hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

GLEN REID, K5HGB
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K6EIL Improved Neophyte

SPRING 1994

• Contents •

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SPRING, 1994 • VOL. 2, NO.2

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• LETTERS •

From The Publisher

I think you will like this issue! We were greatly pleased with the contributions last issue of all involved, of course our stalwart yeomen **Larry Feick, NFØZ** and **Bill Mason, NØKEP**, and most notably the input from **Bruce Williams, WA6IVC** and **Fred Bonavita, W5QJM**, both of whom enjoy no small stature in our hobby, and are widely published and recognized. We thank also **Bill Todd, N7MFB**, the NWQRP Club President, always a staunch backer of **Hambrew**, both in contributions and philosophical support. We are grateful, Bill.

This issue debuts our first article from one who needs no introduction, having achieved a longstanding preeminence among builders who publish: **Doug DeMaw, W1FB**. We hope to spotlight future articles by Doug, who continues to inspire and influence both first-time and OT builders worldwide. We value his ongoing contributions to the hobby and this publication.

Bruce Williams continues his series on QRP Design and Construction with a valuable and useful section on transistors and ICs. This series should appeal to those of us who devour information which relates to the practical side of the construction/design process.

The Rig-O-Rama contest continues to draw responses from readers, and we present two rigs in this issue, both interesting in design and purpose: **Lew Smith, N7KSB** debuts an unusual and interesting 5/15 watt 15 Meter rig in which you will find a fresh approach to oscillation. It is modifiable to other bands as well. **John Cristopher, NG7D** has offered a modified TwoFer transmitter for 40m which we like very much. He has much improved the design with not only a sidetone oscillator, but a nifty variable power output control and a beefed-up final filter section.

On a somber note: we regret to report the passing of **Wes Farnsworth, KEØNH**, who became a silent key February 8, 1994. Wes was with us at the nativity of **Hambrew**; he loved the magazine and the idea of its purpose. He contributed to the first issue, and continued to provide ideas for future articles. His cheerful optimism and prolific outpouring of ideas and creativity in the face of his own personal medical situation give all who knew him an example of courage which we will carry for the rest of our lives. He will be missed.

Elsewhere in Spring, '94: **John Pivnichny, N2DCH** has a great article on adding narrow band sweep to your signal generator. **Wes Baden, K6EIL**, lays out a very nice-looking Improved Neophyte Receiver which is very impressive indeed (see page 26), and a designer in Washington state, **Roy Gregson, W6EMT,** shows us a keen 10 meter varactor-tuned receiver based loosely on the Neophyte prototype. Roy will reappear in the Summer Issue with an 80 meter transmitter which has a VXO that has an extra-wide frequency-swing capability - interesting! As usual, we welcome our new subscribers - glad to have you with us and do keep spreading the good word!

Dear Hambrew,

I was very pleased with my sample issue of "Hambrew" (Autumn, '93)...

I'm a neophyte and would appreciate 1 or 2 articles in each issue aimed at Home Brewers at this level. I really feel that "Hambrew" can serve a particular segment of the hobbyist population very well.

Keep up the good work & good luck!

Morton Goodman

New York, NY

Thanks Morton! We try in each issue to provide something for each level of experience. And for the information of our regular subscribers, we do not provide sample or back issues on a speculative basis. We feel (and some subscribers have mentioned this) that it devalues the investment made by our subscribers. We value your importance to our survival! And we welcome Morton to the fold!

Hambrew Magazine
Dear George-
Received your ...first issue the other day. At first $20 for four issues seemed a little steep, but on reflection and consideration it becomes apparent that your magazine is a bargain. Four concise contruction articles alone would work out to $1.25 per article. But considering the many more construction articles it is indeed a bargain.
J.P. Isom, KA7KOI
Halsey, OR

And we hope that we are getting better each issue, J.P.! This issue alone has more projects than any single one previously published by us, and we work always for a higher "Q"!

Dear Hambrew
The last few weeks of Ramsey remodeling have been great. On the air, and on the work bench!
My latest project was a TWO BAND RAMSEY 15/17 Meter Transmitter. This was so simple I'm waiting for the TRAIN WRECK! One socket has a 21.120 crystal and the other 18.090 MHz. The seven element 15 meter output filter takes care of harmonics above 21.4 MHz. Can it really be this simple?
Operating a Two Bander Ramsey is really a blast! The JAN crystals cover about 12 KHz on 17, and 16 KHz on 15 meters. This is NOT like 30 or 40 M with only 3 or 4 KHz of swing. This rig is a real joy to build and operate!
Next I want to cover all of 15 meters, and that means crystal switching or a VFO.
A new RF probe confirms power output of 1 watt for the 15 meter transmitter with 2SC1017, and the same for the 17 meter rig with a 2N3866 (NPN VHF/UHF AM).
The TO-39 2N3866 works very well when going for higher frequency bands like 15 and 17 meters. It replaces Q3 like the stock transistor, and is fairly cheap. The TO-220 style transistor must be adapted to the board, and the BCE holes enlarged. If using this style, cross the C and B legs; the printed side faces the rear of the board.
Another option is the NTE299 (Hambrew #1 Ramsey 30M). This is a TO-202 style transistor, and the three legs are set up CBE so it's a better fit once you enlarge the holes on the board. It didn't have the power when asked to work on 15/17.
An overall winner is the 2N3866 at this stage of the game. And in this hobby if someone finds a cheaper and easier to get final for 15/17 meters we all win! This may also be better than the stock 2N3053 if you actually use your Ramsey QRP-20 on 20 meters, Hi Hi!
My little Ramseys are tucked away in nice Radio Shack metal cases with knobs now, and looking pretty good!
I've worked Hawaii, France, South & Central America, Antarctica, Hungary, The Bahamas, Cuba and Alaska with my ONE watt Two Bander Ramsey! If you hear me on the air, you might notice a minor frequency variation. I'm (lacking) $30,000 (to install) power poles and running on batteries. The battery voltage can change some if a cloud passes by and the solar array is eclipsed!
Jim Hale, KJ5TF (Tired Fingers)
Kingston, AR

(More Letters, Page 6)

Egg-On-Face Dept.

