1 watt resistors in parallel to "make" R1, R2 and R3, and get a power handling ability of 4 watts continuous key down or up to 8 watts intermittently. I could have "squeezed by" using single 50 ohm 1 watt resistors for R1, R2 and R3, and holding the key down only long enough to view the LED, but the closest available value (47 ohms) would sacrifice accuracy of the LED indicator. Get the idea?

The toroidal core (T1) is an FT-37-43 with four windings, three of which are connected in series to produce a 1:3 voltage step-up transformer. The coils are challenging to wind, but Dan is presently pumping out prewound and

ready to install toroids for 3 dollars each (how long this deal will continue is unknown). Just send your request to Dan Taylor, N7VE, 14240 S. 7th St., Phoenix, AZ 85048. I left marker tabs on mine and shot a "right before soldering" photo so you can see how neat Dan makes up toroids (Figure 6-4). Alternately, you might try "rolling your own" transformer by winding 36 turns of number 28 wire on an FT-37-43 for the LED and then winding 12 turns over it for the bridge. Do not substitute a regular FT-50-2 or FT-37-6 for the FT-37-43 core, however; their inductance is too low for this "transformer application." Now two quick final notes. Use a clear LED for greatest visibility when barely lit, and try increasing the LED resistor (R4) if your lowest SWR is 1.15, 1.20 or 1.25 to 1 rather than exactly 1 to 1. I found 1700 ohms perfect for extinguishing the LED at 1.2:1 with 5 watts output substituting a variable resistor with an SWR-calibrated dial may also hold merit. Use your ingenuity! N7VE's one LED indicator is a treat. Build one! You will like it!

VXO For Rock-Bound Rigs

Many basic QRP transmitter circuits employ crystal control for simplicity and frequency stability, and are easily modified for VXO operation. As examplified in Figure 6-5, adding an inductor and variable capacitor in series with the crystal and ground usually permits warping the frequency plus/minus a few KHz while retaining "rock" stability. Typical values for the inductor are 1 or 2 microHenry for 20 meters, 4 to 5 microHenry for 30 meters, and 5 to 6 microHenry for 40 meters and 6 to 8 microHenry for 80 meters. Typical capacitor values are 15 to 60 picoFarad for associated bands. Experiment with values as you wish. If your selected inductance and/or capacitance values are too low, frequency shift/"VXO range" will be low or miniscule. If your selected inductance/capacitance values are too high, frequency shift will also be high (wow--what range!)--but stability will be compromised. Additionally, the circuit

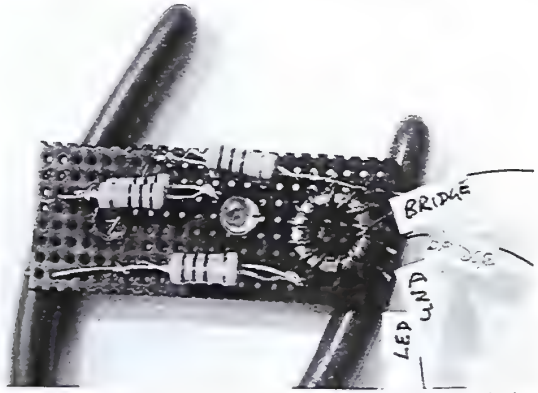


Figure 6-4 Photo of my N7VE one LED SWR indicator during assembly. Markers/circuit references on toroidal coils were removed one at a time when connected.

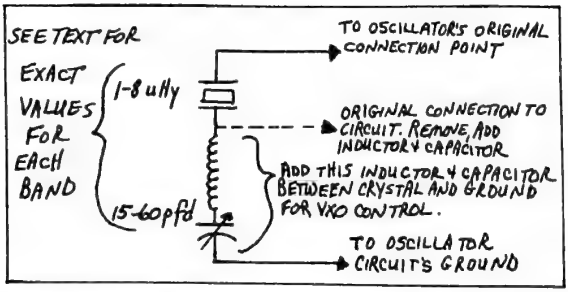


Figure 6-5 Adding a fixed inductor/coil and variable capacitor in series with an oscillator's crystal yields good VXO operation and newfound frequency agility.

may "drop out of oscillation at one end of the capacitor's range. Get the idea?

Molded inductors and small trimmer capacitors are available from many small parts suppliers like Mouser Electronics and DigiKey. Older vacuum tube-type transmitters may also be frequency-warped using this inductor and trimmer idea. Since they draw more current, however, use physically larger inductors and trimmers than you would use in a solid state transmitter. With a bit of ingenuity, the two components plus a crystal could even be mounted in a small metal box for plug-in operation with beautiful old-time rigs like a Heath AT-1 or Johnson Adventurer. Enjoy!

A Four-Component SWR Monitor

One of the minor inconveniences of ultra-light or personal portable operations is carrying along extra support items like an SWR bridge. Even if the unit is smaller than your transceiver, fumbling with cables to connect and disconnect the meter can become a mite entangling. In light of that fact, I began thinking about how a simple SWR monitor could be built into the circuitry of my favorite mini-rig (or any QRP rig). Checking schematic diagrams of several kits, I noticed a 35 to 50 volt zener diode was often connected between an RF output transistor's collector and ground for high SWR protection. When the antenna's SWR is above approximately 2:1, the zener conducts and shunts excess voltage around the transistor to protect it from damage. Hmmm---suppose we add a low value resistor between the zener and ground, and then place an "isolation resistor" and LED across the zener's resistor like illustrated in Figure 6-6. When the zener conducts due to high SWR, a small amount of voltage is dropped across its related resistor. That voltage, in turn, is sampled and used to illuminate the LED. Viola: Visual indication of a higher-than-desired SWR. A quick repositioning or adjustment of the antenna, and we are ready to operate without fear of rig damage and consequent repairs after

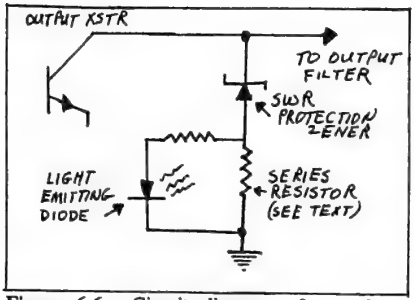


Figure 6-6 Circuit diagram of my four-component SWR monitor. As discussed in text, exact values of resistors and zener depend on your rig's output power and point you wish indicated as high SWR.

returning home. I have shared this circuit idea with several friends, and a few kit manufacturers, so you may (hopefully!) see it integrated in circuits of future rigs. Meanwhile, you can add it to your own rig.

