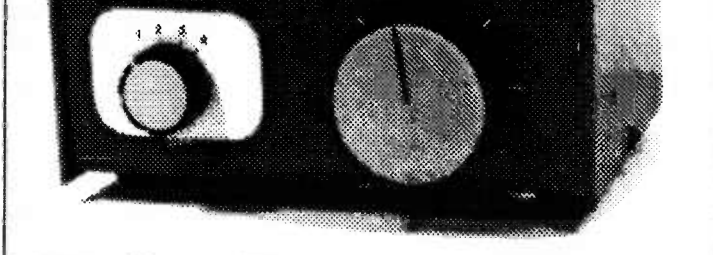
hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

LONGWIRE TUNERS



WINTER 1995

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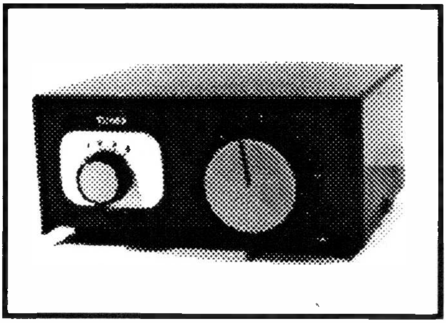
ON THE COVER



W6EMT and *KJ6GR* *provide some great QRP ATU schematics for long wire antennas. These are great starting points for hours of experimentation and fun developing one just right for your specific antennas and favorite bands of operation.*

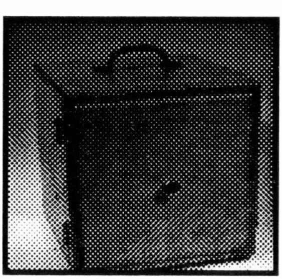
ALSO

WA6IVC *shows us how to get started building a neat transmitter using only 2 transistors to get 3watts out.*

Shack Shots & Fall Festival Winner ***NFØZ***

W5QJM *utilizes wall transformers for great inexpensive power supplies.*

W5NOE *has an 800 milliwatt "Showcase" Transmitter that is clearly a winner.*



Hambrew cooks up another "Shack In A Box". Plus The Contest Guru, more projects and information on building and theory of design.

• Contents •

Photographic Credits:
Fred Bonavita, W5QJM: pp. 9, 12, 16, 17; Robert van der Zaal, PA3BHK: pg. 40; Dan Giles, VE7QM: pg. 40; All others: Hambrew

hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

WINTER, 1995 • VOL. 3, NO. 1

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Contest Editor..............Bruce Muscolino, W6TOY/3

Writers, Editors and Contributors:
Fred Bonavita, W5QJM; Bruce O. Williams, WA6IVC; Dave Anthony, W5NOE; Roy Gregson, W6EMT; James G. Lee, W6VAT; Bill Shanney, KJ6GR; Josh Logan, WX7K; Dan Giles, VE7QM; Robert van der Zaal, PA3BHK

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• LETTERS •

From The Publisher

AD 1995 is a threshold year for *Hambrew*. As you now have no doubt noticed, we have a new look which makes the magazine more affordable to publish and purchase. This affects your subscription in a direct way. The blanket decrease in price is passed along to subscribers thus: if you have paid $20 for a subscription and have received no copies as of yet, your subscription has been extended times two (example: previous one year now equals two years). If you paid $20 for a subscription and received one magazine, take the remaining issues due under the old price (three) and double that amount. You now will receive six issues before your renewal is due. This system applies to Canadian and Mexican subscribers also.

It is important to point out that there really was no alternative for us in this matter, save shutting the magazine down. The marketplace has spoken loudly and clearly. Our renewals due Fall, 1994, while substantial, were simply not what we expected for a healthy growth pattern and the continuation of the established format. So those of you who did renew, and there were many, did appreciate what was presented, and the format thereof. The problem stands, however, that enough did not choose to renew, and we think the problem is price, perhaps as much for International, Canadian and Mexican subscribers as for those in the United States.

So now the magazine is more affordable, and should pull the extra subscribers needed for survival. We will see. For our part, we plan to "keep on keeping on" without pause. For those who care, the magazine is not in danger. Not by a long shot.

Adjustments for International Subscribers were a tad more subtle: the formula was modified to 1/3 remaining issues due doubled, as postage is the real issue in the difference in price between international and domestic categories. We are doing our best to be fair without actually just giving the magazine away.

We hope you can understand that this move, while necessary, is difficult for those who found the original version of the magazine "just right". Consider the following case, however. I spoke with a retired gentleman who had just enough money budgeted from his fixed income to purchase one magazine subscription per year. Thankfully, that magazine is *Hambrew*. But how many others out there are in the same boat? Well, we will never know, save making the expenditure for a huge market study costing thousands of dollars.

But now, for all those who moaned that the twenty dollars was too much for a subscription, there is not much left to moan about. The cost of this magazine is now such that the value is tremendous to a ham with any realistic budget. The trade-off is one involving a lack of slick paper and an admittable reduction of photographic resolution. We hope that this is acceptable to the loyal cadre of *Hambrew* subscribers who liked us as we were. The alternative, remember, is oblivion... which we firmly reject as an option. Thanks for your understanding, and enjoy those extra gift issues! • • •

NEW *HAMBREW* SUBSCRIPTION RATES:

DOMESTIC: $10/YR.

CANADA/MEXICO: $15/YR. (FIRST CLASS)

INTERNATIONAL: $21/YR. (FIRST CLASS)

Dear George,

Having seen the letter from Pat Bunn of 624 Kits and the mention of the ONER in a recent QST, I feel I must set the record straight. The original ONER transmitter was designed by George Burt, GM30XX, a well-known UK QRPer and was first published in SPRAT the Journal of The G QRP club. It has never been published by the RSGB, nor was it designed by me!

The ONER was so named because it was designed to fit on a one inch square printed circuit board. It is suitable for any band from 160-20m with a suitable crystal and lowpass filter. The ONER transmitter design was followed up by several other one inch square boards from Ian Keyser, G3ROO. These include: a receiver board, a VFO board and a Transmit/Receive change-over Board with Sidetone Oscillator. Yes ! each on a one inch board. The VFO and Receiver boards were designed for 75 meters but some builders have adapted them for other bands.

The original design was copyrighted to the G QRP club with permission to sell kits granted to Kanga Products. There is a US agent for Kanga: Bill Kelsey, N8ET, 3521 Spring Lake Drive, Findlay, OH 45840. who sells the full range of ONER board kits

I am not sure when 624 Kits appeared in the ONER saga but the addition of a lowpass filter negates the one inch board of the name and makes it a single band design and the added ferrite bead is a relatively minor importance. Also GØBPS of Kanga UK is none too pleased about another company adopting the ONER name for a kit product ...but that is the way of free market trading!

Incidently, the original author, GM30XX, is only too pleased to see his design gaining popular support in the US.

Keep up the good work with HAMBREW

George Dobbs G3RJV

G QRP CLUB

Hi,

I just got my first issue of Hambrew, ordered xtals for my 8P6 rig, and I fear that the 20 meter crystals won't be in by the time of the Fall Festival. Oh well.

Speaking of crystals, the new cost of just a few of them is more than the cost of an old Argonaut. Further, it seems that any junkbox that has old crystals is devoid of any in the ham bands. Is there any group purchase or volume discount that your readers can get in on?

The Digi-key catalog lists some computer crystals, for under two dollars, but it would be a real exercise to get them even near the ham bands. Would these crystals be adequate for a receiver or down-converter? Several of them would work to convert ham frequencies to 18 mHz, but would this be worth the trouble? The rocks are: 10mHz, 6.757 mHz covers part of 12 meters, 3mHz, 0 mHz for 17 meters, 4, 8, 11, (14.5 mHz for 80 meters would have to be from some high cost supplier,) and 16.257 mHz will cover part of the 160 meter band.

After that I would have to find the old articles about crystal filters and crunch through them for an IF filter. I guess I'll be busy this winter!!

I'm interested in the Neophyte, I wish there was mention in the story of how to get a collection of drawings or re-prints.

You are doing good work, don't get discouraged, I think there are lots of experimenters amongst us who need a common forum. Others who might like scratch-building if they could find a place to start, help when things get tricky, hints and kinks from people who have been there before, etc..

Roy Parker, AAØB

Columbia, MO

Thanks, Roy. We have received a few requests for reprints of various articles, and, unfortunately, we do not have the staff or time to process individual requests for them. I guess an option for readers is to maintain a collection of back issues (the first Neophyte Roundup article appeared in the Winter, '94 Issue). Also, for your information and the info of our readers, an index of Hambrew articles and issues is presented in this issue, and will be repeated for each year of publication in the Fall issue of that year. We hope this will help locate articles as we increase our volume of published matter!

Still Available

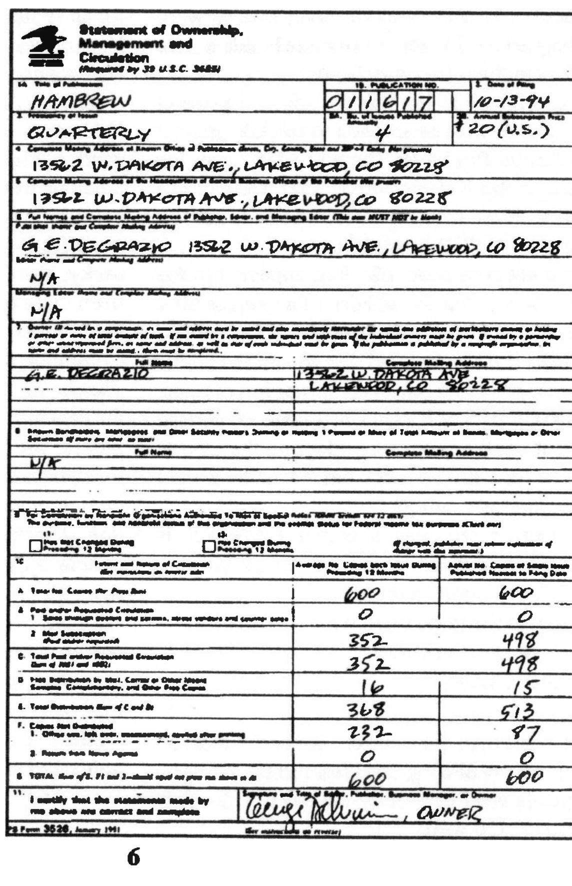
This certificate for contact with WFØK is still being offered. Any QSO with WFØK will now qualify. Simply send your QSL card with the request. The certificate will be mailed to you postpaid.

BACK ISSUES OF HAMBREW:

To keep your **Hambrew** collection complete, we still have a number of back issues available. Our Inaugural Issue was Autumn, '93. Back issues up to and including Fall, '94 are $6 each, issues published after Fall, '94 are $3.50 ea. mailed in an envelope via first class mail. Supplies are limited.

MOVING?

Notify us of your new address - don't miss a single issue of ***Hambrew!***



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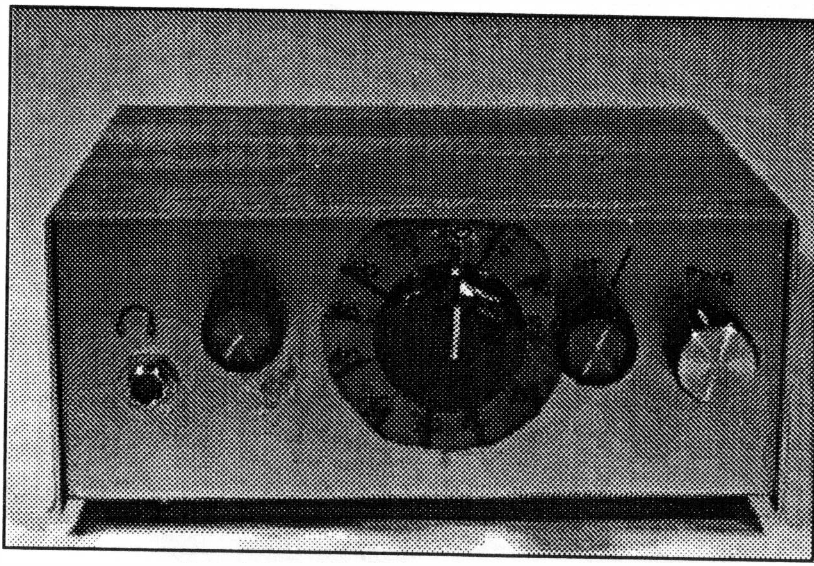
PS Form 3526, January 1991

KIT REVIEW

The W6EMT NW 20 QRP Transceiver

Josh Logan, WX7K



The working end of the W6EMT NW20 Transceiver. The case is a Ten-Tec TP series with wood-pattern contact sheet applied (see text).

I received my kit from Dan's Small Parts in Montana. The kit is a single board and I decided to use a Ten Tec enclosure 6 1/2" wide, 5 1/2" deep and 2 3/4" high. Both Dan (the supplier) and Roy (designer and troubleshooter) were very helpful. A few parts were missing, but Dan quickly mailed the missing parts and sent along a different final PA transistor, which he said would handle power (5 watts out) much easier. Roy supplies very careful instructions, step by step. You actually check off each step. There are a few toroids to wind, and the directions are very good, and there are some errors on the silkscreen which Roy is correcting.

The front of the rig has the following controls: Volume, Tuning, RIT and Power. The power pot varies output from milliwatts to well over 5 watts out! After final assembly I was unable to get the rig up and running. I sent the entire rig to Roy up in Washington along with $25 and return postage. He fired it back within a week! I was amazed. I made a bunch of common errors and a few errors due to omissions in instructions and/or errors in silkscreening on the circuit board.

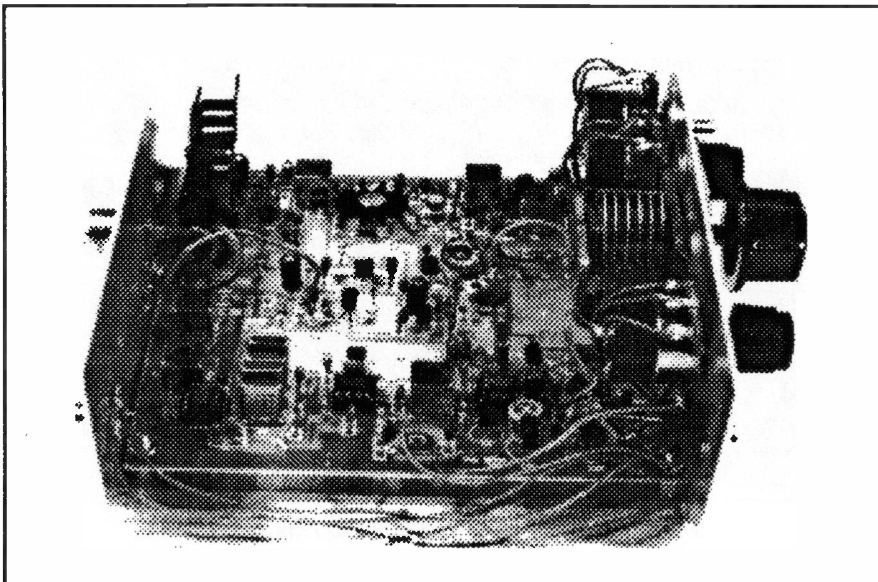
Initial testing confirms that the receiver is very hot with lots of audio. I could easily drive an outboard speaker to a loud level. There is at present no filter. The rig sounds about 2.0 KHz wide as compared to my other receivers. It hears very well.