Yes, the Pipsqueak Xmtr, due to a rushed and late insertion into the Winter Issue, had some incorrect values and a missing component. The little guy is out of the hospital, and will be shown in the Summer Issue with a brand-new working power amp and an adjustable power output of a heady 600mw!

Don't miss the new Pipsqueak X-1- Coming Soon in Hambrew!

(More Letters)

Sir:
Just wanted to let U know I have seen a copy of your wonderful magazine.
Unfortunately, I can't afford $20/yr for a quarterly publication!
I know printing costs are high for any magazine at start-up. Just know that some of us out there would love to subscribe, if our pockets were deeper!
Philip Corlis, KB7OPD
Coeur d'Alene, ID

Dear Philip:

Just a quick note to thank you for the nice QSL card and complimentary words about our magazine. I appreciate your comments!

You are absolutely right about the high costs of printing a quality magazine, and the costs do not go down with longevity. I do get a fair share of comments about the cost of subscription, and we are inundated with requests for (free) sample copies. We did give away 3000 copies of our inaugural run, and we gave our paying subscribers a free issue to be equitable. Naturally, if we behave this way all the time, we will be known as the "great philanthropists" of the ham publishing world, but it simply will not pay our bills. Unfortunately, our very high-quality printer does not give out sample press runs and sample expensive paper in 23" X 35" sheets. The post office does not give us sample shipping and postage, and the phone company does not give sample months of 800 number usage.

I know you understand all this, but it helps to get it off of my chest! As to the price of Hambrew...let's put it into perspective. The Spring Issue will have two transmitter schematics, two receiver schematics and a circuit for adding an S meter to DC receivers, among other articles. What would be the price of each project plan? Less than a dollar. Add in free classifieds to subscribers, commercial or non-commercial, and you are getting some bang for the buck.

I have a copy of an amateur radio news magazine in front of me. It costs $2 per issue. It is 32 pages in length and has the equivalent of 16 pages of advertising. It is now down to 50% of actual informational content. There is one project outline for an antenna preamplifier. Commercial classifieds are .80/word. It is printed on newsprint.

There are some great QRP Clubs out there (I'm a member of several) - and I enjoy getting their publications, which generally have no photographs and are not magazine-quality. For this, I am happy to pay $10/yr.- and I get a membership number.

Don't get me wrong, I have nothing against other magazines or QRP/Radio Clubs. I'm just trying to make a practical comparison. The cost of one Szechuan Chinese dinner, consisting of one plate of chicken in garlic sauce, one plate of Mongolian beef, one large bowl of rice, two bowls of sweet and sour soup, two eggrolls and a pot of tea costs $26 including a $2.50 tip. If it takes 26 minutes to enjoy the meal, that's $1/minute. Hambrew lasts a lot longer, but I must confess does not taste nearly as good (or so they tell me).

I know all of this doesn't make anyone's pockets deeper, but know that Hambrew is a real player: we are in it for the duration, God willing, and we will be around when you have the wherewithal to make the investment. Thanks again, Philip, for the card and comments, and thanks for hearing this litany of my concerns.

KIT REVIEW

Oak Hills Research QRP Wattmeter

George Franklin, WØAV

4417 N. Elmwood Avenue, Kansas City, MO 64117

As an old-timer in the world of QRP operation, I have always had a bit of a problem in determining with any degree of accuracy the RF power output of a particular QRP rig. Oak Hills Research has solved this problem nicely and rather economically with their excellent Model WM-1 QRP HF Wattmeter kit.

When I read the ad for the WM-1 in one of the ham mags, I had no reservations about ordering one, based on previous very satisfactory experiencewith the OHR 40M QRP CW transceiver kit. Dick, the main man at OHR, informed me that WM-1's were selling like the proverbial hotcakes, but that mine would be shipped in a week or so, pending arrival of the metal enclosures from his supplier. True to his word, the kit arrived promptly, in time for my QRP Show and Tell at the recent KC hamfest.

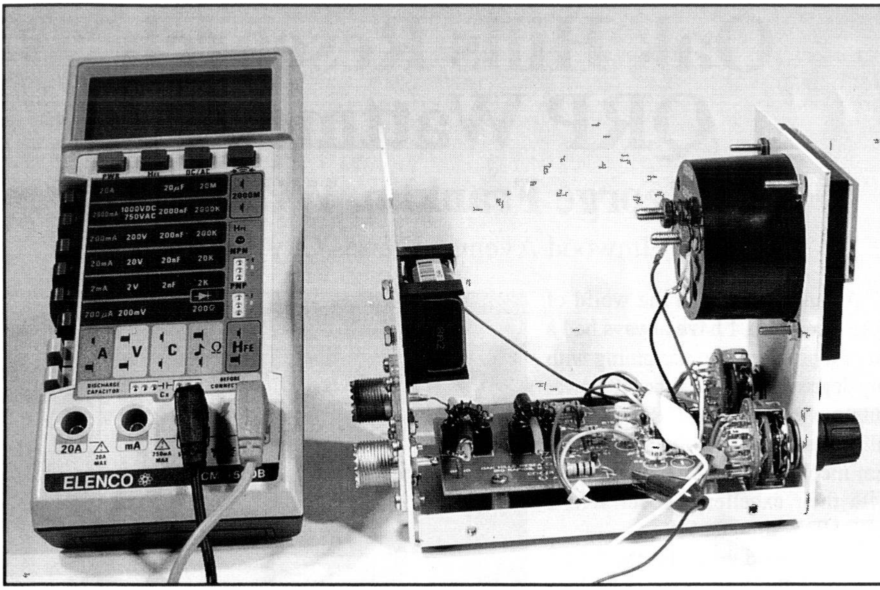
The WM-1 is not only a QRP wattmeter, but a forward/reflected (VSWR) meter as well, with scales of 10W, 1W and 100mW! The attractive unit measures approximately 4 X 4 X 6 inches, with a large, easy-to-read panel meter and two switches on the front panel. Two SO-239 jacks adorn the rear panel for connections to the transceiver and load.