Exact value of the zener and its series resistor will depend on the output power of your transceiver and the point you wish detected as "high SWR," and will require some experimenting. Adding the series resistor will raise the zener's point of high SWR protection up to near 3:1. Check and confirm that fact, then substitute a lower voltage zener (approximately 25 volts) to drop the detection point back near 1.7 or 2.0:1 as indicated by the LED. Initially, you might even use a potentiometer for setup, and replace it with a fixed resistor after determining values. A good "starting point" is a 47 ohm resistor.

A convenient way to determine precise zener and resistor values follows. Connect a tuner between your transceiver and antenna, and adjust it for a near 1:1 SWR as indicated on the tuner's bridge/meter. Ensure the transceiver is delivering full output and the SWR monitor LED is not illuminated. Next, adjust one of the tuner's capacitors to increase the SWR while watching to ensure power output decreases in a transistor-protecting manner at 2:1. Then select a value or adjust the zener's series resistor until the LED is brightly illuminated (careful here. Hold the key down only long enough to check SWR). Got it? Okay, reset the tuner for a lower SWR and ensure the LED extinguishes. Clever idea, eh? Just remember to check the "SWR LED" when using various antennas--and enjoy good results!

This chapter could obviously continue indefinitely, but it is time to shift focus to additional hot areas of QRP interest. Hopefully, however it has pointed out the benefits and personal gratifications of turning a handful of loose parts into a viable piece of QRP gear. Additionally, you learn more about electronics in the process. Who knows--it might even "spin off" a neat item and you will be the next person producing a kit. Good luck, and keep on homebrewing!

CHAPTER 7

CLEVER POWER SUPPLY IDEAS FOR QRP

One of the special advantages QRP has over "big rig" setups is its low energy demands or light power supply requirements. Indeed, a true QRP transceiver uses less than half the current to transmit a five watt signal that a 100 watt transceiver uses just for receiving signals at low volume. This "low current" aspect opens new doors for both portable operations with small battery packs and home operations with very small DC power supplies. In fact, many QRP transceivers can be powered from a healthy wall adapter! Now that feat is an impossibility for a 100 watt rig! Even those small 12 volt battery packs used with hand held FM talkies are great for powering QRP transceivers for a solid five watt output signal. Yes, and their operating time between recharges is greater when used with a (short duty cycle) CW rig than with a (100 percent duty cycle) FM rig. Remember those facts during power outages and/or emergencies: They can be a real asset!

Mating QRP Rigs and Power Packs

Okay friends, it is size comparison time. Now answer truthfully; which is larger - your QRP transceiver or its related power supply/battery pack? Surprisingly, many casual QRPers concentrate on acquiring or building an exceptionally small rig, yet borrow a large power supply from their home 50 or 100 watt setup for checkout - then continue using it regularly (sound familiar?). Ah, but is not portability the real beauty of QRP? I must admit, however, defining "portability" depends on individual needs and viewpoints.

Assuming enclosure space is available, an internal battery pack capable of powering your transceiver for two or three hours of contest-type operation, plus an AC supply no larger than that transceiver, is ideal for "go anywhere" use. If space is not available inside the rig's case, fitting the battery pack into a second enclosure to match the transceiver is a clever alternative (QRP twins!). If full stand-alone operation over a weekend is your goal (like camping or IOTA expeditioning), however, a high current and physically larger battery like a 12 volt lantern battery is a logical choice. How do we estimate energy needs and power supply capabilities for sizing everything appropriately, you ask? Let's answer that query with a typical example, then you can substitute figures from your rig's specs for estimations. Let's start with batteries, then consider AC supplies.

Most QRP transceivers operate at the 12 to 14 volt DC level, drawing around 50 ma during receive (use 50 ma per hour) and 350 ma for 2 watts output (350 mahour) or 700 to 800 ma (700 to 800 mahour) for 5 watts output during transmit. During an hour's time of heavy contest-style operating at the 4 watt level and assuming a 60% receive, 40% transmit cycle, we tally current demands

as follows. 60% of 50 ma = 30 ma per hour receive and 40% of 700 ma = 280 ma per hour transmit. The total (310 ma) doubled for 2 hours equals 620 ma. Assuming we use 10 - 1.3 volt rechargeable AA batteries (which are typically rated at 650 mahour), a fully charged pack can power our QRP transceiver two hours before "running dry". Need longer operating time? C cells are rated at 1000 mah and D cells are 1400 mah. Made into a battery pack and used with the same "310 ma per hour" transceiver, we get three and four hours operation respectively.

Say your little one watt QRP rig can operate from a 9 volt battery? Okay, a regular or alkaline "9 volt battery" can deliver 90 ma for one hour. Unless you parallel-wire several of them for more current, transmit time will be quite short! Alternately, consider using a 1200 mah (!) Lithium-type 9 volt battery (sold by Mouser Electronics and Digikey). Now that is a long life battery! Although an "unconventional match," combining a Lithium 9 volt and three alkaline AA cells makes a very compact 13.5 volt battery pack for 2 to 5 watt rigs. The AA cells will need replacing twice for each Lithium 9 volt, but the arrangement yields supreme portability and small size.