The rig tunes 14.000 to 14.200 but can be modified to tune a smaller range, say 14.000 to 14.070, by removing plates from the variable capacitor. It tuners lower sideband so SSB signals are not readable. My dial goes from 14.000 to 14.060 in the first 360 degrees of rotation. My calibration markings are every 5 KHz.

On the air tests with local and distant friends verify that the rig sounds good - no chirps or clicks!

Since then I have made many North American contacts on 20 meters using this rig.

What needs improvement: my sidetone has a lot of clicks - Roy says to replace the B+ lead that runs under the board with some coax. And a sharp filter on receive would be helpful - but I still managed quite well during the CQWW contest! I heard DX from all over the world! In summary, the kit sans enclosure is $69 and a very good buy! The customer support from Dan (supplier) and Roy (designer) is second to none! They are very helpful and very quick to respond! If you have a small gel cell (4.0 AH) and an antenna, you can easily go hiking and set up a remote portable operation - in my case, I have the Rocky Mountains at my back door.



Inside the project case: the board is well laid out, and improvements are being made to make parts identification for placement easier for the builder.

I easily adjusted the output to 5 watts. I live in a condo and presently am restricted to an indoor long wire only 24 feet long, end fed Zepp-style through a tuner. The wire is attached to the ceiling and bends in an "L" shape. This is certainly nothing fancy! During the CQWW contest I worked the super station in the Canary Islands EA8EA - it took 25 minutes in a huge pile up and I was going 40 wpm. By the way, the rig is QSK ! Very useful for DX pileups! I also worked a Brazilian station and a Peruvian station. I could not raise any Europeans at QRP level. I know I would have done so easily if I had an outdoor wire loop!

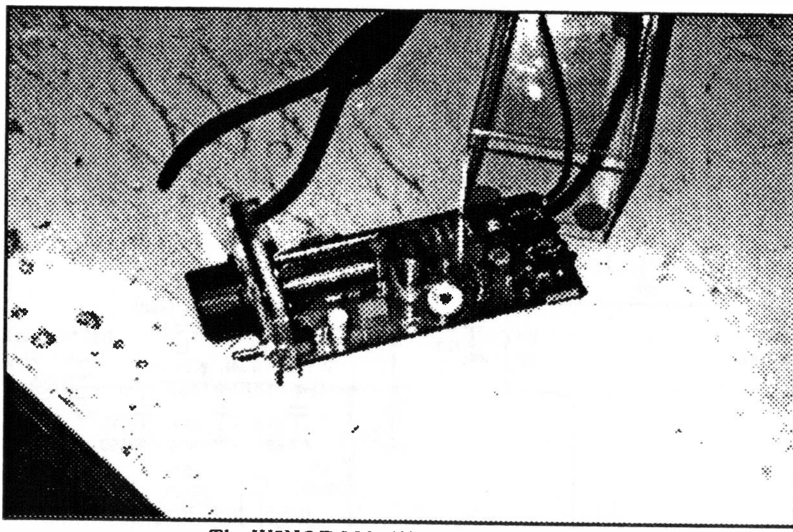
The W6EMT NW20 Transceiver is available from

Dan's Small Parts and Kits
1935 SO 3rd West #1
Missoula, MT 59801
(406) 543-2872 (phone, FAX)

The 800 Milliwatt Showcase

Dave Anthony, W5NOE

145 Milentz Street
Columbus, TX 78934



The W5NOE 800mW transmitter for 80m poses outside its showcase (photo: Fred Bonavita, W5QJM).

THE CHALLENGE

You've just worked the rarest of DX, Nankipoo Land, and the homebrew rig has done you proud. Certainly would be nice to show the gang the innards, but rows of sheet metal screws make that awkward. No piano-hinged lids as in the old tube days! What to do? Well, here is one suggestion: The 800 Milliwatt Showcase.

THE CIRCUIT

The schematic is shown in Fig. 1. Q1 is a variable crystal oscillator (VXO) in the 80 meter band. It drives the power amplifier, Q2. Q3 functions as a switch to key the Vcc line of the oscillator. The circuits used are popular ones, genesis DeMaw, and I take no credit whatsoever for them. C1 and L1 allow the transmit frequency to be varied over a total range of approximately 3 kHz. I used a 140 pF variable capacitor, but 100pF will give al most the same swing. T1 is a stepdown transformer with its primary tuned to the oscillator frequency by C3 and C4 in parallel. If you use a trimmer that has a different range, you may need to change the value of C3.

The power amplifier yields a solid 800 milliwatts output. The collector load is followed by a 5 element Chebyshev low-pass filter. Although it hasn't been tried on the air, it appears that eliminating the small emitter bias of Q2 would boost output to a full watt without compromising stability. Try grounding the emitter (right at the transistor) and see how you make out. Q3 is in a familiar PNP switching circuit with some RC shaping of the keying.

W5NOE "SHOWCASE" TRANSMITTER

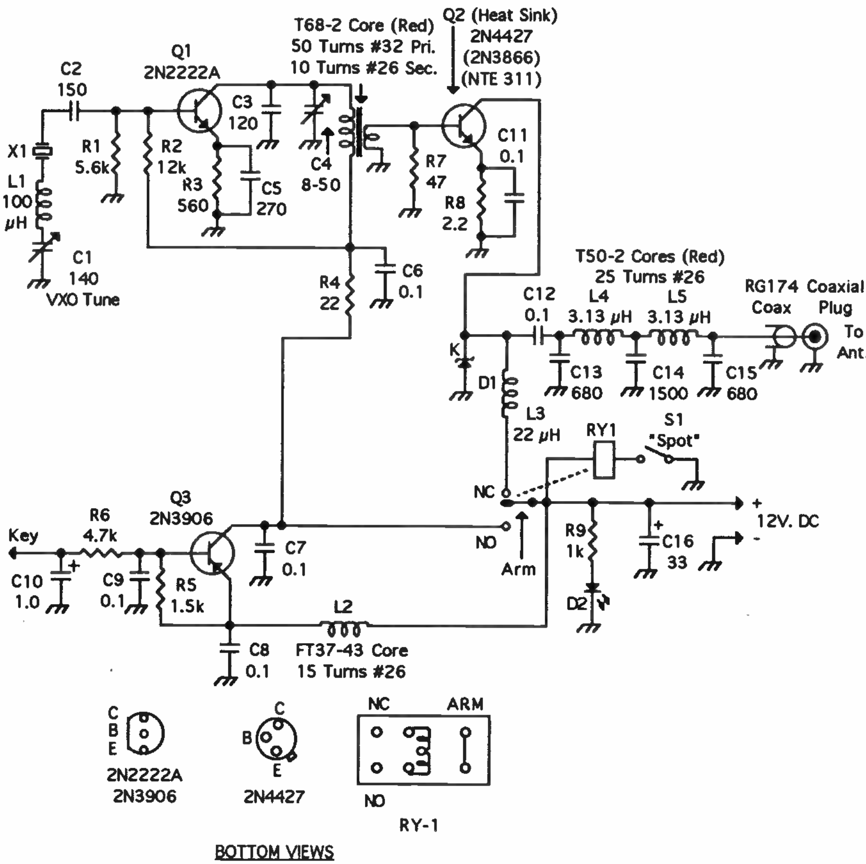


FIGURE 1

TABLE 1: W5NOE SHOWCASE PARTS LIST

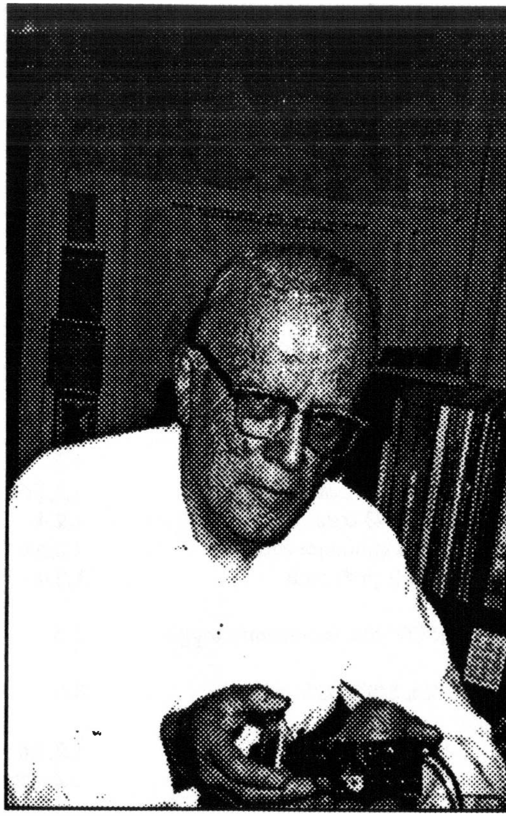
Part	Description	Sources	Notes
C1	140pF air variable	1,2	Hammarlund HF 140 used
C2	150pF ceramic disc	1,5,6	
C3	120pF poly or silver mica	1,2,5,6	
C4	8-50pF ceramic trimmer	1,2,5	See Text
C5	270pF poly or silver mica	1,2,5	
C6,7,8 9,11,12	0.1μF monolithic	1,2,5,6	
C10	1.0μF tantalum or electrolytic	1,2,3,5,6	Axial lead
C13, 15	680 pF silver mica	1,2,5	
C14	1500pF silver mica	1,2,5	
C16	33μF, 25V electrolytic	1,2,3,5,6	Can be 22 or 47μF. Radial lead
X1	3560 kHz crystal	1,2	Standard QRP freq. See text.
	Crystal socket	1,2	For HC 6/U holder
L1	100μH miniature choke	1,2,5,6	
L2	FT 37-43 core	1,2,4	
L3	22μH miniature choke	1,2,5,6	
L4,5	T 50-2 (red) core	1,2,4	
S1	SPDT min. momentary toggle	1,5	
RY1	Min. SPDT 12V relay	3,5	RS # 275-241
D1	1N974B zener diode	1,2,5,6	Can be 1N4753 or 1N5258
D2	LED	1,2,3,5,6	
Q1	2N2222A	1,2,3,5	Several other NPN types ok
Q2	2N4427	1,2,5	2N3866, NTE311, NTE346 ok
Q3	2N3906	1,2,5	Almost any PNP will work well
T1	T 68-2 (red) core	1,2,4	
R1	5.6k	1,5,6	All resistors are 1/4 watt carbon
R2	12k		
R3	560		
R4	22		
R5	1.5k		
R6	4.7k		
R7	47		
R8	2.2		
R9	1k		
Board PC board	Double sided copper	1,3,6	
Tapes	0.125" & 0.080" most useful	1,5	
Case	2 1/4" X 2 1/4" X 5" long	Made by AMAC Plastic Prods. Corp. Sausalito, CA	

NOTE: For listing of source numbers, see Table 1A, pg. 13

A low cost relay turns on only the oscillator when the SPOT switch is depressed. I prefer this to the erratic operation I've experienced with spring-loaded SPDT momentary contact toggle switches. Parts for this project are, happily, quite easy to locate. The parts list and sources are shown in Tables 1 and 1A.

CONSTRUCTION

A 2" x 4 1/2" double-sided printed circuit board is used Fig. 2 is the etched-lead bottom side of the board, and Fig. 3 is the topside layout of parts. With the advent of tiny monolithic bypass capacitors, I find myself putting them on the underside of boards and eliminating some etched leads and drilled holes.



Dave Anthony, W5NOE, with his mighty 800 mW Showcase Transmitter (Photo: Fred Bonavita, W5QJM)

Fig. 2 locates cable connections that tie the transmitter to my station keyer/VOX/power supply. Your situation will determine if you need to modify.

The plastic case is described in the parts list. The one I chose has proved to be remarkably solid, easily drilled, and having a snug fitting cover (our "panel"). C1, VXO TUNE, is mounted in the center of this panel. In turn, the PC board attaches with one screw to the tapped hole of C1's bracket. C1 is a vintage Hammarlund HF140 which is available from one of the listed sources. Of course, there are many other possibilities, so don't hesitate to try something different.

You'll note that the etched-lead side of the board (Fig. 2) has no graceful and curving leads. Sorry! I am a firm believer in black tape for one-of-a-kind boards. Have a clean copper surface and firmly attached tapes, especially at the overlaps. The result is a board that is quite non-critical of etch time. I prefer to use squared tape ends at hole locations and pass up the use of donut pads and the attendant overlaps.

Hole locations on my board accommodated the various parts I had available. Some of these parts may no longer be available, and substitutions will have to be made. The results will be entirely satisfactory, but the pin/terminal spacings will have to be altered to match the new part. Trimmer capacitor, C4, is a good example. Another is the crystal socket, board holes for which are dimensioned for the HC 6/U holder.

ALIGNMENT and OPERATION

There is little to be done to check out the rig.

Connect a 12 volt DC supply and terminate the output pi filter with a 50 ohm resistive dummy load. A high-impedance voltmeter with RF probe across that load will measure the RF output voltage. Key the rig and peak this output voltage by adjusting C4 to resonance.

CONCLUSION

Even with a random wire antenna and a tuner this little transmitter will surprise you with many fine QSOs and flattering reports.

Work Nankipoo Land with the 800 Milliwatt Showcase? On 80 meters? Well, maybe not right away. But you'll be able to show the gang what your enthusiastic homebrewing looks like! • • •

A parts-placement diagram and etching pattern are on page 14.