The circuit consists of a directional coupler utilizing two prewound toroids plus two IC's. It is powered by an internal 9V transistor battery which should last for many months, since the drain is only 1.2 mA.

Assembly is easy, straightforward and fun for anyone who likes building kits. Calibration is extremely simple, requiring only a few adjustments using a low-cost digital voltmeter. After calibration of each scale is accomplished, snipping a jumper readies the WM-1 for service. No accuracy specification is provided, however comparison of the WM-1's reading on quality two-way radio test equipment showed no meaningful discrepancies whatsoever in the HF range.

The assembly manual, while not quite up to "Heathkit standards", is entirely adequate. It includes basic component identification information in addition to a parts list, component layout, PCB drawing (Continued on page 8)

(Continued from page 7)



Calibrating the OHR WM-1 is a snap! A digital voltmeter is required.

schematic diagram and other useful information. A simple Operation section is included, although the well-labeled front panel controls leave no doubts in that respect. The unit carries a one-year limited warranty, including the usual outstanding Oak Hills personal technical support by phone (616) 796-0920.

Once again, OHR has done an excellent job in meeting QRPer's need for good, simple, low-cost equipment. Their new Spirit QRP transceiver (see magazine ads or call Dick at OHR for further information) promises to be another QRP winner. • • •

WM-1 QRP Wattmeter: $89.95

Available from Oak Hills Research
20879 Madison Street
Big Rapids, MI 49307
Orders: (800) 842-3748

We've Upgraded!

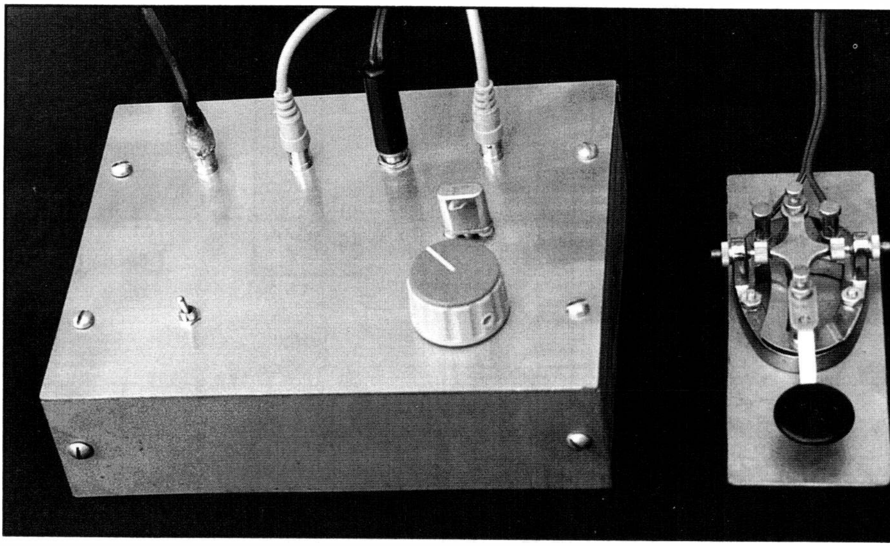
Notice a difference this issue? Henceforth, subscriber issues of Hambrew will be protected in plastic for the journey from here to you. We have applied for and are currently mailing via second class to provide faster and safer service to you. As articles increase, look for more pages in each issue - the long-term goal is to go bimonthly - <u>at the same price</u>. We're growing, thanks to you!

Rig O Rama

An Easy To Build 15 Watt Transmitter

Lew Smith, N7KSB

4176 N. Soldier Trail, Tucson, AZ 85749



Here is an easily constructed, low cost 15 watt transmitter that can be built first as a 15 meter novice rig and later modified for 15, 17 and 20 meter triband operation. A combination of four inexpensive (just over $3 total) semiconductors results in a simple yet clean-sounding rig. Construction has been simplified by eliminating the usual metal chassis, metal heat sinks, etched boards and toroid transformers.

The circuit (figure 1) uses a 74HC240 octal inverting buffer logic IC for both oscillator and driver functions. One of the eight inverters is used as a Colpitts crystal oscillator. The other seven inverters are wired in parallel to operate as a driver for the final. The 74HC240 is operated somewhat above maximum rating to squeeze out as much power as possible.

The final is a low-cost IRF510 power MOSFET. It is driven fairly hard to obtain more output than expected from straight class B operation.

The circuit in figure 1 uses a 15 meter (only) filter that transforms the 25 ohm MOSFET impedance to 50 ohms at the antenna terminal. A triband modification will be described later.

A 7.5 volt regulator and a Darlington PNP keying transistor complete the circuit.

I chose to build all the circuitry on the top surface of a 2" x 8" x 6" (H x W x D) box. This top surface is a 1/16" thick double-sided PCB that serves as a combination front panel, heat sink and ground plane. Fiberglass PCB material is rigid enough for the job, yet extremely easy to cut, drill and file.