When considering AC power supplies, our focus shifts from hourly current consumption to maximum transmit and receive current demands and voltage regulation. Generally speaking, a well regulated supply capable of delivering 1.5 and 2 times the transmit current drawn by your transceiver with no voltage variation between transmit and receive ("stiff" regulation) is a good "no-miss" choice. A "less stouthearted" power supply may introduce frequency drift and/or chirp on your transmitted signal.

A number of QRP transceivers have a built-in 3-terminal regulator for stabilizing voltage on all internal circuits except their transmitter's power output stage (check your unit's diagram). An unregulated DC supply can often be used to power such a rig, provided some stipulations are observed. The supply's full load/key down voltage should not fall below the (rig's) regulator's "drop out point," and no load/receive voltage should not challenge the regulator and output transistor's maximum rating (spec sheets helpful here). Additionally, a large capacitor (like 10,000 or 25,000 mfd) can often be parallel-connected across the output of a "wimpy" supply to minimize full load/no load voltage variations (it extends the time constant, so key fast for best results). Testing, experimenting, and checking to ensure your signals do not drift or chirp is the key to making a particular transceiver and power supply compatible. Maintain a positive QRP attitude and go for it!

Alkalines Versus Nickel-Cadiums For QRP

Homebrewing a battery pack for use with your QRP transceiver? Perplexed about which type of cells to select? Here are some helpful thoughts worthy of consideration.

Nickel-cadium cells like used in battery packs of FM "talkies" are a good choice for "everyday operations," as they can be drained and recharged 500 to 1000 times (a good "cost-per-hour" of use factor). Used only occasionally, however,

they have the drawback of short shelf life (store a nickel-cadium pack a few months and it will drop to less than 50% charge). Nickel-cadiums also exhibit the familiar "memory effect" when subjected to occasional brief use and frequent "top ups." In other words, they become accustomed to getting recharged when only half discharged and consequently are useful for only half their current rating. An easy way "around that drawback"/effect (particularly with FM "talkies") is keeping the batteries "exercised" with plenty of use and/or carrying a spare pack to swap when one becomes discharged.

battery pack using alkalines. In deciding between alkalines and nickel-cadiums, consider your portable operating preferences. If you operate "field style" daily, nickel-cadiums may be most attractive. If you operate portable only occasionally, you will probably find alkalines more attractive.

Another option worth considering is the new Ray-O-Vac "renewable alkalines." These cells exhibit long shelf life, have high current ratings, and love frequent "top ups." They are readily available in variety stores nationwide, reasonably priced, and can be recharged up to 25 times. They combine the best

Figure 7-1 Which type cells make the best battery pack for your QRP transceiver? That depends on your operating preferences. Nickel-cadiums are low in cost for daily use, alkalines are more economical and reliable for once-a-month use, and renewable alkalines love frequent top ups for emergency preparedness. Details in text.

Alkaline cells exhibit a noticeably longer shelf life than nickel-cadium cells, and their discharge curve is also more gradual than nickel-cadiums. As a result, you have more forewarning of a depleted

aspects of alkalines and rechargeables, and may even give your rig a little more voltage for higher output. (A typical cell measures 1.63 volts at full charge.) Their disadvantage? The cells must be pulse-

charged and their voltage continuously monitored during charging. Fortunately, Ray-O-Vac's mating charge is less than half the price of a "talkie charger." Check them out!

Wall Warts For Widdle Wigs

Wall adapter-type power supplies have become quite popular for home operation of numerous small items like TVS, VCRs, electronic keyboards, and more. Might such palm-size "wall warts" also prove suitable for powering QRP transceivers? Yes indeed, provided they are properly selected, modified, and interfaced to deliver pure DC within the voltage and current range/tolerances of a mated rig. A difficult task? Not really. A brief amount of planning and dinking makes it easy (see Figure 7-2).

First, a friendly warning: never blindly connect a "seems right" wall wart to your QRP rig and hope for good luck. There are too many variations in voltages and polarities to warrant such gambling. Start by tracking down a physically large wall adapter marked as delivering between 11.5 and 13 volts **DC** output at 1.5 to 2 times the transmit current requirements of your transceiver (assuming, naturally, your rig uses 12 volts for power). Check to ensure the adapter's output voltage is reasonably pure DC; add an external 5000 mfd capacitor if necessary. Note no-load voltage (wall warts are not regulated: a regulator must be included in their powered unit), and mark their output positive/negative polarities for proper connection to your transceiver.

Next, check your transceiver's circuit diagram and maximum voltage

Figure 7-2 Cleverly selected and properly interfaced, "wall warts" make ideal "go anywhere" power supplies for QRP rigs in the 1 to 3 watt category. A big "wart," however, is required for 5 watt rigs.

rating of components to ensure they will not be damaged by the wall wart's no-load/receive voltage. Also check to ensure frequency determining/oscillator stages are stabilized by an on-board regulator - and full/no-load voltage variations from the wall wart fall safely within the regulator's range. If necessary, add a three terminal regulator and extra capacitors to the wall wart's output. With planning, these components can be mounted right to the "wart" with a metal strap that doubles as a heat sink. Think creatively!