TABLE 1A

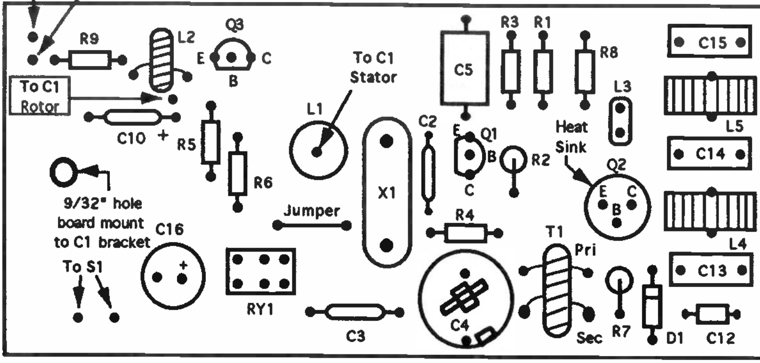
PARTS SOURCES

1.	Ocean State Electronics PO Box 1458 6 Industrial Drive Westerly, RI 02891	1-401-596-3080 FAX: 1-401-596-3590 1-800-866-6626 (order line)
2.	Dan's Small Parts and Kits 1935 So. 3rd. West #1 Missoula, MT 59801	1-406-543-2872
3.	Radio Shack (Local stores- a charge for catalog)	
4.	Amidon Associates PO Box 956 Torrance, CA 90508	1-310-763-5770 FAX: 1-310-763-2250
5.	Mouser Electronics (Four sales and distribution centers)	1-800-346-6873 (order line) 1-800-992-9943 (for catalog)
6.	Digi-Key Corporation 701 Brooks Avenue South PO Box 677 Thief River Falls, MN 56701-0677	1-800-344-4539 (order line) FAX: 1-218-681-3380

All except Radio Shack will send free catalog on request

"Showcase": Layout of Parts, Bottom of Board (not to scale)

Figure 1



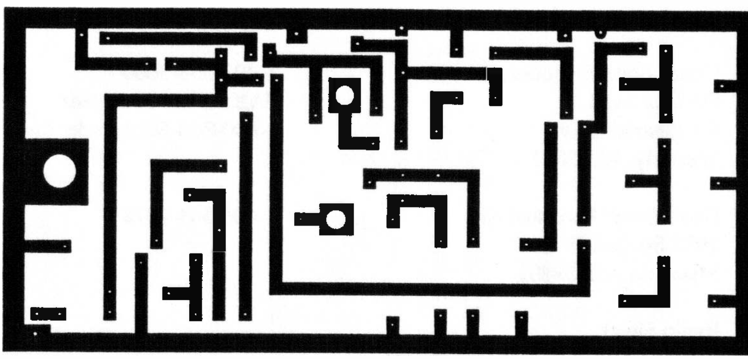
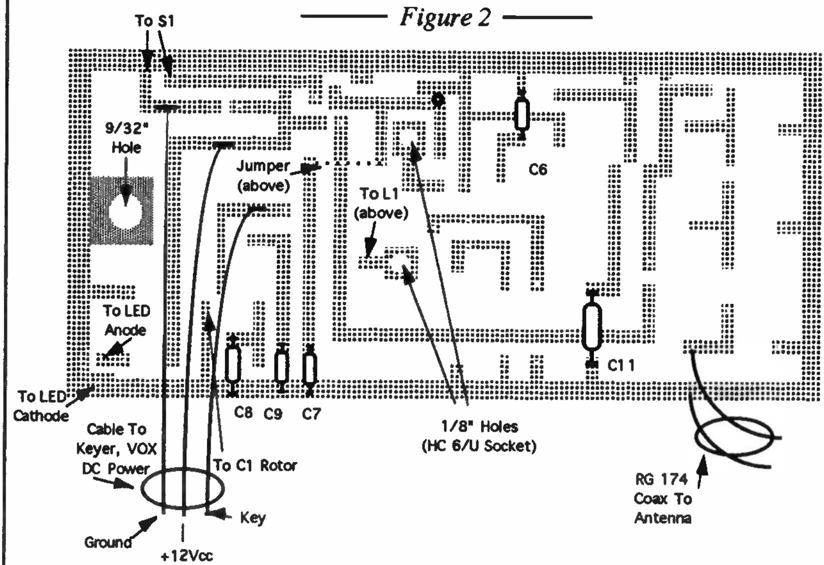
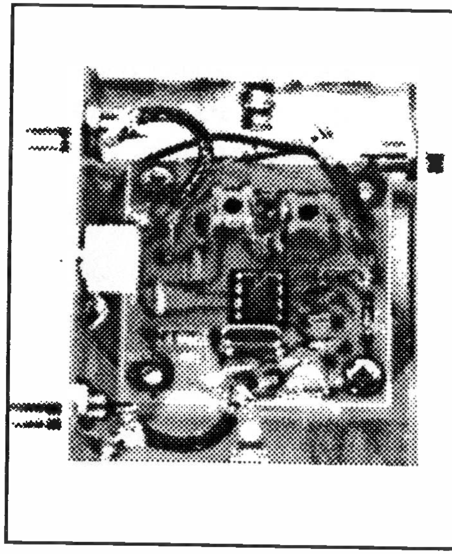


Figure 2

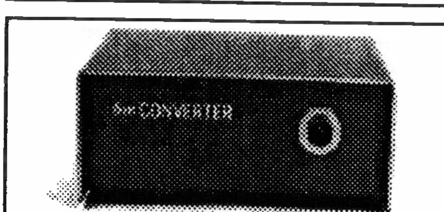


• New Products •

New Ten-Tec 6 Meter Receive Downconverter Kit



The circuit board is roughly 1 3/4" square



As you may already know, Ten-Tec has a new line of kits. These are so new that as of November, 1994, all kits in the line were not yet available. By the time this issue goes to press that may change.

The 6 meter receiving converter (T-Kit 1061) is a reasonably-priced kit which can allow a builder to monitor the 6 meter band by down conversion to the 10 meter band. It uses any 10 meter receiver (or transceiver) as a "tunable IF" to permit reception of 50-54 MHz signals in any mode available on the receiver itself (e.g., SSB, CW, AM and FM modes). The converter is for receive mode only. Transmitting through it will fry it!

The principle of the circuit is fundamentally simple: a crystal oscillator built around the Signetics NE612AN mixer-oscillator IC, optimized to pass 50-54 MHz signals while attenuating significant unwanted signals such as 28 MHz and 6 MHz (the latter being the difference between 28 and 22 MHz). The oscillator runs at 22 MHz, so the difference between 50 and 22 MHz yields the 28 MHz RF output. Thus, if a 10 meter receiver's top end is 29.999, conversion is available to 51.999 MHz.

The kit incorporates top-quality components, with one exception. The two slug coils in the oscillator could be easily damaged by tuning with a metal-bladed screwdriver. Use only a wooden or plastic tool for this purpose, and be sure to solder the coils firmly to the board for support. The circuit board is glass-epoxied, etched, cleaned and component-identified. The project can easily be completed in one evening, and is not complex. The kit price ($17, plus S. & H.) does not include an enclosure, hardware or LED as in our version. Upon completion, our kit worked right away, receiving the WØIJR 6 meter CW beacon. This is an inexpensive route to access the 6 meter band for builders who do not wish to fork over the big bucks for commercially-built equipment. Other crystals may be used to expand the coverage (e.g., 24.000 MHz microprocessor crystal for conversion to 52+ MHz). Not a bad deal! *Ten-TecT-Kit, 1185 Dolly Parton Pkwy., Sevierville, TN 37862, (615) 453-7172, FAX (615) 428-4483*

Easy, Quiet Power Supplies for QRP Equipment

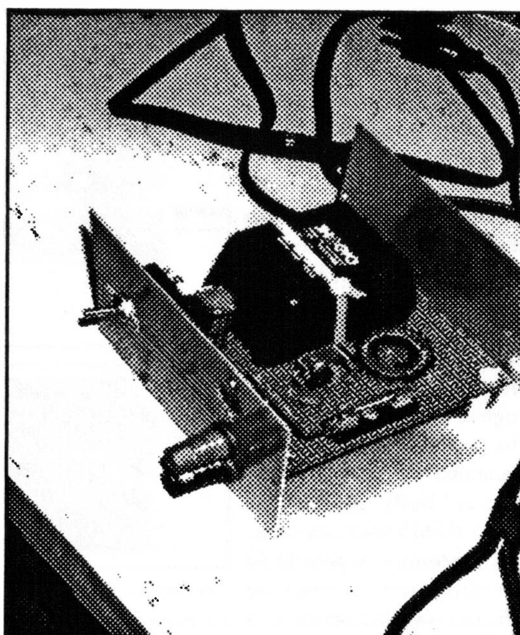
Fred Bonavita, W5QJM

P.O. Box 2764
San Antonio, Texas 78299

Plug-in wall transformers are an inexpensive, compact source of power for QRP equipment, but they also can be only marginally suitable, as is, for use with some rigs.

Common-mode hum, inadequate filtering, lack of bypassing and lousy voltage regulation have made most of us wary of these transformers, whose designers and manufacturers gave little or no thought to Amateur Radio use of their products.

These transformers deserve a closer look, however, especially by those hunting bargains and willing to spend a few nickels and do some work to produce a fairly versatile device with numerous applications that won't cost an arm, a leg or another part of the anatomy.



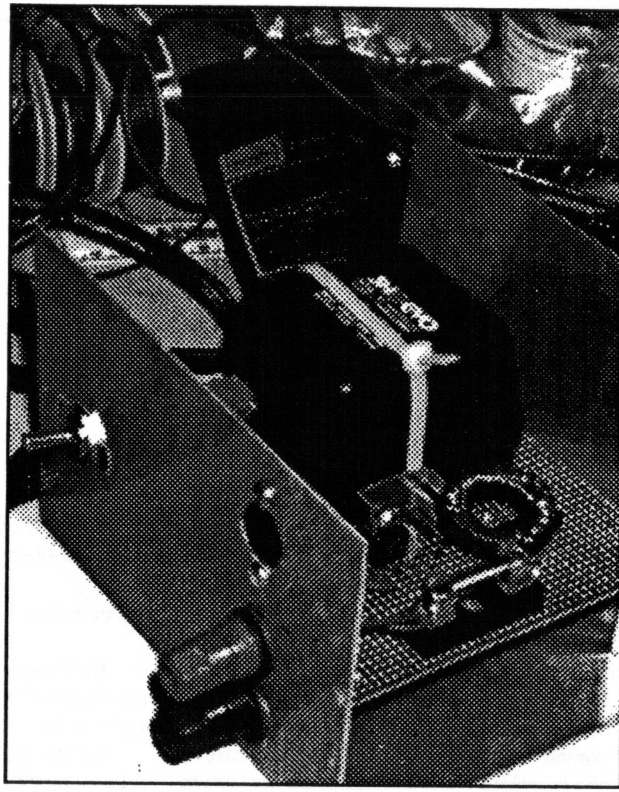
This 12-volt, 1 amp supply is based on a $4 wall transformer with an output of 14v dc at 1.1A. Grouped around the transformer are a filter capacitor (2200 µF, 50v), a 12v, 1-amp regulator with its heat sink, the toroidal inductor and the 1.5A output fuse. The primary fuse and bypass capacitors are beneath the perfboard (Photo above, page 17: Fred Bonavita, W5QJM).

Wall transformers appear regularly on the surplus market, and a list of some sources is provided below. Prices vary from as little as $2.50 (for 3v dc at 300 mA) to $9.50 (12v dc at 1.5 A), for example. Sharp-eyed bargain hunters can find them at flea markets often for less, but examine the power ratings on the transformer before you buy! It doesn't do much good to pay as little as $1 for a unit only to discover, once back home, that it supplies only 9v dc when at least a 12-volt unit is needed.

The best discussion of plug-in wall transformers for amateur use is by Doug DeMaw, WlFB[1] and it's recommended reading, as are two of his QRP-related books.

Curing the problems Doug lists is relatively easy and inexpensive. Fig. 1 shows a schematic for a typical wall transformer — a bare-bones device indeed.

Adding proper filtering and/or regulation is a snap. DeMaw's article shows some possible circuits, and more can be found in the power supply section of the ARRL Handbook and "Solid State Design for the Radio Amateur," by DeMaw and Wes Hayward, W7ZOI. A very good design for a variable output voltage system appears in the Power Supply Handbook[2] at page 144, and it is accompanied by a good discussion of the reasons certain components were used.



Some wall transformers' ratings (mostly those with an ac output) are stated only as a "VA" value, a measure usually skipped in discussions of power supplies but which is easily translated. For instance, I paid about $6 for a wall unit with dual outputs: 18v ac at 18 VA and 8.5v ac at 1.28 VA. Using the $P = E \times I$ formula, the first output translates to 18v ac at 1A, and the second is 8.5v ac at .14A. Those voltages, when rectified and regulated separately, produced outputs of 12v dc at up to 1A and 5-8v dc at sliqhtly more than 100 mA without straining regulation.

Wall transformers with a dc output usually need only some added regulation, filtering and bypassing to make them better for QRP use. Those with ac outputs need rectifiers, filtering, regulation and bypassing and offer the chance to include most of the hum-reduction suggestions DeMaw and others make.

The power supply in the photographs is typical of what can be done. This bargain (about $4) wall transformer has an output of 14v dc at 1.1A, and all it needed was better filtering, a regulator and bypass caps. It was made to plug directly into the ac outlet, and the dc output was two screw terminals on the bottom. It is held in place on a piece of perf board by a 12" plastic tie, and one-inch standoffs elevate the perf board for easy access to the under side for bypass caps and a fuse in the primary, none of which makes for good photos.

The filtering and bypassing came from two of DeMaw's books: the "QRP Notebook" and "WlFB's QRP Notebook," both from ARRL. A bifilar-wound toroidal choke in the output voltage leads helps suppress common-mode hum and keeps stray rf out of the power supply. The toroid is an FT-114-43 wound with 20

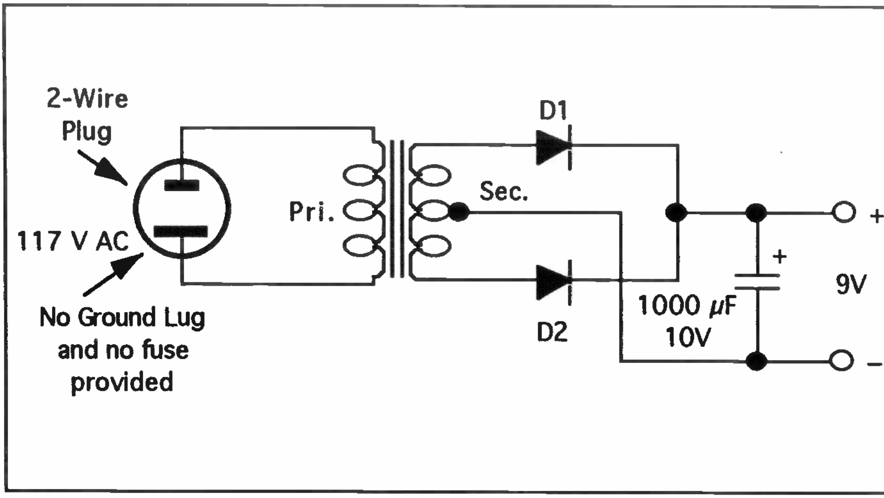


Figure 1: The schematic diagram of the dc wall unit. Filtering is minimal, and there is no regulator. The 117 V ac line is not bypassed and no fuse has been included.

bifilar turns of No. 20 enameled wire.

Bypass caps are 0.01 uF lkv disc ceramics at the point the ac line connects to the transformer primary. The 12v dc output terminals on the "outboard" side of the choke are bypassed with 0.01 uF 50v caps. The positive and negative leads of the output are kept above chassis ground, and the primary and secondary are fused.

This package is perhaps bulkier than it should be, given the low power involved, but the cabinet (4 x 5 x 6 inches) was found at a swapfest for $2. The extra room made work easier, and air can circulate around the heat sink better. There is room on the face for a meter, should I want to measure voltage, current or both. I have less than $10 invested in this take-along unit.

Watch surplus catalogues for these transfomers and pounce on the bargain units quickly. Buy a couple, if you can. The truly good units — those with power ratings of interest to QRPers — usually sell out quickly.

• • •

Footnotes:

[1] "Plug-in Wall Transformers — A Super Bargain!" by Doug DeMaw, QST, June 1985, p. 36.

[2] The Power Supply Handbook, by the Editors of 73 Magazine, TAB Books, Blue Ridge Summit, Pa., 1979.