The rest of the box is a combination of 1" x 2" wood and PCB material. I used wood for the right and left sides, and PCB for the rest. The top, bottom, front and rear sides are fastened to the wood using screws. By removing four top (Continued on page 10)

(Continued from page 9)

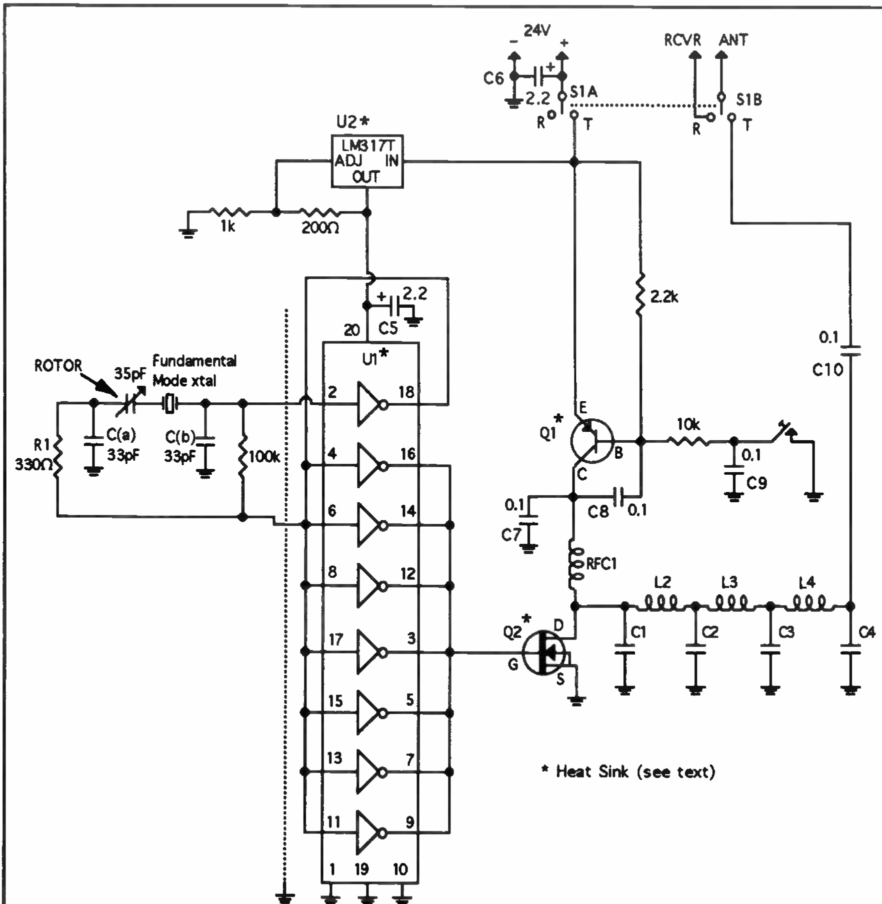


Figure 1

N7KSB 15 Meter
4/15 Watt Transmitter

C1, C4	150pF (mica)	L2, L3, L4	6 Turns, 1/2long, #14 to #18, 3/8" ID (see text)
C2	620pF (mica)		
C3	300pF (mica)		
C(a), C(b)	33pF (ceramic)	RFC1	25 Turns, close-wound, #18 to #24 3/8" ID (see text)
C5, C6	2.2μF (tantalum)		
C7, 8, 9	0.1μF (ceramic)		
C10	0.1μF (cer. disk)	S1A, S1B	1 amp DPDT sw.
Q1	TIP115	U1	74HC240 (see text)
Q2	IRF510	U2	LM317T

(Continued from page 10)
side screws, the electronics can be removed for servicing. Aluminum foil should be glued to the inside and all mating wood surfaces to allow good shielding.

Ground plane (or "ugly") construction is recommended. RF leads, especially the MOSFET leads, should be kept short. Try to drill the tuning capacitor and T/R switch holes 5" apart to allow enough room for all the RF components.

The 74HC240 is epoxied upsidedown to the main front panel PCB. This heatsinks the part. Remember to mark pin one on the bottom before applying epoxy. Also note that IC pin numbers go clockwise when viewed from the bottom.

The other three semiconductors are heat sunk by using three 1" x 1" pieces of 1/16" PCB material as heatsink insulators. The 1" x 1" pieces are epoxied to the main PCB and then the metal tabs of the semiconductor packages soldered on top (see figure 2a).

Most parts are readily available from local sources and/or mail order houses. However, the variable capacitor may require some shopping. Although a 35pF variable capacitor was used in this circuit, I have successfully used a 20pF and also a 70pF capacitor in similar designs. A plastic-foil style 70pF tuning capacitor cannibalized from a pocket AM radio will work well. If all else fails, use a trimmer capacitor until something better is found.

Shield the variable capacitor and the crystal socket from the final amplifier by using a piece of PCB material. Since the rotor of the capacitor is ungrounded, a 1" or larger plastic knob should be used to minimize hand capacitance effects.

Full power operation requires a one amp 24 volt supply. The simple unregulated (but well filtered) 22 volt supply shown in figure 3 works well. For QRP work, a 12 to 14 volt supply will give an RF output of approximately 4 watts.