Ready for the big moment? Connect your transceiver for on-the-air operation with a known-good power supply, in-line wattmeter and use an auxillary receiver to check transmitted signal quality. Confirm normal/good operation, check receive/transmit voltages and output power, then substitute only the "wart" for the power supply and immediately repeat the checks. If receive voltage is too high, quickly disconnect the wall wart and add or change the regulator. If the rig's transmitted signal is raspy, add more filtering capacitance (you did select a DC-output "wart" didn't you? Check it with a scope!). If the "wart's" voltage drops excessively during transmit (like from 15 volts to 9 volts), you are probably asking too much from it. Hunt for a larger/higher current wall wart or reduce the drive/output power of its mated transceiver. I have found "healthy size" wall adapters (500 to 600 ma) work fine powering rigs up to 2.5 watts, but not 5 watt rigs: they require a large VCR, computer printer or musical keyboard-type adapter.

Figure 7-3 A super sized "wall wart" for big-time QRP! This new MFJ-4110 is a two-piece power supply that delivers 13 volts DC at up to 2 amps output. Details in text.

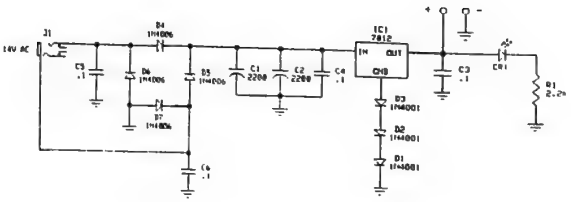


Figure 7-4 Circuit diagram of the MFJ-4110. Wall unit contains a hefty AC transformer and plugs into extra box containing rectifiers, filters and regulator.

Finally, we have a ray of hope and good news for folks without time to "roll their own" wall wart supply. MFJ Enterprises recently introduced their model 4110 "super wall wart" DC supply shown in Figure 7-3 and 7-4. This two-piece unit (which can be rubberbanded together for all-in-one convenience) features a stout 2-amp AC transformer plus bridge rectifiers, filters, and regulator in a separate box. Output is adjustable in .7 volt steps from 12.4 to 13.8 volts by jumpering diodes connected to the regulator's center/control pin. This "wart" will comfortably power any QRP transceiver up to 5 or 6 watts output. It is a treat!

Solar Powered QSOs

Have you ever considered using a solar energy to power your QRP rig? The two are an ideal combination, especially if you live or vacation in a sunny coastal area. Understand I am not talking about just using a solar panel to power your mini-transceiver: that is comparable to holding a cup out a window to catch drinking water during a rain. When the weather changes, you are left dry. Catching all available rain and storing it in barrels for future on-demands is the key. Relating that concept to our needs, we use a solar panel to collect energy and then store it in (rechargeable) battery packs! Pertinent details follow. Read close as we move fast!

The circuit diagram of our easily basic homebrewed solar battery charger is shown in Figure 7-5. It consists of a solar panel, a charge controller, and the battery pack(s) to be charged. It is that simple!

The charge controller's purpose is limiting charging current to the battery pack during times of bright/full sunlight, and preventing the pack from discharging back through the charging circuit during times of no sun. It does this by using a three terminal regulator (mounted on a heatsink) and a reverse current-protecting diode, each selected according to your particular battery pack's full charge voltage.

Suppose, for example, your QRP rig's battery pack is rated at 12 volts and 500 mah. A 15 volt/1.5 ampere regulator and a IN4001 50 volt/10 ampere diode do

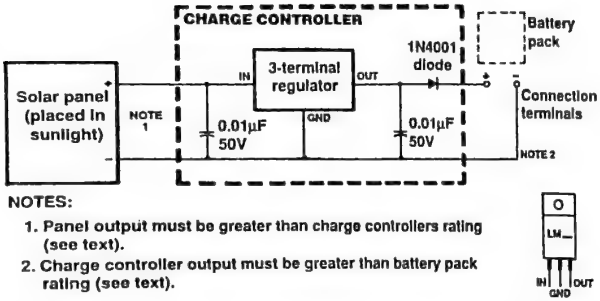


Figure 7-5 Circuit diagram of an easy-to-assemble solar charger for battery packs.

the trick. Now let's look at specifics. First, select a solar panel with an average output of 3 to 8 volts more than your selected regulator's output. This consideration provides the necessary "headroom" for proper regulator operation. Second, choose a regulator with an output of 2 to 5 volts more than your battery pack's full charge voltage. Third, bear in mind the reverse current-protecting IN4001 diode produces a .7 volt drop--and charging voltage must always be higher than a battery pack's voltage.

Let's assume you are using a solar panel with an average output of 18 volts and a 15 volt regulator plus a reverse current-protecting diode to charge a 12 volt battery pack. 18 volts into the regulator gives 3 volts "headroom," 15 volts out minus .7 volt drop across the diode = 14.3 volts. This should yield a charging current between 100 and 400 milliamperes, depending on your pack (check it with your milliamp meter!). If necessary, add a second IN4001 diode in series with the existing IN4001 diode to drop charging voltage to 13.6 and lower the ma charge rate if required.

The charge controller's regulator should be mounted on a heatsink to avoid overheating. A small 1 by 2 inch finned heat sink is usually adequate, or you can mount the regulator directly to the side of a metal box for heat sinking.

Most rechargeable batteries are marked with their voltage and current rating. They are normally recharged at 1/10 their milliamp-hour rating for 10 hours, plus an additional one-half to one hour to overcome charging losses. The normal charge rate for AA cells in a 12 volt battery pack, for example, is 45 ma for 10.5 to 11 hours (assuming the pack was fully discharged). Most of today's battery packs can also be rapid charged at their full mah rating for one hour-plus a few minutes more to overcome charging losses. Other "between normal and rapid charge" rates can also be utilized, provided charge time is adjusted accordingly. Using our previous 450 mah pack as an example, it can be recharged at 220 to 240 ma for approximately two hours or 110 ma for approximately 4-1/2 hours, or even 150 ma for three hours and a few minutes. In other words, charging parameters are simply a matter

of ma times hours. We must bear in mind, however, that "unattended" rapid charging (not monitoring/adjusting voltage and/or checking cell temperatures periodically) can cause cell overheating and permanently damage the pack. Likewise, rapid charge rates above a pack's rating for less than an hour should be avoided in homebrewed chargers.