Sources of Wall Transformers:

All Electronics, P0 Box 567, Van Nuys, Calif. 91408 0567. Free catalogue.

Hosfelt Electronics Inc., 2700 Sunset Boulevard, Steubenville, Ohio 43952-1158. Catalogue $2.

Ocean State Electronics, PO Box 1458, Westerly, Rhode Island 028gl. Free catalogue.

Marlin P. Jones & Associates Inc., PO Box 12685, Lake Park, Florida 33403-0685. Free catalogue.

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An ATU for a 50-Foot Longwire

Bill Shanney, KJ6GR

Hambrew-built KJ6GR Antenna tuner used with a 65 foot long wire. Jumpers can accomodate a half wave wire length (see figures 1a, 1b, page 21).

Antenna tuners are one of my favorite subjects. I've been playing with a 50 ft long wire for portable QRP operating. The length selection was very scientific, it is a standard roll of wire from Radio Shack. My little MFJ tuner has no problem on any band, it is the standard 'T' network. My Z-match tuner also works fine. Both of these are bigger than you would like for portable work. A simple L-network consisting of a series inductor and a shunt capacitor works in many situations and can be made small. Figure la shows this design which will tune wires that are a quarter wave and longer unless they are close to a half wave which have very high impedances. For wires near a half wave long a tapped parallel tuned circuit will work fine. Figure lb shows this circuit.

Using simple clip leads these two circuits can be switched easily. A QRP portable tuner could be made in a small plastic food container using copper foil for critical grounds. When in use the cover could be removed to facilitate changing the inductor tap or for reconfiguring the tuner.

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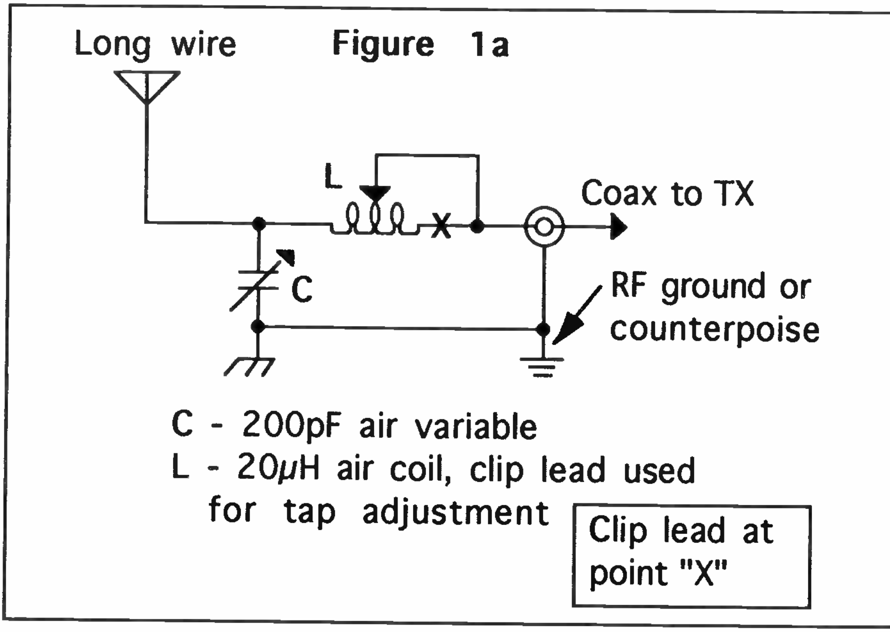
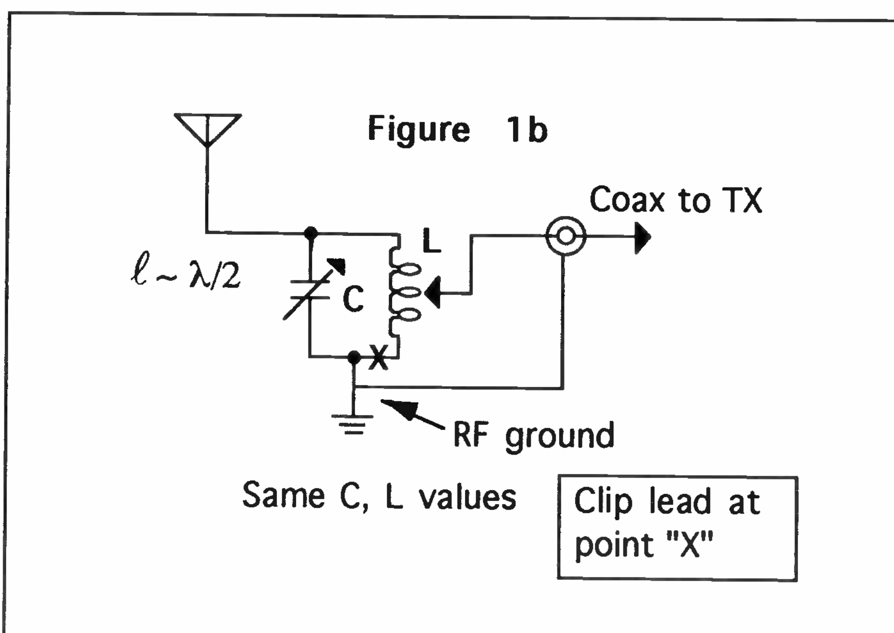


KJ6GR Antenna Tuner for a 50 foot long wire antenna



Half wave long wire option. Clip lead if needed.
More photos, page 23

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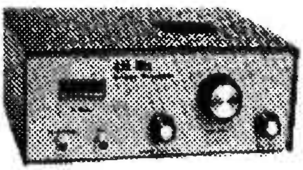

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Curtis 8044ABM Keyer Kit

Based on the new Curtis 8044ABM Chip, this keyer is a great addition to any rig. The PC board is 2" x 2" and will fit nicely into most QRP rigs. Power can be supplied by a standard 9 volt battery or from your rig's power supply. The kit includes all parts, PC board and the 8044ABM chip with data sheet.

8044ABM Keyer Kit $31.00

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W7EL QRP Wattmeter

This kit is based on the excellent design described in February 1990 *QST*. It uses a unique microstrip line on the PC board and is accurate to 450 Mhz. It measures both power and SWR in 3 ranges: 10, 1 and .1 watt. Our kit includes th PC board and parts, all switches and controls and the battery connector. We also have available an LMB minibox and a nice meter as options. The kit uses a 9 Volt battery for power.

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With Minibox and meter $53.00

Mini Circuits Labs Mixers

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SBL-3	$6.50
TUF-1	$6.50

Toroid Cores

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T37-6	.38	T50-6	.45
T68-2	.50	T68-6	.55
T68-7	.60		
FT37-43	.30		
FT37-77	.45		
FT50-43	.40		
Small Type 43 Bead			.10
Large Type 43 Bead			.15
Large Type 73 Bead			.18

All of our cores are made by Micrometals and Fairite, the same suppliers that Amidon uses.

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LF353N	1.00
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MC3362P	3.50
LM6321N	5.00

Specials

NE602AN 10 for $14.50 Postpaid

10 FT37-43 cores $2.25

10 T50-2 cores $2.25

10 T37-2 cores $2.25

Experimenter's Kit

This kit includes a FAR Circuits Prototype PC Board from the QRP Notebook and the following parts:

5	T50-2 cores
5	FT37-43 cores
1	T68-7 core
1	T68-6 core
6'	#24 Magnet Wire
6'	#26 Magnet Wire
2	MPF 102 FET
2	2N2222A Metal
5	2N3904
1	2N3866 and heat sink
10	.1 μF Monolythic Capacitors
10	.01μF Ceramic Capacitors
5	10μF Electrolytic Capacitors

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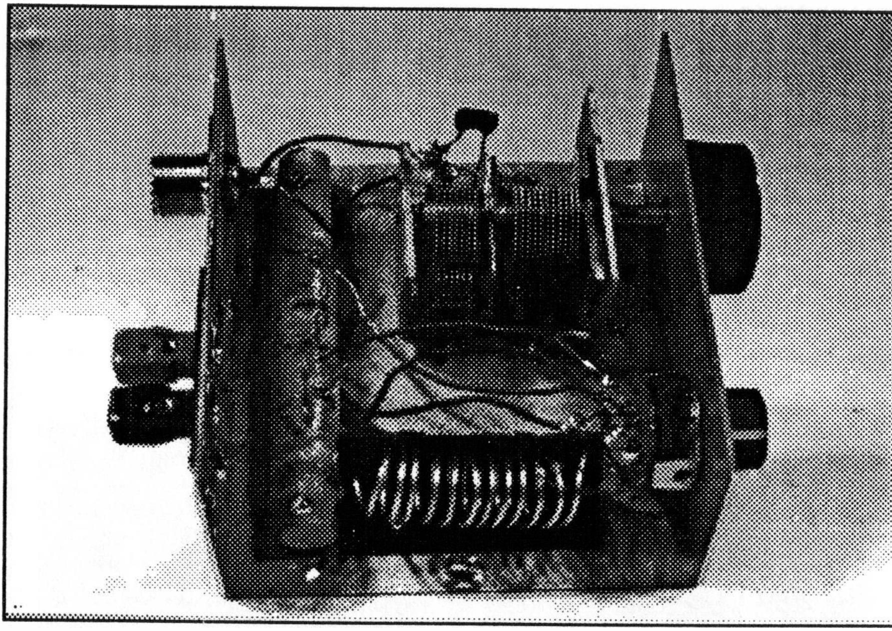
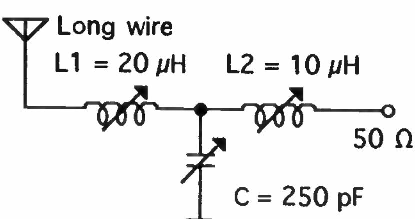


The Hambrew-built KJ6GR tuner uses two coils in series. The longer coil measures to 17 μH, and the shorter, 2 μH. This configuration tuned an approximately 65 foot end-fed long wire to a 1.2 : 1 SWR on 80 meters. It tuned 30 and 20 meters to 1.0 : 1 and 1.1 : 1 respectively. The counterpoise used was only 30 feet in length. This unit was not built for QRO operation.

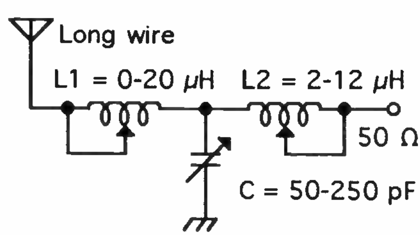
An 85 foot long wire is a good compromise for 40, 30 and 20 meters. On 40 meters a low pass 'T' matching network will work great: Component values are maximum.



On 20 meters the same network will work: L1 = 3 μH = L2, C = 200 pF max. (50 pF min.)

On 30 meters, short out L1.
L2 = 12 μH max., C = 50-100 pF

So a single tuner can easily match an 85' long wire on all three bands:

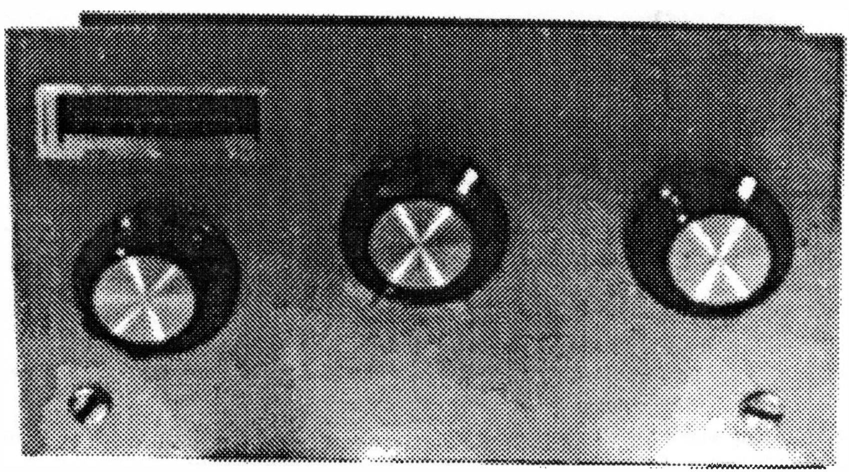


Just a few feet too long will make 30m very difficult to match, so if 30m is a problem, shorten the wire a few feet.
I really don't like the performance of a long wire fed against ground, so I am now playing with an offset-fed horizontal wire. I'll let you know how it looks when I'm through.
(The Hambrew-built version is on page 34)

W6EMT QRP Antenna Tuner

Roy Gregson, W6EMT

13848 S.E. 10th.
Bellevue, WA 98005



Roy reports that the above tuner works very well with the antennas shown in Figures 1 and 2. For lower-frequency bands (40 and below), additional turns on T1 or a longer wire may be required. The meter on the prototype is a 200μA edge-readingtype from Dan's Small Parts and Kits. Uninsulated buss wire is used on the tapped side of T1 to make it easier to tap without needing to strip shellac from the wire. Care should be taken to assure that the buss wire does not touch and short on itself in the winding of T1.