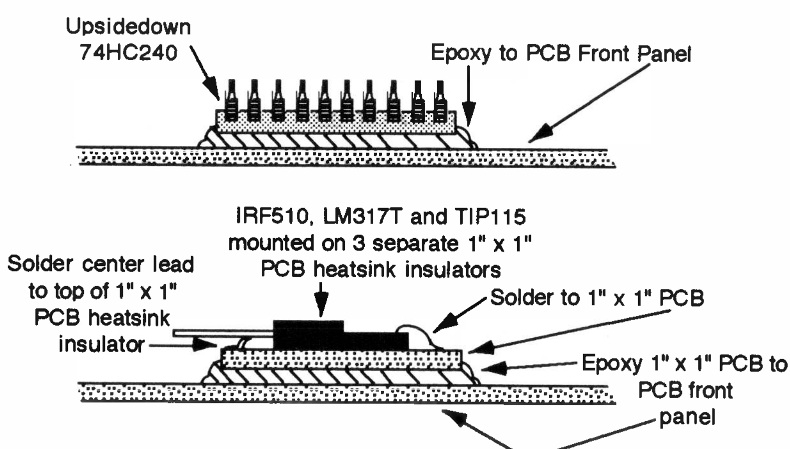


Figure 2a

The self-supporting ("airwound") coils are wound on a 3/8" mandrel (a 3/8" rod, dowel or the chuck end of a 3/8" drill bit will do). An attempt should be made to mount adjacent coils at right angles to prevent unwanted coupling.

Debugging is straightforward if the 74HC240 is temporarily disconnected from the LM317T. Also temporarily short the MOSFET gate to ground and solder a 10k resistor from the TIP115 collector to ground. Now apply power (Continued on page 12)

(Continued from page 11)
and check the LM317T output for roughly 7.5 volts. Check the TIP115 collector voltage: key up should be near zero and key down should be near the supply voltage. Also check to see if the T/R switch disconnects the receiver from the antenna in the transmit position. Now reconnect the 74HC240 and remove the gate short and the 10k resistor.

Next, check out the oscillator. To prevent MOSFET damage, be careful not to key the transmitter until the oscillator is working. Check for reliable oscillator starting (decrease Cb if necessary). Also watch for excessive frequency drift in the first 30 seconds (increase Ca if necessary).

Add a dummy load and check for key down output power. If a power meter or RF voltmeter is not available, output can be estimated by calculating 2/3 of the input power. Expect about 12 watts on 15 meters and , in the triband version, 18 watts on 20 meters when using the 22 volt supply shown in figure 3.

Power is a very sensitive function of the LM317T output voltage. If low regulator voltage is causing a problem, it can be raised 1/2 volt by adding a 2.2k resistor in parallel with the 200 ohm resistor connected to the LM317T adjust and output pins.

Other low output (or no output) problems may require probing with an RF voltmeter to determine whether the MOSFET, the filter, the seven inverters or the T/R switch is at fault. Once the transmitter has been debugged, it is ready to put on the air. (Continued next page)

IRF510	G	D	S
TIP115	B	C	E
LM317T	adj	out	in

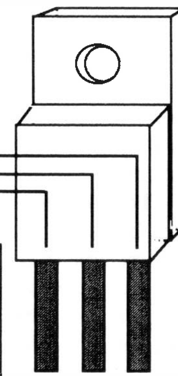


Figure 2b

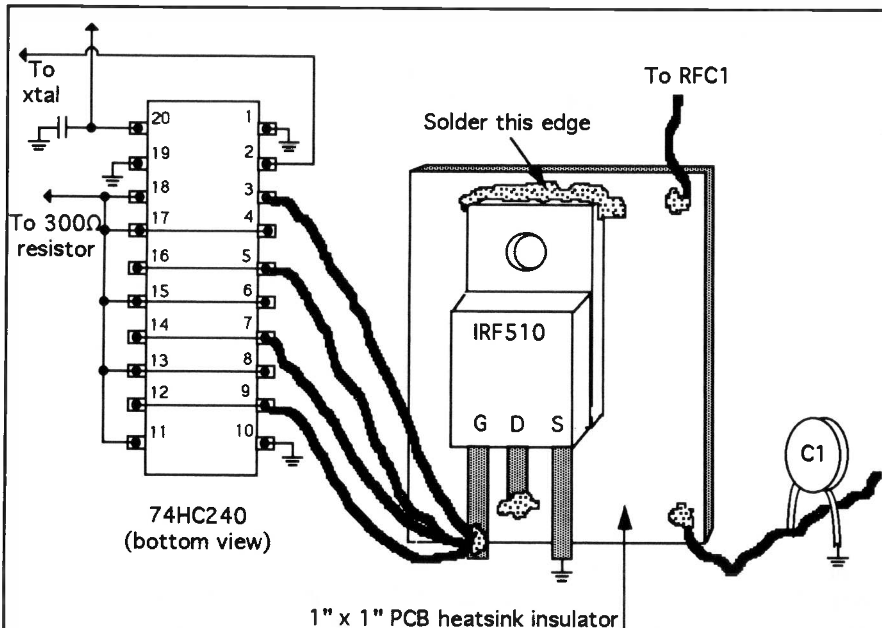


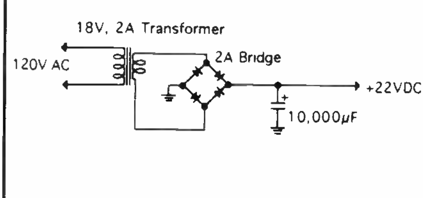
Figure 2c

The tuning capacitor allows about an 11 kHz range on 15 meters. This can be increased to roughly 30 kHz by inserting a coil between the tuning capacitor and the crystal. Approximately 30 turns of #30 wire closewound on a 3/8" plastic rod are needed. The exact number of turns must be determined experimentally. If too many turns are used, frequency stability will become very poor.