I will leave the physical arrangement of battery connection terminals for the battery pack to your ingenuity and creative thinking. In my case, I simply filed the tips of a couple of screws bolted to perfboard materials and positioned to mate with my battery pack's terminals, then used a rubberband to hold it in place while charging. The setup is simple, but it works - and I enjoy solar powered QSOs. Try it! Solar panels from small to large, incidentally, are available from Alternative Energy Engineering, P.O. Box 339, Redway, CA 95560, Telephone 1-800-777-6609. Check out the variety of solar panels in their free catalog and start enjoying solar QSOs!

CHAPTER 8

LOW PROFILE & HIGH PERFORMANCE ANTENNAS FOR QRP

As discussed in Chapter 3, QRP success is directly related to three main factors: equipment, operator expertise, and antenna system. Of those three factors, the most important (and the one giving you the most "bang for the buck") is the antenna system. That is because QRPers typically communicate using less power than many "average setups" lose by using compromise or makeshift antennas. How so? Let's say you are using a 100 watt output transceiver connected to a ground mounted vertical, installed close to your house. The 100 watt signal will be degraded 3 to 6db by absorption in nearby foliage and structures. Poor ground conductivity and lack of a sufficient radial system plus losses in aged cable and/or poor connections between transceiver and antenna adds an additional 3 to 6db loss. The resultant *effective radiated power* of this setup will be between 10 and 25 watts. Now visualize a QRP setup running five watts output to a fine-tuned dipole with new wire and an unbroken length of fresh coaxial cable connected to the transceiver. In this case, the *effective radiated power* will be approximately four watts. The QRP signal will be only 4 to 6db weaker than the signal from a "big station." Now look at your receiver's "S" meter and consider each 3 db of doubling/halving a power level equals between one-half and one "S" unit. If distant stations receive the "big rig signal" at S-8, your QRP signal will be S-5 to S-6. Try tuning in some S-5 and S-8 signals on your "big rig" right now. Can you actually hear a difference in strength, or must you look at the rig's S meter to determine which signal is the weakest? Interesting, eh?

Does our previous discussion suggest better QRP results are obtained when using a horizontal antenna rather than a vertical? Not really. If you are atop a hill or mild rise so the vertical has a clear radiation area and assuming you are using a good ground radial system, the vertical will do an excellent job. If your QTH is surrounded by trees, changing the vertical to a ground plane mounted at roof level is more beneficial. Regardless of the antenna you select, never overlook fine points! Use only new, top grade, and low loss coaxial cable. Avoid any splices! Firmly solder all connectors and connection points. Trim antenna ends for lowest possible SWR. When you can honestly say "what an impressive skywire for such a small rig," you are on the right track for QRP success.

Special Tips For Homebrewing Antennas

The following information will prove most beneficial to newcomers, and it may seem "general knowledge" to more experienced amateurs. Even if the facts are in the back of your mind, they are always worthy of reiteration for good QRP results. When planning your first antenna, strive to select a foolproof type like a dipole or single band Delta Loop. These antennas are low in cost, do not

require a tuner, and they are a good reference for comparing future antennas. Multiband doublets and G5RV-type antennas should be accepted as what they are: a compromise (particularly on the WARC bands). When routing coax cable into the house, exercise care to avoid sharp bends or pinches. Remove strain from the coax cable by propping it on available ledges, etc. and whenever possible, lift it off the ground and out of direct sunlight for longest cable life. If you end up with extra coax cable from your antenna "in the shack," cut it off rather than coiling it up in a corner. Remember excessively long cable lengths usurp valuable power. Many people feel that SWRs up to 2:1 are acceptable if their transceiver does not overheat. Personally, I have found any antenna exhibits its best performance when end-pruned and coax length-trimmed for an exact 1:1 SWR. Some amateurs may find humor in my quest for perfection, and that is fine. It is only my opinion. I will just keep on working DX like crazy while they laugh and call . . . and call . . . and call.

Have you ever noticed how a newly installed antenna seems to work like gangbusters, then slowly "drop off" with age? Close investigation of this phenomena reveals some interesting facts. A few months after installation, an antenna (and operator!), "settle in" to an acceptable norm in an unrealized manner. The antenna is attacked by weather and deteriorates with time. A strand of wire here or there cracks and breaks, a balun's case cracks and allows water seepage, and connections corrode or loosen in the weather. The SWR may rise ever so slightly, but it occurs so slowly we seldom realize it. Meanwhile, the coax cable is attacked by harsh chemicals and strong ultraviolet rays. Its inner dielectric bakes like it is in a microwave oven, and lumped impedance points are produced. Finally, the wire breaks and we put up a new antenna only to realize a new world has opened!

Can this dilemma be avoided? Sure! Begin by selecting top grade wire, coax cable, a high quality balun, and good connectors. After soldering connections and/or installing connectors, be sure to weatherproof those outdoor points with a good grade of silicone. I have found Coax Seal®, sold by amateur radio dealers nationwide, tops for weatherproofing connectors and cable ends. Remove excess cable strain on center connections or baluns whenever possible. Plastic cable clamps affixed to your coax and secured to the antenna center insulator work fine here. Strive to support the coax cable to avoid wind flexing (use window ledges, wood chocks, flowerpots, etc.). Teflon-insulated PL-259 connectors are also encouraged. They deteriorate very little with age. All coax cables are not produced equally. Plastic or rubber-jacketed cable is more susceptible to chemicals and sun damage than polyvinyl chloride-jacketed cables. Their lifespan, incidentally, is approximately 12 years from the time the cable is produced. That 12 year figure includes the time the cable is stored in a dealer's warehouse. I mention this because you can estimate a cable's life when purchased new, and then estimate the cable's remaining life and replace it accordingly. Yes, I know some amateurs brag about using the same unmaintained antenna and coax for 20 years, and I love beating them out in the pileups! Enough said?