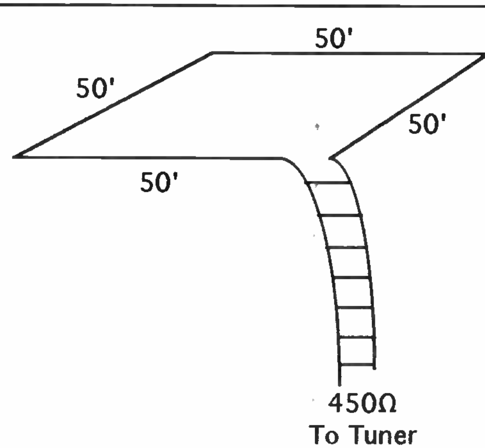
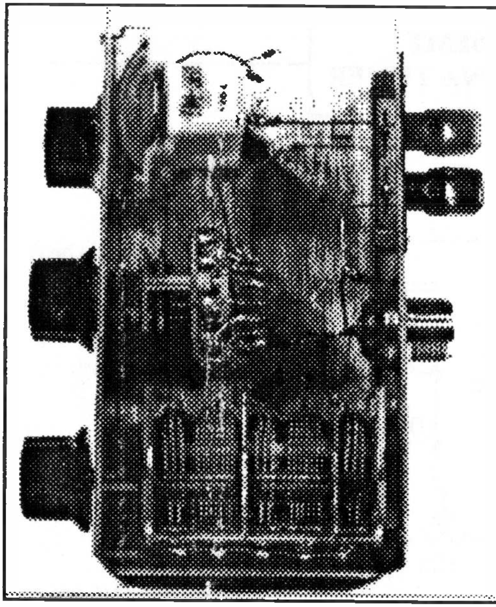


Figure 1



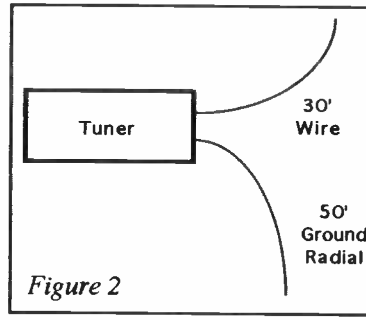
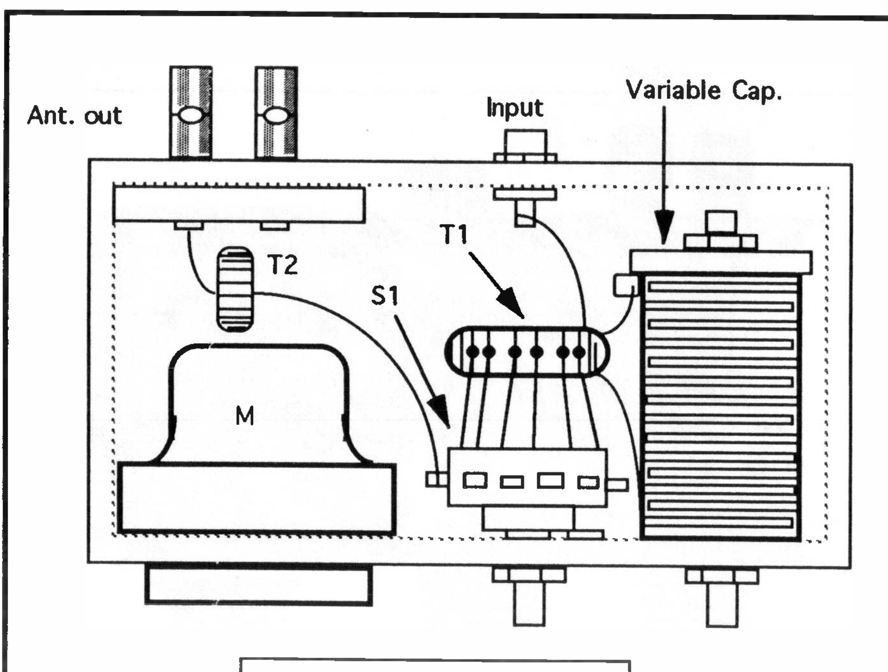


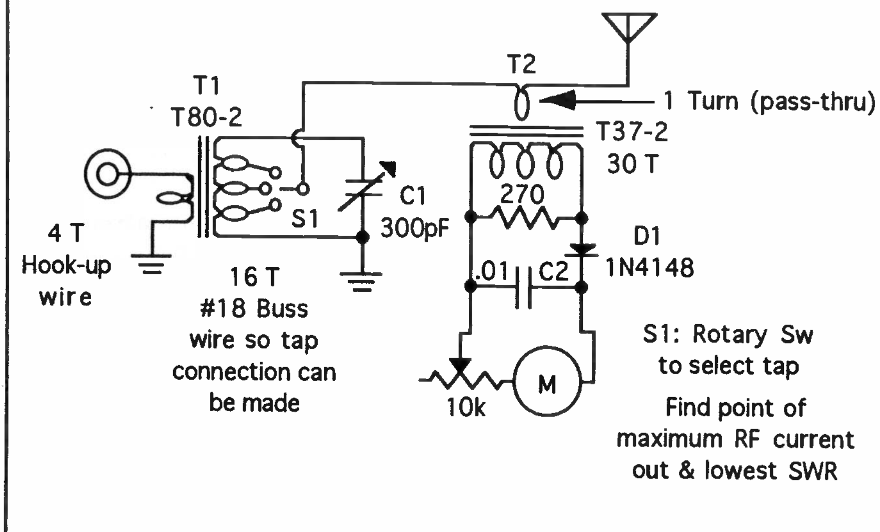
Figure 2

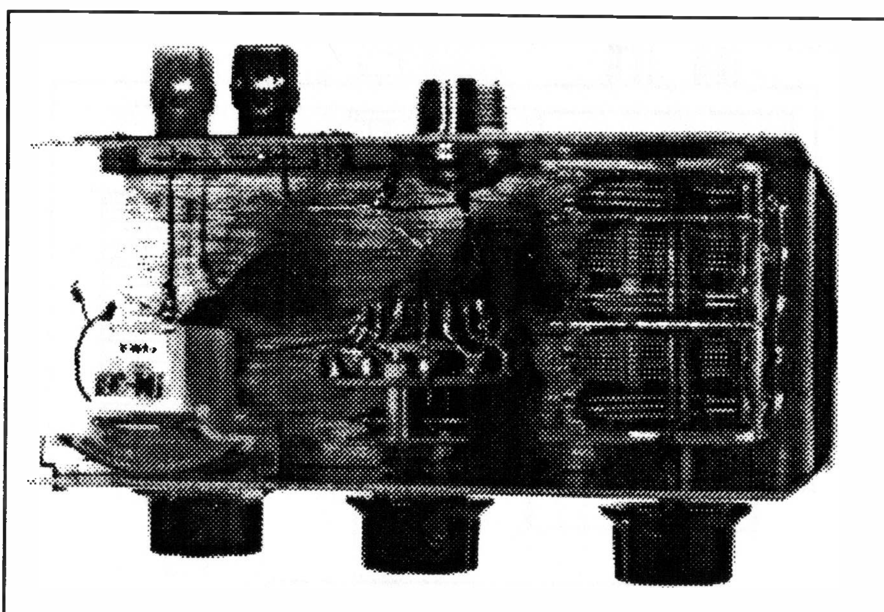
Roy was able to tune to both types of antennas on bands from 40 meters up without a hitch. In addition, a 15 foot wire was tried inside the shack without any difficulties. The tuner worked fine on 40, 30, 20, 15 and 10 with a 65 foot longwire end-fed.



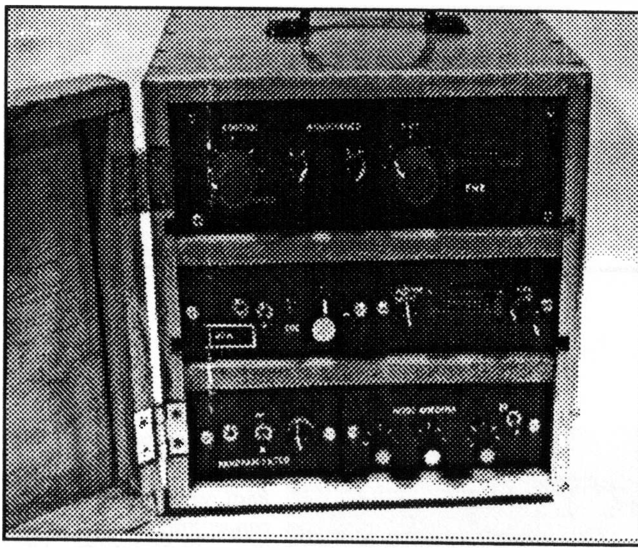
W6EMT ANTENNA TUNER

W6EMT ANTENNA TUNER





"Shack In A Box", Continued...



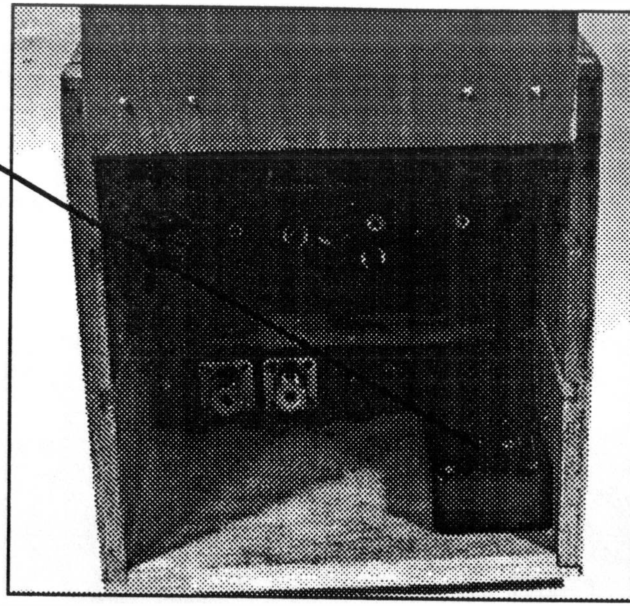
The box has grooves dadoed into the side panels to accomodate passing leads from front to back. Shelf height was determined for specific LMB project enclosures. The wood is D-Grade pine, sometimes called "drawer stock".
No power supply was included in this version.
(more photos, next page)

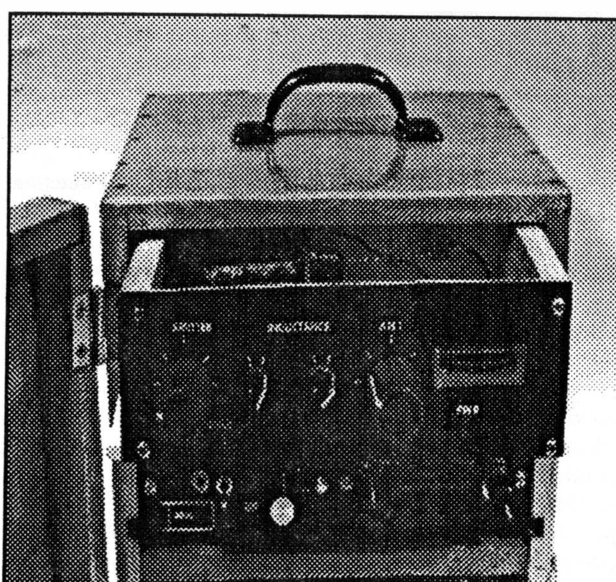
The "Shack In A Box" photographs of the homebrewed stations of Ernie Helton, W8MVN (*Hambrew*, Spring, 1994) and Tom Creede, WB3JJK/QRP (*Hambrew*, Autumn, 1993) preyed upon our thoughts as being nifty, portable, self-contained stations which would facilitate easy setup and tear-down for field day or travel use.

In building our version, we had to make use of a table saw which was less than perfectly aligned, which, coupled with our "wood-butcher's" sensibility of woodworking, placed the finished product well apart from any category of fine furniture. In spite of this, the resulting box worked well as the container for a modest 40 Meter station which included an antenna tuner (top), a transceiver and SWR bridge (middle shelf), and a bandpass filter and noise antenna (bottom). The antenna tuner is a modified version of one from the W1FB*QRP Notebook* by Doug DeMaw (ARRL Pub.), the transceiver is an interesting item called the "Pixie 2", which is a modified version of the original design of RV3GM published in *SPRAT*, the G-QRP publication, modified by David Joseph, WA6BOY, as set forth in the December, 1993 issue of *QRPp*, the publication of the dynamic Northern California QRP Club.

The SWR bridge is also from The *QRP Notebook*, and was selected for its simplicity of design. The power meter in the antenna tuner is the same circuit in the 20/20 Hindsight article in this issue of *Hambrew*. Rubber foot pads were installed on the bottom of the box, which measures 8"(H) x 8"(W) x 8.5"(D).

The Shack In A Box includes a junction box for the supply voltage. Any jack may be used to supply the junction box and any jack may be used to distrubute the power to individual devices, meter lights, etc. The back door is hinged at the top to provide access to the antenna leads and jumpers.





The antenna tuner is contained in a drawer(the final version is lined with copper foil). This suggests the possibility of a Shack In A Box with all modular elements constructed as interchangeable drawers (e.g., a 20M transceiver built in a drawer, etc.). Band changes could thus be made by insertion of a new drawer.
The little shack was launched on July 22, 1994 with its first QSO with KAØFVB, Ed, in Velva, North Dakota, garnering a whopping 239 RST report. Pixie power: 250Mw.

20/20 Hindsight

Looking Back Into Past Issues • Updates & Elaborations

Comments on "Counterpoise and the Antenna"

Bill Shanney, KJ6GR

When I first read Wes Farnsworth's article in the Autumn 1993 issue of *Hambrew* I made a few notes to myself but didn't have time to get back to it until recently. The figure at the bottom left of page 32 is very misleading. Let's start at the top. Les Moxon, G6XN wrote an excellent article[1] recently in which he shows that the base impedance is 18 ohms, not 36 ohms for an elevated ground plane antenna. I have verified this using NEC for wires[2]. I also ran comparison plots of 20 meter ground plane antennas with horizontal and sloping radials. The results are shown in Figures 1 and 2. It is clear that there is no noticeable change in radiation angle. The low angle radiation is determined only by the characteristics of the ground. I used $\varepsilon_r = 13$ and $\sigma = 4 \times 10^{-3}$ Seimens for these calculations. This characteristic of vertical antennas over ground is explained in *The ARRL Antenna Book.*[3]

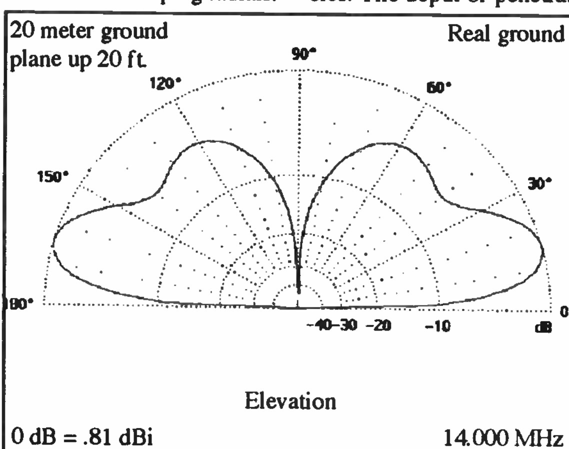


Figure 1. Elevated 20 meter ground plane antenna. Radiation Resistance is 18 ohms and peak radiation is at 16° elevation. (4 radials)

Horizontal Antennas are not affected by ground in the same way as verticals are. The low angle radiation continues to improve and is not limited to 15° as stated on page 34. Figures 3 and 4 clearly show a decrease in radiation angle from 10° to 8° when a 20 meter dipole is raised from 100 to 130 feet.

While it is true that the effective ground is below the actual ground, measuring it as described with a 10 GHz source is not appropriate. That will only tell you the ground location at 10 GHz, it will be deeper for lower frequencies. The depth of penetration of an electric field in a conductor (i.e.: Earth) is inversely proportional to the square root of frequency.[4] The effective dielectric constant (ε_r) and the conductivity (σ) of real ground vary with frequency, compounding the problem.

I would also like to comment on the KEØNH decoupling loops. The coax cable decoupling loops are a very effective way of preventing unwanted RF from flowing on the outer shield of coax cable. Current on the outer shield radiates like the rest of the antenna and can cause severe pattern distortions. The resulting imbalanced feed to the antenna halves may further hurt the performance. I always use a decoupling loop or a current balun at the feedpoint of my antennas to ensure proper operation.