Triband (15, 17 and 20 meters) operation is possible if the 25 to 50 ohm transformation feature is removed from the filter and performed with external coax networks as shown in figure 4. A separate coax network is needed for each band. In addition to transforming the output to 50 ohms, the 1/8 wavelength section attenuates the second harmonic by an additional 30dB.

Note: Do not use the extra coax sections if the transmitter has been built as a single band 15 meter rig using the values of C3 and C4 given in figure 1.

Ten meter operation was tested but never put on the air. The following ten meter circuit values should work, but there may still be a few bugs to iron out. Expect 5 to 10 watts of output.



A Simple Power Supply *Figure 3*

Change these parts for 10 meters:

R1	change to a 22pF cap.
Ca	22pF
Cb	10pF
C1	75pF
C2	470pF
C3	220pF
C4	100pF
L2, L3, L4:	5 turns, 3/8" ID, 1/2" long

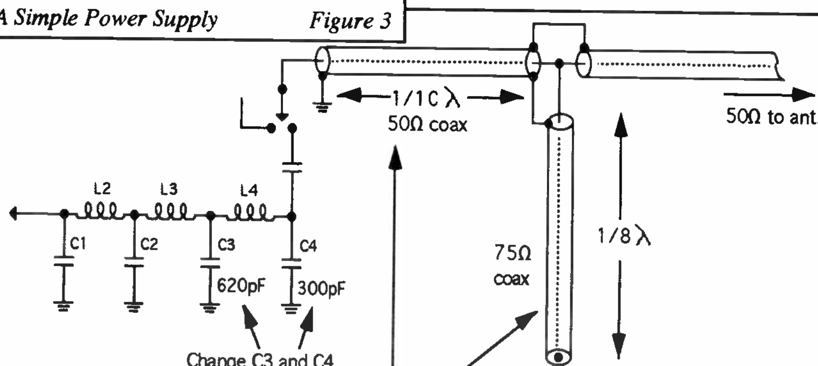
The ground plane construction technique makes it easy to add extra circuitry. I added a meter and a spotting position on the T/R switch in one version of this transmitter.

This transmitter has been fun to build and operate. This rig and a groundplane antenna are all I need for good DXing. • • •

• See additional photographs on inside back cover of this issue.

Coax Transformation Network Lengths
Values for both solid and (foam coax) given

Band	1/10 λ	1/8 λ
15m	37" (45")	46" (56")
17m	43" (52")	54" (65")
20m	56" (68")	70" (84")



Modifications For Triband Operation *Figure 4*

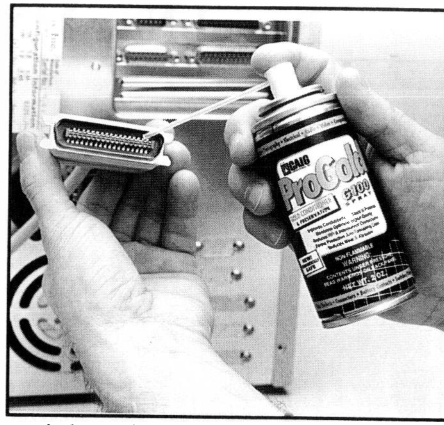
• New Products •

Environmentally-Safe Spray Connector Cleaner and Preservative

CAIG introduces an environmentally-safe aerosol for its **ProGold** product. ProGold's active ingredients are formulated to clean, lubricate and protect gold, base metals and other precious metal connector surfaces without the need for carrier solvents for dilution or cleaning surfaces. The spray container provides short bursts of 100% concentrate of ProGold via a precision metered valve.

ProGold is a non-abrasive/non-corrosive formula that conditions gold connectors, enhancing the conductivity characteristics to efficiently transmit electrical signals. ProGold coats the entire connector surface, providing superior protection from abrasion (insertion resistance) andwear, arcing and RFI, tarnishing and atmospheric contamination.

Ideal for use on edge connectors, batteries, interconnecting cables, plugs, sockets, switches, relays and other metal surfaces, etc.



Caig Laboratories, Inc.
16744 West Bernardo Drive
San Diego, CA 92127
Phone: 619-451-1799
Fax: 619-451-2799

New Software Aids Designing and Component Referencing

Computer Applications by Noel Sivertson and Mike Liddy of Gateway Electronics has developed two new computer programs that will be of interest to the electronic technician and hobbyist.

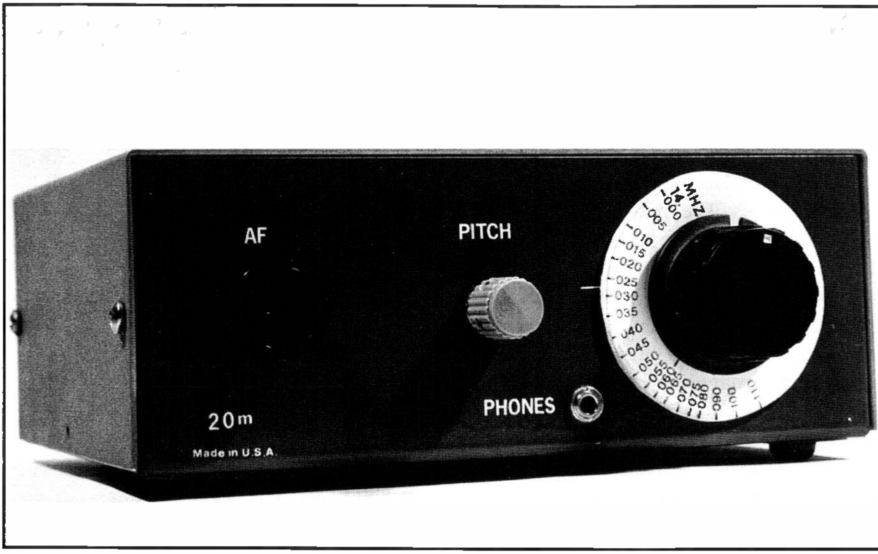
The Electronic Technician's PC Assistant is a menu-driven program that will perform most of the tedious calculations associated with circuit design. It will solve AC and DC circuit problems such as calculating voltage dividers and resonance. Select TIMERS from the menu, choose MONOSTABLE option, enter pulse width desired, and your computer will calculate the resistor and capacitor values. It also displays the closest standard values for resistor and capacitor values and the pulse width for the standard value components. If you select LOW PASS FILTERS and enter the CUT-OFF FREQUENCY, the program will perform the calculations, displaying both calculated and standard component values. Charts for copper wire and coax cable specs, common battery properties, screw dimensions and limited look-up tables for semiconductors and integrated circuits are also features.