Personally, I prefer basic-style stranded and insulated wire for antennas. The size is a matter of personal

preference. Number 18 or 20 is quite easy to work with but may break during high winds, whereas number 12 or 14 is stronger but slightly more difficult to handle. Select wire according to your own preference and remember to check the full antenna system once or twice a year for weather damage.

Installing Wire Antennas

The easiest way I have found to install wire antennas involves combining modern technology with personal creativity. In other words, using a slingshot or weighted tennis ball tied to a light nylon rope to lasso a high positioned limb rather than climbing a tree. If you have not tried this approach, practice in an open countryside away from power lines and homes before looking like a moonstruck baseball pitcher in your backyard. After an hour's practice, you will probably be able to zip a line right over a selected tree limb with only a few attempts.

I have found the new style of slingshots called "wristrockets" great for erecting wire antennas. These items are available at sporting goods stores. They are fitted with surgical tubing rather than rubber bands, are quite powerful, and can propel a large bolt or fishing weight over 100 feet in the air with good accuracy.

Alternately, a weight inserted in a regular tennis ball makes a superb "throwing object." Whether you use the tennis ball concept or wristrocket approach, the installation procedure is similar. Begin with a couple of practice shots, then connect one end of the lightweight nylon cord or fishing line to your weight/tennis ball. Be certain there is enough nylon cord to extend from your position to well above and beyond the selected support or limb and back to the ground. Ready? Aim and fire! If you do not reach a desired branch, consider your odds for success before continuing longer. Once you are successful or accept a less than optimum limb, tie the light nylon cord to the heavier nylon rope you will use for securing the antenna. Connect the opposite end of that rope to an end or corner insulator on your antenna, raise it into approximate position (and retrieve your lightweight throwing line), then move to the antenna's other end or support areas and duplicate the previously discussed process. Finished? Great! When pulling your antenna into final position, remember to allow plenty of leeway for tree limbs to move in both normal breezes and heavy wind gusts. You may also prefer to install light weights like bricks or paint buckets filled halfway with sand on rope ends so they will automatically take up slack during high winds.

Invisible and Hidden Antennas

Modern housing conditions, covenants and restrictions (CC&Rs) often challenge our ability to set up a good antenna system, but rest assured where there is a will, there is a way. Yes, and resorting to miniature attic - installed radiators is only one of several solutions. As one who has "been there and done that," I have found CC&Rs are usually instigated to ensure a clean appearance (no extraneous structures or wires), safety (to people and property) and peaceful coexistence (no TV, telephone or stereo interference). Invisible and/or hidden antennas and QRP conform

Figure 8-1 Can you spot the hidden 40 meter Delta Loop, 80 meter longwire and multiband vertical in this apartment complex? Neither can unsuspecting tenants. Viva la DX!

perfectly with those stipulations and cleverly installed, put the world at your fingertips. Really!

Simply explained, invisible antennas can be almost any type of wire antennas (dipoles, Delta Loops, vee beams, etc.) that are transparent to untrained eyes. Ideally, they are made using clear end insulators and thin (18 to 24 gauge) enamel wire or insulated "hookup" wire in a color to match the sky or their background. Such wire is readily available in 50 and 100 foot rolls, economical in cost and, when an insulation color like medium or light gray is selected, you can look directly at the antenna and not see it. Your odds of being condemned for enjoying the world's greatest hobby then hinges on two factors: being "discovered" installing an antenna and/or causing interference (a dead giveaway). You can sidestep those entanglements by quick-installing an antenna during early morning or midday hours of "quiet times" like Tuesdays or Thursdays and by running QRP. When possible, striving to position your antenna (or antennas!) at right angles to power lines and telephone cables: it minimizes interference. Pick an antenna style suitable to your location and available supports, get some insulated stranded wire, and start assembling that skywire soon! Great band conditions and plenty of exciting QSOs await you!

With respect to hidden antennas, an endless number of options are possible. Loading a rain gutter, using an indoor antenna, erecting a windowsill-mounted whip, or running an extension coax to your mobile antenna are familiar examples. Ah - but you want new and unique ideas, right? No problem!

The creditable performance of full size dipoles and large loops is well known, so why settle for less simply

because outdoor supports like trees or poles are not available or acceptable? Tape-Tenna™ has a couple of hidden antenna kits worthy of consideration at this time (Figure 8-2). The "original kit" contains 4 rolls/108 feet of adhesive-backed copper foil and a clip-on SO-239 you use to make various types of antennas like outlined in their accompanying manual. The "new kit" is a cut-to-length or ready-made (plug-and-play) package containing precisely what you need to make a specific antenna like a 20 meter vertical, 30 meter loop, 40 meter dipole, etc. The adhesive foil in either kit sticks firmly to a roof, eave overhang or even an attic rafter. Sections of foil can also be curved, bent, cut or spliced. You simply place the antenna in a selected position, connect SO-239 and coax, prune overall length for lowest SWR, then paint the antenna to match its surroundings. It is then totally unnoticeable--except for on-the-air results. Yes, and several chaps have made DXCC using 100 watts and Tape-Tennas™ for various bands - even loaded 160 meter radiators - while living in highly restricted dwellings. Tape-Tenna™ kits are available from Larry Feick, NF0Z of Hamco, P.O. Box 25, Woodland Park, CO 80866. Check them out!