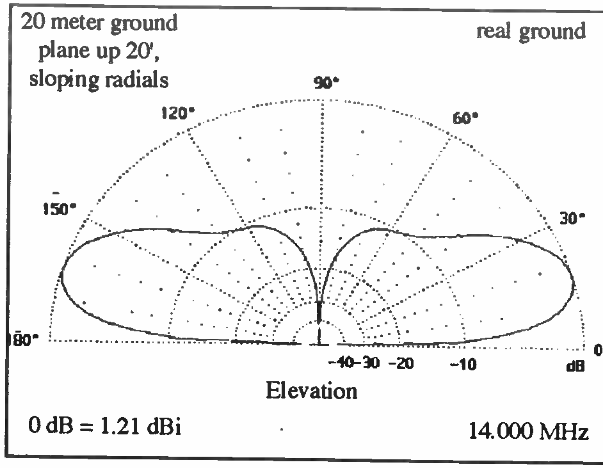
References

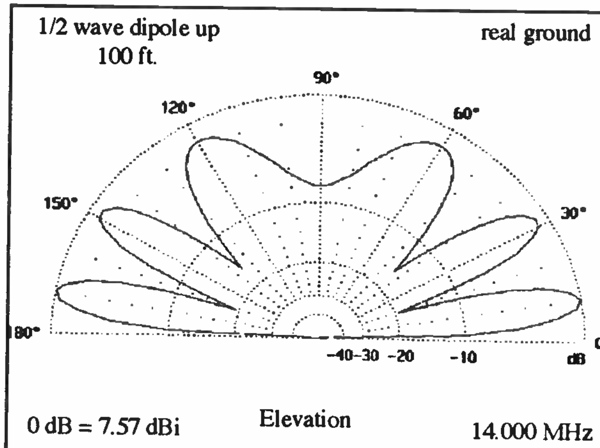
1. L. Moxon, "Ground Planes, Radial Systems, and Asymmetric Dipoles", *the ARRL Antenna Compendium*, Volume 3, 1992, pp.19-27.

2.NEC 1.0 by Brian Beezley, K6STI, 5071/2 Taylor St. Vista, CA 92084

3. *The ARRL Antenna Book*, 17th Edition (Newington, CT: ARRL,1994

4. Ramo, S., et.al, *Fields and Waves in Communication Electronics* (New York: John Wiley and Sons, 1965) pp. 249-254.





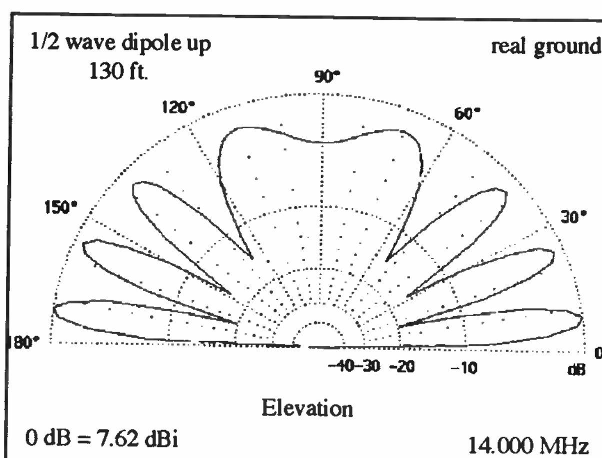


Figure 2 (top): Elevated 20 meter ground plane antenna with 4 radials sloping down at 45°. Radiation Resistance is 48 ohms and maximum radiation is still at 16° elevation.

Figure 3 (middle): 20 meter dipole up 100 feet. Maximum radiation is at 10° elevation.

Figure 4 (bottom): 20 meter dipole up 120 feet. Maximum radiation is at 8° elevation.

Noise Antenna Update

(Autumn, '94)

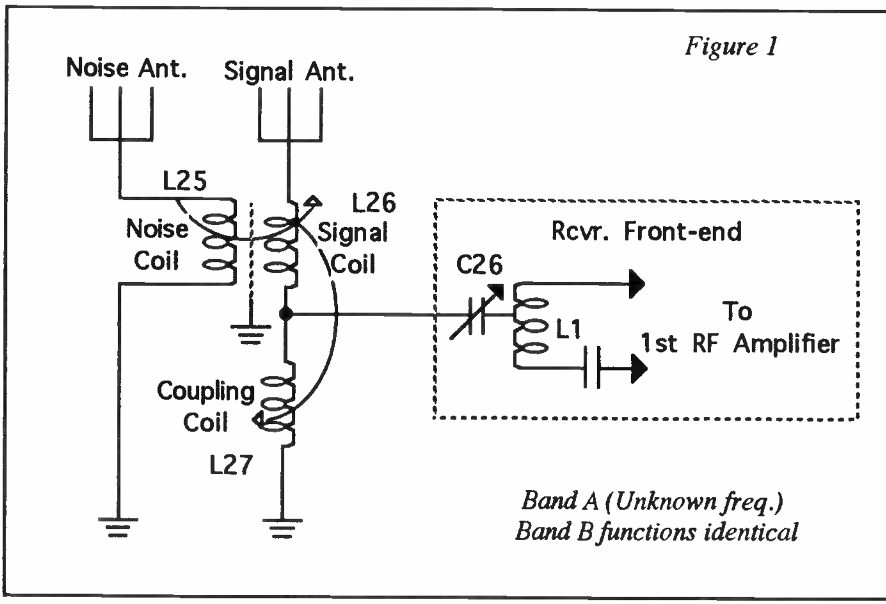


Figure 1

The above schematic and the Figure 2 schematic on page 32 are reproduced from a manual for the models BC-312 and BC-342 radio receivers manufactured for the U.S. Army Signal Corps by the Farnsworth Television and Radio Corporation (note: a neon lamp symbol has been deleted from the schematic). This information has been provided through research done by Roy Gregson, W6EMT. The copy in the manual which accompanies the schematics follows:

"b. A noise-suppression circuit is included in the antenna portion of Radio Receivers BC-312, BC-312-A, BC-342, and in earlier models of Radio Receivers BC-312-C and BC-342-C. The noise suppression circuit (*above-Ed.*) is provided to reduce motor ignition interference when the receiver is mounted in a vehicle. This circuit consists of three coils, L25, L26, and L27. Coils L25 and L26 are separated by an electrostatic shield to insure that the coupling between them is entirely electromagnetic, while coils L26 and L27 are separated by an electromagnetic shield to insure that the coupling between them is primarily electrostatic. Both couplings are adjustable. A NOISE BALANCE control is provided on the front panel to adjust the coupling between coils L25 and L26 and serves to adjust the amount of noise introduced into the receiver circuits from a *noise antenna located alongside*

20/20 cont.

of the vehicle engine (italics ours- Ed.). The coupling between L26 and L27 is controlled by the NOISE ADJUST control and determines the phase relationship of the resultant noise voltage introduced into the receiver. The coupling between L25 and L26 is adjusted to produce minimum noise (not always zero). The coupling between L26 and L27 is then varied to reduce the noise to zero thereby insuring that the phase of the noise voltage fed by the separate antennas results in cancellation. Coil L27 also acts as an r-f choke between the antenna and ground. Coils L25, L26 are no longer available as replacement parts. Therefore, when failure of any of the coils occurs, it is advisable to eliminate the noise-suppression circuit from the receiver."

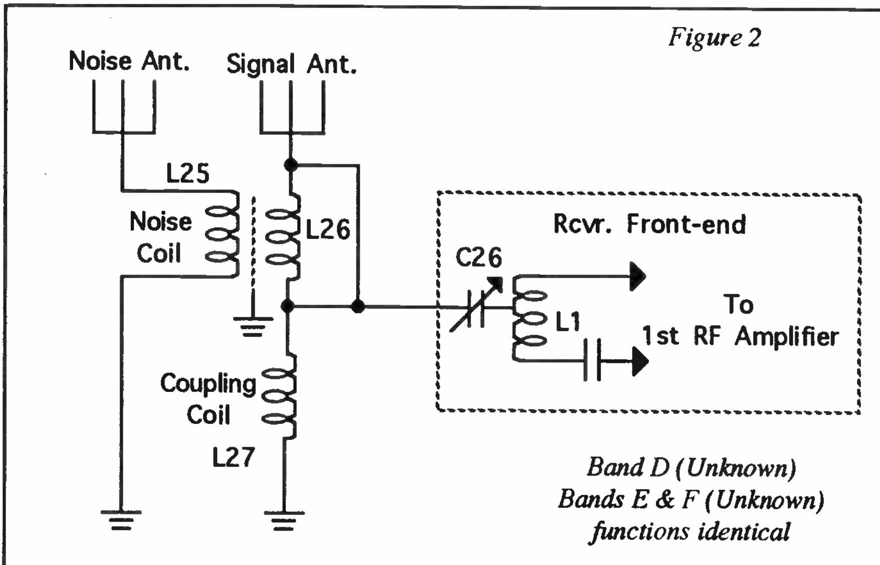


Figure 2

Band D (Unknown)
Bands E & F (Unknown)
functions identical

From the above copy, we theorize that the coils were coupled by positioning L25 over L26 (this has yet to be proven) in an adjustable (see Figure 1) configuration, and that the two were shielded from one another by ground isolation. In figure 1, there is an adjustable relationship between L27 and L26 as well (note curved arrow symbols). In Figure 2, no adjustability is indicated. If any reader has access to the above-named receivers, we would welcome information regarding the configuration of the coils and their values.
See page 33 for additional Noise Antenna information.

Fall, '94

Photos of decoupling loop, pp. 31, 32 by Bill Mason, NØKEP.

Dan Giles, VE7QM, kindly provided direct information regarding the "Jones Noise-Balancing Circuit" from the RADIO HANDBOOK of 1938. The schematic is shown in Figure 3. The copy is as follows:

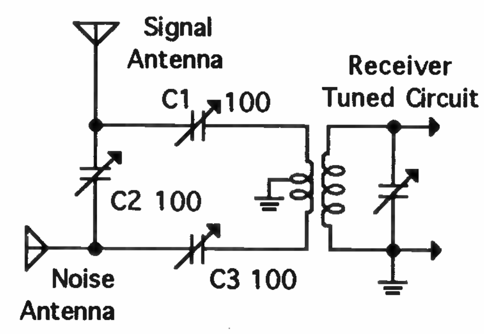


Figure 3

"A very troublesome form of interference which has heretofore been incurable, except by elimination directly at the source, is that which is carried along the power lines. This form of interference is of such a continuous nature, or buzz, that none of the noise-limiting circuits has proved of value in reducing the noise. Noise limiters are effective only on popping types of noise, such as automobile ignition.

Power line noise interference can be greatly reduced by the installation of a *noise-balancing* circuit ahead of the receiver... The noise-balancing circuit adds the noise components from a separate noise antenna in such a manner that this noise antenna will buck the noise picked up by the regular receiving antenna. The noise antenna can consist of a(n) ...additional wire, 20 to 50 feet in length, (which) can be run parallel to the a.c. house supply line. The noise antenna should pick up as much noise as possible in comparison with the amount of signal pickup. The regular receiving antenna should be a good-sized out-door antenna, so that the signal to noise ratio will be as high as possible. When the noise components are balanced out in the circuit ahead of the receiver, the signals will not be appreciably attenuated.

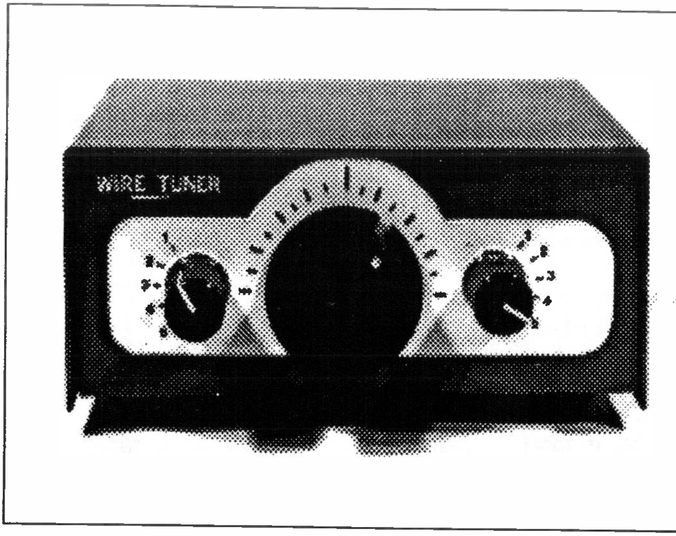
Noise-balancing is not a simple process; it requires a bit of experimentation in order to obtain good results. When proper adjustments have been made, it is possible to reduce the power leak noise from 3 to 5 R points without reducing the signal strength more than one R point, and in some cases there will be no reduction in signal strength whatsoever. This means that fairly weak signals can be received through terrific power leak interference. Hash type interference from electrical appliances can be reduced to a very low value by means of the same circuits.

The coil should be center-tapped and connected to the receiver ground connection in most cases. The pickup coil consists of four turns of hookup wire 2" in diameter which can be slipped over the first r.f. tuned coil in most radio receivers. A two-turn coil is more appropriate for 10- and 20-meter operation, though the four turn coil is suitable if care is taken in adjusting the condensers to avoid 10-meter resonance (unless very loose inductive coupling is used).

Adjustment of C1 will generally allow a noise balance to be obtained when varying C2 and C3 in nearly any location. One antenna, then the other, can be removed to check for noise in the receiver. When properly balanced, the usual power line buzz can be balanced down to nearly zero without attenuating the desired signal more than 50%. This may result in the reception of an intelligible distant signal through extremely bad power line noise. Sometimes an incorrect adjustment will result in balancing out the signal as well as the noise. A good high antenna for signal reception will ordinarily overcome this effect.

Some readjustment is necessary from band to band in the short-wave spectrum; noise-balancing systems require a good deal of patience and experimenting at each particular receiving location."

The Hambrew-built version of the "T" type ATU ended up with lower values of inductance. L1 is 17 turns #22 wire on a T68-6 toroid. L2 has 18 turns #22 on a T68-6, yet does work well for 40 meter operation. The capacitor is a 365 pF air variable.

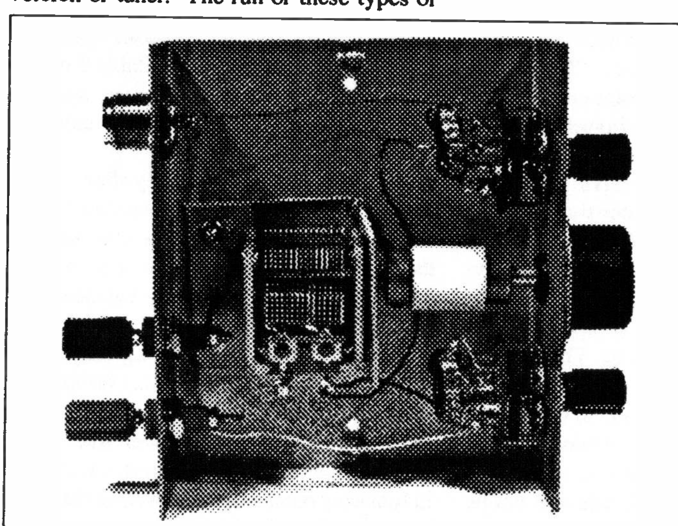


This tuner works also for 20, 15 and 10 meters using a 65 foot long wire. It is adequate but needs additional inductance at L2 better results on 40 meters.

All of the tuners mentioned in this issue are given as generic starting points for experimentation with different antenna lengths and values of inductance and capacitance for each version of tuner. The fun of these types of projects lie not in the rote repetition of what is given here, but in attempting to find the optimal performance and best values for both antenna length and design for construction of the ATU itself.

We hope readers will share results of their projects with us.

All tuners presented in this issue are designed primarily for QRP usage. QRO use requires air-wound coils and prudent spacing of air variable capacitor plates in the design.