The Electronic Technician's Semiconductor and IC Finder is a database of over 15,000 transistor, diode and integrated circuit part numbers. Enter the number of a part which you cannot identify, and the program will display a description of the part on the screen. For transistors and other semiconductors, specs such as VC, IC, hfe, etc. are shown. Searches for parts by description or specs are also possible: transistors, TTL's, etc.

Available from Gateway Electronics in St. Louis, Denver and San Diego. The Electronic Tech's PC Assistant is $19.95 and the Electronic Tech's Semiconductor & IC Finder is $39.95.

• New Products •

Brand-New MXM Transceiver!



Yep! We've gone and went back-to-back with MXM reviews in two consecutive issues, but we really aren't trying to play favorites, although, well...we can't help but consider an MXM product as a favorite to operate, due to the good sensitivity and spot-on frequency stability of the receiver sections of these kits (warm-up drift lasted less than five minutes on our 20 meter unit). They are fun to operate, and one can appreciate this fact after using a less-than-MXM quality receiver. The fact is we wanted to scoop the monthly big-gun magazines on this new product, which can be tough to do since we are currently a quarterly.

The MXM Simple Transceiver is a double-conversion, dual filter CW monoband transceiver which is offered for 80, 40, 30 or 20 meter operation with electronic QSK. More on that below.

Caution! Do not let the name deceive. The Simple Transceiver may be simple to the advanced designer, but it is *not* a beginner-level kit! It is to be built carefully, and some lab instruments are needed: an oscilloscope or a frequency counter capable of tracking a 4 MHz signal, and an RF signal generator (a 4 MHz oscillator may be used, constructed temporarily using a 4 MHz crystal supplied with the kit). Although the builder is ushered through the different stages of the kit, and each stage tested and known to function properly before proceeding to the next stage (this insures at least a general clue as to the location of a particular problem if the stage does not work), the new builder doubtless would feel a bit overwhelmed by the complexity of a transceiver such as the MXM, though this is a compact (5 1/2" X 4" board) unit (see photo).

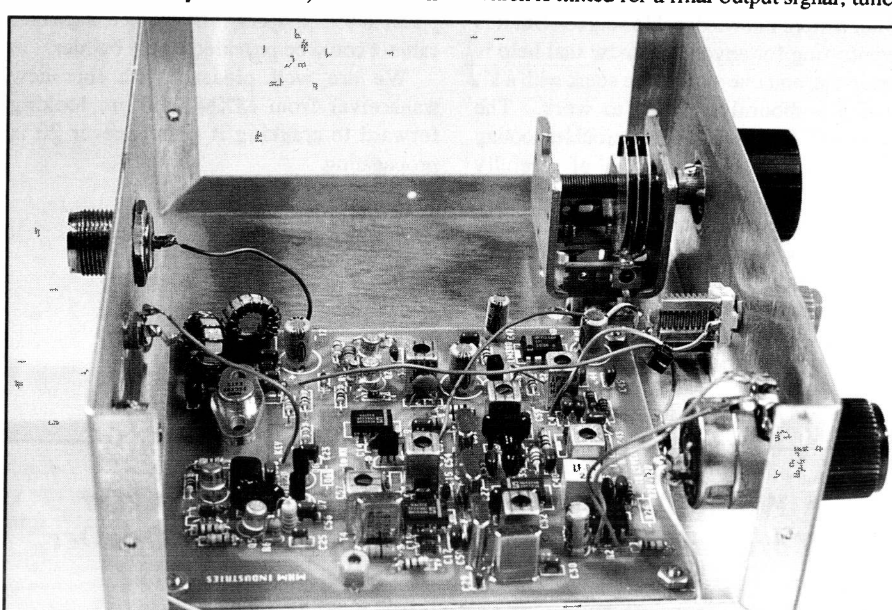
The RF section features a twin transistor T/R switch worth noting: in the RECEIVE mode, one transistor conducts to forward bias two diodes, routing the signal to the receiver; in TRANSMIT mode the second T/R transistor is biased via a "detector" diode and, while conducting, the transistor grounds the base of the first transistor, turning it off. The T/R chores are subject only to the energy provided in the TRANSMIT mode - instantaneously, with no delay to adjust. An interesting configuration. No breaks or pops were heard from the changeover, and no signal loss on receive as can be the case with a twin diode/coil QSK circuit.

An input filter is constructed in the familiar MXM fashion using a 10.7 MHz "can" with a capacitor in parallel, and the first mixer is the ever-useful NE602, configured as a double-balanced type. The oscillator, however, is an external (i.e., "off-chip") transistor-based one, generating a 4 MHz IF signal brought out of the chip, filtered through a crystal filter (bandwidth selectable by the builder) and sent on along to the IF section.