Another idea for inconspicuously radiating a big-time signal involves mounting a new-style "no radials" vertical antenna like Cushcraft's R5 or R7000 on a rotor for tilting.

Figure 8-2 Hidden antenna kits from Tape Tenna™ are available in both "ready-made" and "design your own" versions. You just stick them in place, paint them gone, and enjoy low profile hamming supreme!

As illustrated in Figure 8-3, the rotor is positioned (laid) horizontally with its base end firmly secured to a roof air conditioner or a homebrewed support frame to fit your particular situation. A two-foot mast is bolted into the rotor's upper end and supported at its "top-end by another homebrew bracket to minimize strain on the rotor. The homebrew bracket holds the mast with one or two loose fitting U bolts, thus allowing the rotor to turn the (horizontally positioned) mast. Between the two supports and in the mast center is a boom-to-mast plate (from an old beam) with a three foot "boom" attached. The vertical antenna's base bolts to one end of the "boom," and a metal counterweight (for balancing load on the rotor) bolts to the "boom's" other end. The vertical is painted light gray or blue and gray to match the sky (use non-metallic Krylon®), then cables are inconspicuously routed into the "shack". When not on the air or when casually

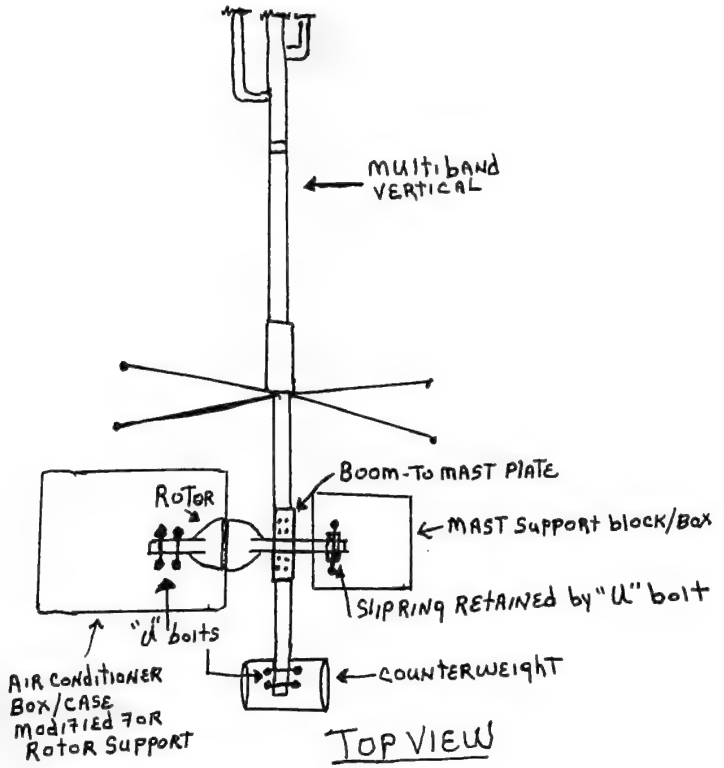


Figure 8-3 Installing a "no ground" vertical on a rotor allows it to lay flat on a roof until needed, then swing up for action. Discussion in text.

listening, the vertical lays horizontal and out of sight on the roof (typically 20 of 24 hours a day). A few "clicks" of the rotor swings the vertical upright, and we are ready for DXing supreme! Properly adapted, this "hiding vertical" concept can be a winner. A second rotor swinging a cover could even protect the vertical from sun rays and exposure to harsh weather. Neat, eh?

Enough, you say? Okay, let's discuss some skywires! Start with the largest one you can comfortably assemble and expand as your finances and time allows!

The Full Wave Delta Loop

This antenna is almost as easy to assemble as a dipole, but it's on-the-air performance is noticeably better. That is because a full wavelength of wire is used as the radiator. For optimum results, the Delta Loop should be mounted vertically with its feedpoint or "apex" closest to the ground. This arrangement puts most of the wire's prime radiating section highest in the air while ensuring the shortest possible length of coaxial transmission line. Layout of the Delta Loop is shown in Figure 8-4. Each side is approximately one-third wavelength, and is typically supported by ropes to tree limbs at the top section. Personally, I prefer using insulated and stranded hook-up wire allowed to slide through top insulators for maximum flexibility. The Delta Loop thus assumes its shape when pulled up into position, and slack wire can slide through insulator holes during wind stress. Since wind is a factor in my particular area, I also route stabilizing ropes from each top insulator to ground supports. Both support and stabilizing ropes tie to the same insulator hole (one opposite hole used for supporting Delta Loop). This

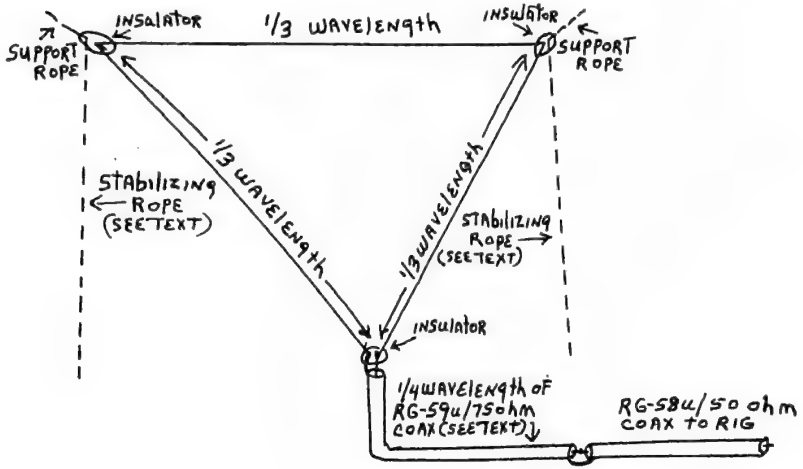


Figure 8-4 Outline of the Full Wave Delta Loop. Note short length of 75ohm cable at feedpoint for balun.

way, all stress is on ropes and negligible stress is on the actual antenna wire.