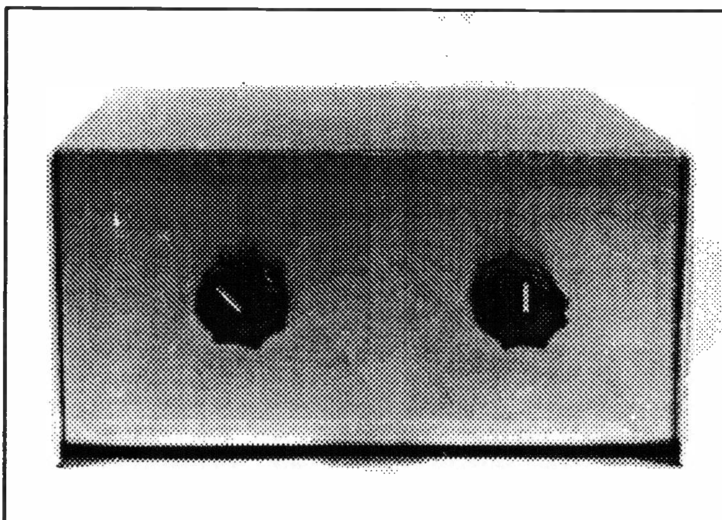
Above and left is the T-match network shown on page 23. The capacitor is mounted to a PCB for stability, and a shaft extention coupling was incorporated. The toroids are tapped every three turns.

Amateur Radio QRP Design and Construction, Part V

Let's Build a Two-Transistor, Three Watt Transmitter!

Bruce O. Williams, WA6IVC

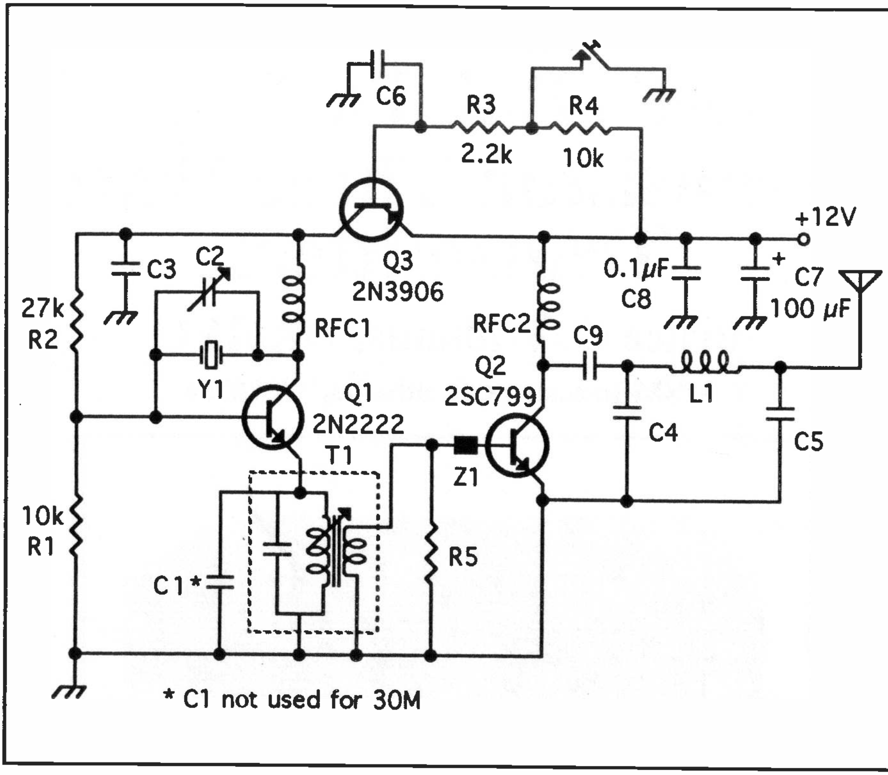
MXM Industries, Smithville, TX 78957



Have you been paying attention this past year? Well, we're ready to finally get down to building something. The transmitter covered in this installment is an outgrowth of the Simple Texas Transmitter that I have furnished in kit form for several years. there are a few differences and lots of options for your consideration. I'll try to take you through it in simple steps so that you can start the design process - that's right, you're going to have to take some design responsibilities!

The Design

Refer to the schematic shown in Figure 1. The crystal oscillator Q1 is similar to the TX TX in that it includes a resonant circuit in the emitter. T1 and C1 form a circuit which is resonant at the crystal frequency. T1 is a micro-miniature 10.7 MHz IF transformer. I recommend using the 7mm version of these transformers rather than the 10 mm size. True, the 7 mm type costs about twice as much as the 10 mm, but I have found that the mix of the core is somewhat better. Since this is your design, feel free to use either and disregard my recommendation if you like. Using either transformer requires that capacitor C1 be placed across the primary side (three pin side) to resonate the transformer in the band of interest. For 40 meters, use around 56 pF. The value is not critical, anything from about 47 to



68 pF will do, since the transformer is tunable over a large frequency spread. Of course, if you are the type of QRPer who likes to work from the junkbox, almost any salvaged 10.7 MHz transformer will work. Look for a green or orange core.

I have used a modified Pierce oscillator because it seems to work better than the Colpitts type in this circuit. That is, it provides about 1.25 volts peak voltage to the final base (Q2). Also remember that I said "Peak" voltage, which is just half of the peak-to-peak value. Remember that since Q2 is operating in Class C,
no current flows until the base-emitter voltage is above the junction threshold voltage of approximately 0.7 V. This means that the final will only conduct while the base voltage is 0.7 volts or more, positive with respect to the emitter. No current flows during the negative-going half of the cycle at the base.

C2 is placed directly across Y1, the crystal, to provide a small frequency shift. If you use approximately 10 to 100pF, variable, across the crystal, you should see a couple of kHz variation. You can try putting a capacitor in series with the crystal if you like, but my breadboard works fine without it. Another option is to place a small RF choke in series with the crystal and a capacitor. This may allow you a little greater frequency swing than as shown, but it depends a lot on the particular crystal you are using.

The rest of the circuit is conventional—if you've seen one, you've seen 'em all. I used a 2SC799 final amplifier because I have a pretty good stock on hand. There are several other final amplifiers that can be used: the RCA 4013 is a fine little transistor, as is the 2N3053 sold at the Shack. Most of the available types run $1.50 or so, and it really doesn't make a lot of difference what you use.

As I told you last time, you can use several different types of construction in your project.

WA6IVC TRANSMITTER

C1	56pF (40 meters), NP0 or silver mica 300pF (80 meters), NP0 or silver mica Not used for 30 meters
C2	0 to 100pF air variable or use switched fixed-values
C3	0.1 μF monolithic or ceramic
C4, C5	470pF (40 meters), ceramic or silver mica 750pF (80 meters), ceramic or silver mica 300pF (30 meters), ceramic or silver mica
C6, C8, C9	0.1μF monolithic or ceramic
C7	100μF, 16V electrolytic
L1	14 T no. 24 enam. on T 50-2 toroid
Q1	2N2222 NPN general purpose
Q2	2SC799 NPN amplifier, or equivalent
Q3	2N3906 PNP general purpose, or equivalent
R1, R4	10Ω, 5% carbon
R2	27kΩ, 5% carbon
R3	2.2kΩ, 5% carbon
R5	47Ω, 5% carbon
RFC1	820 μH molded choke
RFC2	15 μH molded choke
T1	10.7 MHz IF transformer, Mouser PN42IF223 or 42IF123 (10mm)
Z1	Ferrite bead

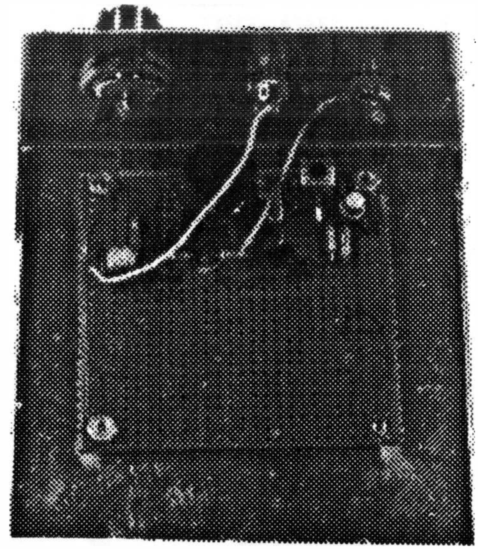
I haven't had PC boards made up for this design yet. If there is enough interest, I could have boards available in time for the next issue of HAMBREW. The board would include the Simple receiver that we'll build next time. If you are interested, let me know!

For about 20 years I have used a product called "Veroboard" for prototyping and breadboarding. That product is available only in England however. A similar product is now provided by GC Electronics in Rockford, Illinois, through several distributors, as "Printed Strip Prototype Board", PN 22-506. They will not sell to you direct, but you can locate a distributor by calling 1-800-443-0852. A piece about 3-1/2 by 6 inches runs around $5—not cheap, but easy to work with. The piece for this project was 2-1/2 by 1 inches, so a sheet of this material can provide space for many projects. The board has strips of copper along the length, and punched holes at 0.1 inch intervals. You can cut the strips with a hobby knife to discontinue one circuit and start another.

Tools and Test Equipment

The following tools and test equipment are required (or recommended):

Tools:
Long-nose pliers, diagonal cutters, soldering



iron or station with 25-watt maximum rating, no. 64 drill bit in pin vise (available at hobby stores), a selection of Phillips and blade screwdrivers, insulated tuning tool.

Test Equipment:

DVM, oscilloscope (recommended), frequency counter (recommended), general coverage receiver, RF probe (recommended), QRP wattmeter or SWR meter.

Construction

If this is your first project, BEFORE you do any soldering plan your layout. Insert your parts to see that there is sufficient clearance around them to allow you to insert other parts if you later decide to. If you are using perfboard or one of the project boards, drill any holes you need before you start soldering. Plan for standoff mounting holes and drill them before you go any farther. Plan the installation of the board in whatever cabinet you are going to use and mark, center-punch, and drill the standoff holes before you start soldering parts to the board.

Assembly and Preliminary Alignment

1. Build the power circuitry first (R3, R4, C3, C6, C7, C8 and Q3). Solder a stranded wire to the junction of R2 and R3 for keying, and wires for the connection of +12 and ground. Ground the key line and verify that the 12V transmit voltage is present at C3.

2. Build the crystal oscillator (Q1, R1, R2, Y1, T1, R5, RFC1 and C1). Apply the 12V power and ground the key line. Verify an RF output at R5 at the desired crystal frequency. Tune T1 for maximum amplitude of the signal, which should be in the range 1.0 to 1.25 volts PEAK. Install C2 and verify that the output frequency shifts about 1.5 to 2.0 kHz around the crystal frequency. Retune T1 as necessary.

3. build the final amplifier circuitry (Q2, RFC2, C4, C5, C9, L1 and Z1).

Caution

Do not energize the complete transmitter without a 50-ohm, 5-watt dummy load. Activating the transmitter without a proper load could destroy the final amplifier, Q2. If you don't have a dummy load, you can construct one from three 150-ohm, 2-watt resistors in parallel.

Attach the dummy load, and energize the transmitter. If you use a QRP wattmeter between the transmitter output and the dummy load, you can measure the output power. In the absence of a wattmeter, an approximation of the output power can be made by measuring the RF voltage across the 50-ohm load with an RF probe or an oscilloscope. The output power should be in the range of 2-3 watts. Peak T1 for maximum output. Verify that the keying characteristics are acceptable. there should be no key clicks or other distortion.

4. Attach a 50-ohm antenna to the transmitter and YOU'RE ON THE AIR!

Options

There is nothing particularly critical about the parts used in this project. Generally part substitutions will not affect the performance. Alternatives for Q1, Q2 and Q3 are: 2N4401, 2N3904, 2N2907, RCA 4013. Capacitors may be monolithic, ceramic or silver mica. Resistors with tolerances of up to 20% should be usable without problems. The ferrite bead Z1 is used to keep the final transistor from oscillating in the VHF and UHF spectrum. It can be eliminated if not required. The final output filter is a simple PI type - it provides some attenuation of harmonics but does not provide any impedance matching. In most cases, it will meet FCC specifications for spectral purity. A half-wave filter may be used as an alternative. See the ARRL Handbook for details on filters.

Most of the parts are available from Danny or Mouser (see notes).

Notes

Dan's Small Parts and Kits
1935 So. 3rd. West #1
Missoula, MT 59801

Mouser Electronics
2401 Hwy 287 N.
Mansfield, TX 76063-4847

RIG - O - RAMA RESULTS

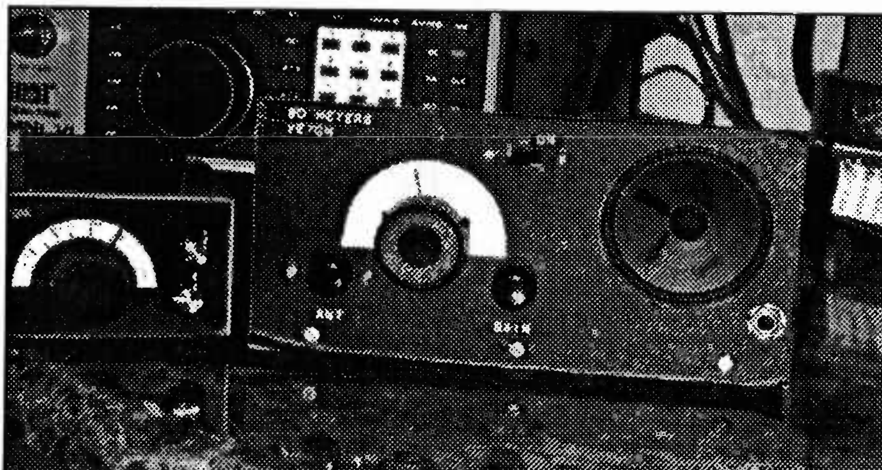
1ST PLACE:
LEW SMITH, N7KSB
5/15W XMTR

2ND PLACE:
ROY GREGSON, W6EMT
80M XMTR

3RD PLACE:
JOHN CHRISTOPHER, NG7D
TWO-FER III SALVATION, ONEDER XMTRS

SHACK SHOTS

Robert van der Zaal, PA3BHK, sends us this shot of his shack where homebrewed rigs abound. Detectable in the photo are a 3 watt, 80m DSB rig, a 2m/70cm varactor tripler, a 2m linear (25w out), a 2m multimode transmitter (3w, AM/FM/DSB/CW) with built-in transmitting converter to 28 MHz (the big box to the left of the Icom R7000), and barely visible in the left-hand corner of the photo is a 2m FM transmitter awaiting a new PA to about 3 watts. Congratulations, Robert! We hope you will send more details and photos!