The Delta Loop's overall length is calculated using the formula 936 ÷ F in MHz = Total Wire Length. As an example, 936 ÷ 14.0 = 66.85 feet. Remember to add two or three inches to that figure for wrapping around the center/feedpoint insulator and for frequency pruning. Since the feedpoint impedance of a Delta Loop is slightly above 50 ohms, an impedance-matching transformer is used. This consists of approximately one-quarter wavelength of 75 ohm/RG-59/U cable. The cable's velocity factor must be taken into consideration when measuring/cutting this matching stub. In the case of RG-59/U, the velocity factor is 0.66. As an example of calculation, one-quarter wavelength at 14.0MHz is 234 ÷ 14.0, or 16.71 feet x 0.66 (velocity factor) equals 11.3 feet total length of matching stub. Similarly, a matching stub for 7.100MHz will be 234 ÷ 7.100 = 32.95 x .66, or 21.75 feet. Solder the center conductor and shield of this matching stub to the Delta Loop at one end, then connect your usual RG-8/U marine grade coaxial cable from the stub's other end to your transceiver.

The most convenient way I have found to assemble and erect a Delta Loop involves initially measuring and cutting the wire's length outdoors, then laying out the antenna on the ground in its final shape. This will give you a good idea of tree limbs to select for supports. Maximum radiation is broadside to the

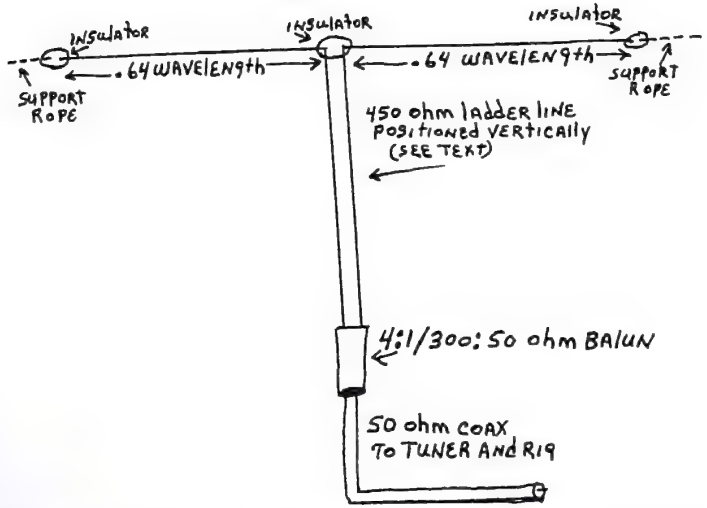


Figure 8-5 Outline of the Extended Double Zepp. Ladder line converts feedpoint impedance to match 300 ohm balun which, in turn, permits use of a simple unbalanced-output tuner.

loop, so select your support tree limbs accordingly. Delta Loops deliver top performance for their cost. Try one: you'll like it!

The Extended Double Zepp

Our next antenna is another "big signal" radiator worthy of consideration: The famous Extended Double Zepp shown in Figure 8-5. It sports slightly more than a full wavelength of wire for outstanding performance, can be erected horizontally, sloping or bent, high in the air or low to the ground, and works like a champ. The antenna's horizontal top section's length is calculated with the formula 600 ÷ 7 in MHz = wire length for each side. As an example, 600 ÷ 10.110 MHz = 59.34 feet. Remember to add 6 inches to calculations for wrapping antenna wire through end and middle insulators and for frequency pruning. The vertically positioned 450 ohm ladder line section's length is calculated with the formula 130 ÷ 7 in MHz = total length from feedpoint to balun. As an example, 130 ÷ 10.110 MHz = 12.85 feet. Again, remember to include a couple of extra inches for center insulator and balun connections. A 4:1 or 300 to 50 ohm balun connects to the ladder line's "low end," then RG-8/50 ohm coax of any required length connects between the balun and a basic antenna tuner's "coax output" socket.

The EDZ can be erected between two or three strategically-positioned trees (a middle support is ideal) or assembled "Tape-Tenna" style and hidden under a long house eave. Either way, its performance is superb!

CLOSING NOTES

QRP is the hottest and most rapidly expanding area of pursuit in amateur radio today, and squeezing complete "what's happening" details into a single book is a supreme challenge. Indeed, new gear and goodies for QRP are hitting the scene in such rapid order that adopting a "stop action" or "snapshot view" approach for description was necessary to reach a publication date. Our apologies for any "omissions that should have been included," and I sincerely invite you to share details of your club, project, or product with me for inclusion in a future edition. Quite possibly, annual updated versions of this book will be published during the future. Stay tuned! Meanwhile, use some of the included coupons to gear up with some goodies of your choice and start enjoying QRP. It is an absolute blast of fun! I will be looking forward to a two-way QRP QSO with you around 14.060MHz or on the lower 25KHz of 30 meters soon! 73, Dave, K4TWJ

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Noted author and CQ magazine columnist, Dave Ingram, K4TWJ, is one of the most popularly recognized and respected figures in amateur radio today. Intensely active in all areas of amateur radio for over 30 years, Dave's enthusiasm is irresistibly contagious. He has broadcast engineered and taught college electronics, plus authored over 600 articles and 20 books about amateur radio. Watch for even more from this noted author.