Above shot by VE7QM, Dan Giles, of Salt Spring Island, B.C., Canada. On the left is a 40m Neophyte in a PC board enclosure. On the right, a 75m version. Dan says "Even though it (the 75m Neophyte) is several years old, I still...marvel how well it works".

hambrew

index

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Wires And Pliers: Voltage Regulator (WAØHKC)
New Products: DeOxit (Caig Laboratories)
The NorthWest QRP Club "30-30" CW Transmitter (KG7CR)
Foamcore Enclosure Construction (W5VSI)
Balloon Telemetry Engine (NØSMR)
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A Sentimental Journey (NØCKW)

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"Circut" Circuit (KB5RQV)
An Inexpensive Noise Antenna (WFØK)

From The

CONTEST GURU

Bruce Muscolino
W6TOY/3
PO Box 9333
Silver Spring, MD 20916-9333

Hello? Is there anyone out there? I know there must be since Hon. Editor assures me the renewals are coming in. Well at least you guys can do something right. I would encourage you to keep on sending in your renewals and also to buy gift subscriptions for any friends you may have who can read. Y'awl missed a heck of a contest, and I think I deserve to know why. Actually George and I went to considerable effort to design a contest that you might enjoy, and only a few of you did. I want to know where the rest of you were?
What kept you off the air?

I'll cut the East and Mid-West a little slack since there were unexpected competing contests. Why didn't you get into one of them? I'll take logs from anyone who made contacts in either the Pennsylvania or Illinois state QSO parties. I'll also admit that at my QTH all I could hear were Pennsylvania stations, and out of sheer desperation I got on and worked 50 of 'em. That was with an NE4040 and 40 feet of #26 magnet wire running through an aluminum window frame out to a nearby tree. For those of you who wonder why I'd use such a "poor" antenna, give me some less expensive and better "stealth" antenna ideas for use from a condo!

OK, I got it off my word-processor, and I feel a little better. Hon. Editor and I had a long chat the other night, and decided that maybe, just maybe, we gave you too long an operating period for the last contest. Perhaps you did try, but when you were on there wasn't anyone else on. OK, I admit it could happen. Not likely, but it could. I just think you're afraid to get on because you think you can't cut it with what you've got. Boy, that's surely nonsense. If you don't get on the air with what you've built, how are you going to know if anyone else can hear you? Remember what I said last time about using a contest to establish the dimensions of your station's performance?

Also, did you read, and grasp the significance of my remarks about contests being at the bottom of progress in many fields? Do you think we'd have cars and airplanes like we have today without competition? Do you think we'd even have radio if guys hadn't stayed up late into the night listening for signals from Europe? Hey, some of you are old enough to have participated in those tests (well maybe I exaggerate a little). What I'm getting at is the pioneers in our hobby, and it was mostly a hobby back then, entered contests as a means of developing their equipment. They also published their design successes AND failures so everyone's equipment designs could benefit.

So, what do we have for you next? Well how about a couple of activity weekends? Let's say the weekend of February 11, and 12, 1995, we'll have a President's Cup Sprint. Two activity periods, one on Saturday from 1300Z till 1700Z and Sunday from 1800Z to 2200Z. You can enter either one or both. They'll be scored separately. All we want is a copy of your log for those periods, you can work anyone you hear, on any band, using any mode. The only extra feature I'll throw in is a SWL section, thinking that some of you may not have built transmitters yet. So send us a log of what you heard during those periods. Of course you don't have to use home-brewed equipment. Run whatcha brung, like they say at the car races. Just send me a log by March 15, 1995 showing who you worked or heard, on what band, at what time, on which day, and details of the signal reports and other stuff, like the other operator's name and QTH. Please give it a try, and I'll have something special for anyone who works me.

Till next time, have some fun with the radios you've worked so hard to get running, work a new station every week. It's recommended by hams everywhere as the best exercise you can give your radio.

DESIGN BASICS SERIES

Thoughts On Theory

James G. Lee, W6VAT

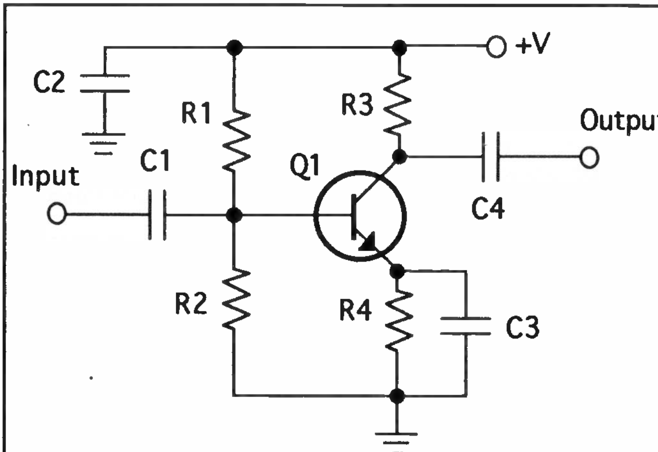

Figure 1.: Typical Amplifier Stage

DECOUPLING AND FREQUENCY RESPONSE

In my first column, I discussed the function of both coupling and bypass capacitors in a typical low-frequency transistor amplifier stage. FIGURE 1 shows the schematic of the amplifier. Capacitors Cl and C4 couple the signal between stage and also affect the overall frequency response of the stage. Capacitors C2 and C3 provide "decoupling", and C3 also affects the frequency response as well.

It may seem obvious to say, but you don't want the signal wandering around where it's not supposed to go. One of the places you don't want the signal to go is out into the DC circuitry. But since you see both the signal and the DC circuits as being interwoven, how do you decouple one from the other?. The best way to do this is to short the signal to ground at any point you don't want it to pass.

Since you don't want the signal to go out into the power supply circuitry, C2 is made large enough in capacity to appear as a short circuit - or a very low resistance - to the signal. To size this capacitor, you must know the lowest frequency the amplifier is expected to pass. As a first approximation, the capacitive reactance of C2 should be no more than 5% of the load resistance R3. I say approximation because there are other factors which also affect the size of this capacitor.

If the reactance - think of reactance as AC resistance - is only 5% of the resistance of R3, then only 5% of the signal voltage will appear across it. This is usually low enough to prevent any unwanted effects due to the signal appearing on the power supply leads. This is important when two or more stages are cascaded to provide more gain. PICTURE 2 shows three cascaded amplifier stages with further decoupling provided by R5, R6, and R7. Here these resistors act at low frequencies much the same as RF chokes do at high-frequencies(HF).

Current flow always tries to take the path of least resistance, and since the capacitive reactances of C5, C6, and C7 in PICTURE 2 are much lower than the value of R5, R6, and R7, the signal current will flow more readily through C5, C6, and C7 to ground which is exactly where it should go. The RC combinations of R5C5, R6C6, and R7C7 are actually low-pass filters which can be designed to provide good filtering and decoupling of each out stage from the power supply.

The values of the capacitors and resistors in a decoupling network such as shown in FIGURE 2 have several requirements imposed on them. Since the resistors are in series between the amplifier stages and the DC power supply, you don't want large voltage drops across them. Therefore, they are usually in the 100Ω to 470Ω range depending upon the current drawn. All of the current drawn flows through R7. 2/3rds of the current flows through R6. and only 1/3rd of the total current flows through R5. This current distribution must be taken into account when designing this type of network.

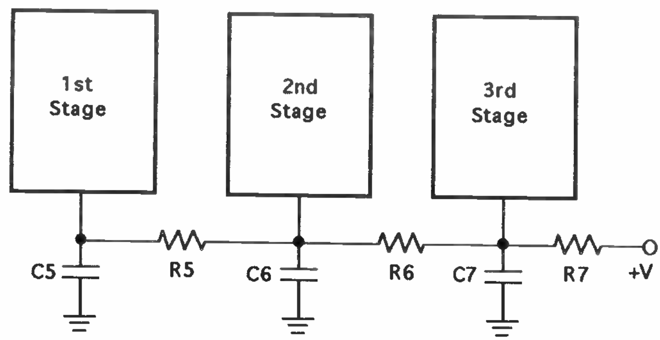

Figure 2: Three-Stage Cascaded Amplifier

The capacitors associated with these resistors can be sized to have reactances no more than 5% of the resistor values. So the capacitors will vary as the resistances vary. If R7 is small to keep the voltage drop across it small, than C7 will be larger in value for the same cutoff frequency. Or each RC combination can be designed as a low-pass filter for a specific cutoff frequency. The cutoff frequency of a simple RC filter is $f = 1/(2\pi RC)$, so that if R = 100Ω and C =10μF, the cutoff frequency is 159 Hz. This frequency must be significantly lower than the lowest frequency to be amplified.

The frequency generated by the above formula is the "3-dB cutoff frequency" (You remember the dB don't you?). Sometimes called the "minus 3-dB down point", it is the point on the frequency response curve of the RC low-pass filter at which signals passing through the filter are reduced to 1/2 of their input power value. If they pass through another similar filter section, they are now down to 1/2 X 1/2 = 1/4 or minus 6-dB in strength.

In this way any signal voltage that tries to go out onto the power supply leads is reduced to the point where it causes no problems. Some of you may be familiar with the term "motorboating". This often happens when the power supply lines between stages are not sufficiently decoupled, or the capacitors become old and no longer shunt the signal voltage to ground. This allows signals to be coupled around the normal input and output connections via the power supply leads. It often results in a low-frequency "putt-putt-putt" sound similar to that of a motor boat engine.

FREQUENCY RESPONSE

A typical RC-coupled amplifier frequency response curve for a fixed input voltage is shown in FIGURE 3. The output voltage begins to drop off at both the low end and the high end of the curve. I've shown the upper and lower "3-dB down points", and these are the two frequencies at which the output voltage has dropped to 0.707 times the mid-frequency value. These two points are often referred to as the *cutoff frequencies*.

"But," you say, "in the last column you said a 3-dB change was equal to a change by a factor of 2. What's this 0.707 value (or 70.7%) doing here?" They're both correct, because in the first example I was talking about power, and here I'm talking about voltage. Recall that power is proportional to voltage (or current) squared, and 0.707 squared = 0.5 or 1/2. So there aren't two different kinds of dB - one for voltage and one for power - they are all equal.

The cutoff frequencies are also known as the *half power* points. and the frequency range between the half-power points is known as the *passband* of the amplifier. Most amplifiers are designed to have a passband which is slightly wider than necessary. This allows for slight changes in component values due to aging and heat cycling. and also allows replacement of any transistors without causing a significant shift on the overall frequency response of the amplifier.

Both the coupling capacitors C1, C4 and bypass capacitor C3 affect the lower cutoff frequency. As the frequency gets lower and lower, their reactances get higher and higher.

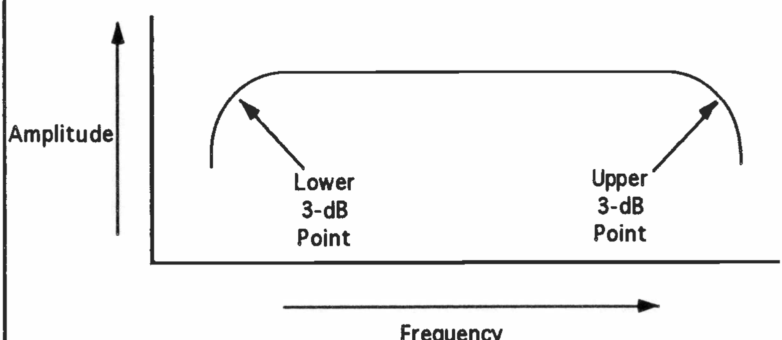

Figure 3: Amplifier Frequency Response Curve

The reactance of the coupling capacitors is effectively in series with the load resistance seen at the input to the next stage. This forms a voltage divider which lowers the voltage available to the next stage. The emitter bypass capacitor reactance gets higher and higher with decreasing frequency and soon no longer shunts the emitter to ground where the signal is concerned.

This means that the emitter resistor now becomes "visible" to the signal. The signal develops a voltage across the emitter resistor which is in "phase" with the input signal. In essence this reduces the input signal seen by the transistor and the gain is reduced thereby lowering the output. We'll talk a little bit more about this in a later column.

The upper cutoff frequency is determined to some extent by the coupling capacitors, but here internal transistor capacitances and stray wiring capacitances begin to cause deterioration of the high frequency response of the amplifier. These capacitances are effectively in shunt with the signal path and their reactance goes down with increasing frequency. This shunts the signal to ground and so limits the high-frequency gain of the amplifier.

So you see that even in a simple amplifier there are many subtle things to consider. In future columns. I'll discuss biasing the stage for stable gain, and show how R4 and C3 can be adjusted to control the input impedance of the transistor as well as have an impact on the frequency response.

• • •

Next Issue:
Transistor Characteristics

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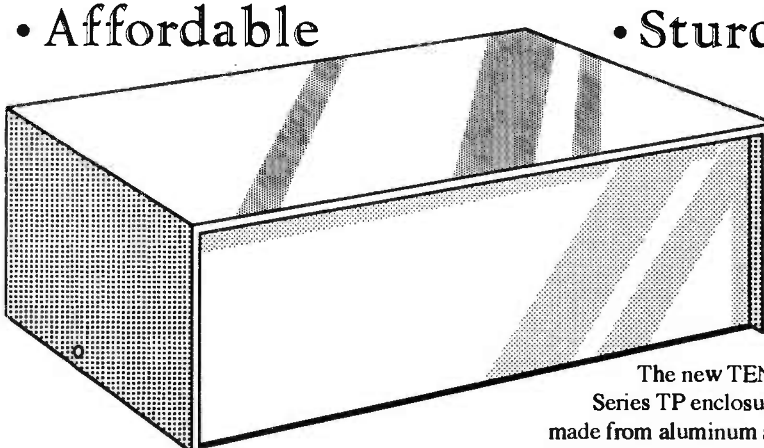

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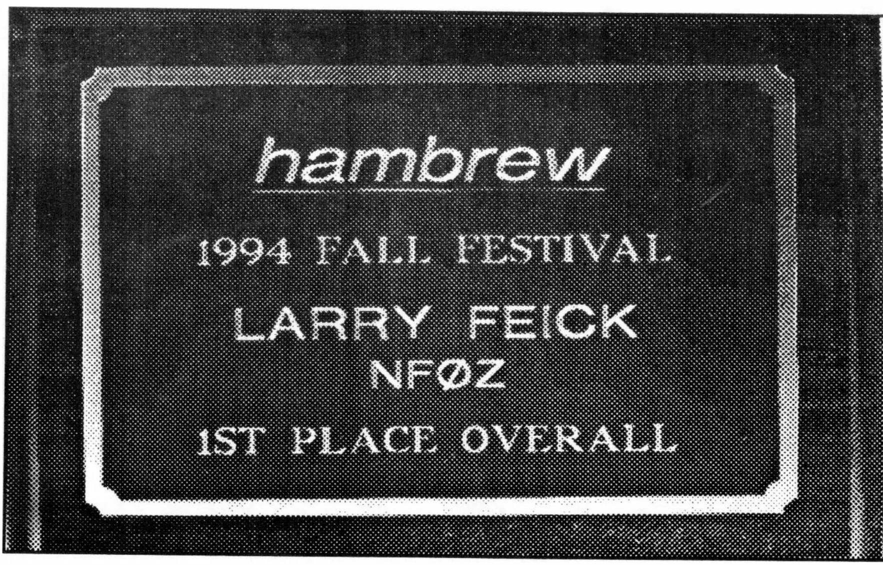

Congratulations to Larry Feick, NFØZ, for taking first place overall in the first Hambrew Fall Festival, 1994. Shown above is the plaque awarded to Larry.

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