The IF section is a fixed-tuned type providing 455 KHz second IF oscillation, which is filtered and fed to the IF amp. Here's where something interesting happens. The AF gain for the receiver section is located here at the IF amplifier, which is a variable attenuator chip. For a sidetone, the receiver detects the actual transmitted signal (which, we noticed, was without the distortion of an overwhelmed detector stage), thereby rendering a true indication of the signal being transmitted.

The product detector is also an NE602 (there are four of these chips in the transceiver), operating at near 455 KHz. It will function for either CW or SSB signals. A pitch control is provided for installation on the panel, an air-variable capacitor which varies the oscillator frequency of the product detector. It serves double duty by also moving the injected signal nearer or farther from the edges of the filter bandwidth. The signal is filtered and peaked near 700 Hz and fed to an LM380N8 audio amp.

The transmitter section uses a VFO signal which is mixed for a final output signal, tuned



through the main tuning capacitor to allow adjustment of the final frequency to be exactly the same as the input frequency, thereby tuning the transmitter to the received signal.

The final is a 2SC799 NPN power transistor., and is capable of two to three watts output. Of course the signal is buffered into it.

Now for the tough part, which is confessing that we had a glitch in construction which stumped us completely. After construction of the IF section, it would not show any inkling of recognition of the generated 4 MHz test frequency. Again and again the schematic, component values, polarities, circuit traces and instructions were pored over, the chips checked for power, the caps checked for reliability. The audio amp remained dead. After much rumination and soul-searching, it was resolved to make a first-hand investigation of the MXM Guarantee: "If you can't get your Simple Transceiver to work, return it to us with $15, and we will make it work...". True to the guarantee, the kit was repaired the same day it arrived in Smithville, Texas. There's no troubleshooter like the designer, tough though it can be at times to admit the necessity of help from a more knowledgeable source. But it is comforting for anyone to know that help is available, and one will not be stuck with a kit which stubbornly refuses to work. The problem? Overlooked on the troubleshooting because of the clear memory of carefully checking the correct lead to connect to the stator of the pitch-control capacitor, the leads were, of course, backwards. Ah, Murphy.

Operation of the Simple Transceiver is truly simple once the tune-ups are completed. There are only three controls on the front panel. On - Off/Volume, Pitch/Filter and Main Tuning. Signals received can be filtered razor-sharp with the Filter control, and the pitch of the sidetone can be set to a pleasing tone. The bandwidth of the main tuning control is approximately 100 KHz on our 20 meter version (who wants to send CW to SSB operators anyway?), and our power out is approximately 1.2 watts at 14 MHz into a tuned Butternut vertical. Plenty of QRP zip for the 20 meter band. On the first evening of operation, prior to alignment of the tuning dial, N6RA, Tom in San Francisco, California, bestowed a 559 RST on the signal from Colorado at a time when the band was not at its best. Later, N7QKX/QRP/2 watts was worked during QSB conditions. Both sides initially assigned RST 539 to one another, later Mert's signal boomed up to 569.

One important note: This transceiver performs best with a truly resonant antenna!

As may be seen in the photo, there is ample room in the project cabinet supplied by MXM with the kit for a keyer circuit and/or a 12V rechargeable battery which could be charged through a jack on the back panel, yielding a self-contained, power-packing transceiver for portable use. If space is of essence, a smaller cabinet could be provided by the builder.

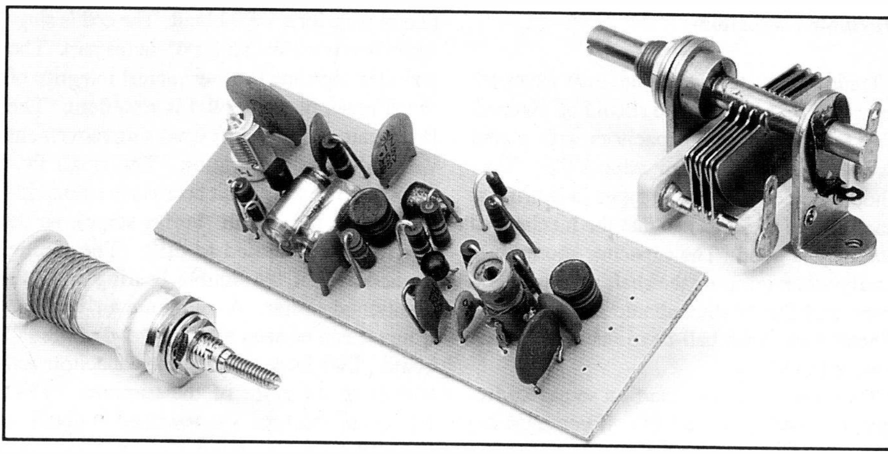
We are well pleased with this new transceiver from MXM, and are looking forward to cranking it up whenever 20 is propagating.

Retail price: $129.95; $5 S & H
Includes Board, components, project cabinet, two air variable capacitors
MXM Industries
Rt. 1, Box 156-C
Smithville, Texas 78957
512-237-3906

Some Tips On VFO Stability

Doug DeMaw, W1FB

P.O. Box 250
Luther, MI 49656



VFOs continue to be an important part of the QRP person's amateur equipment, but inexperienced builders are frequently troubled by long-term drift problems. A VFO that won't settle down and remain on frequency after 10 or 15 minutes is often worse than having no VFO at all. The malady is compunded further if the person who is receiving the unstable signal is using a receiver with a 250- or 500-Hz CW filter. The drifter's signal can vanish from his receiver passband quickly! This article offers some down-to-earth procedures for minimizing short- and long-term drift.

As RF current flows through the frequency-determining capacitors in an oscillator, there is a certain amount of internal heating that causes minute changes in the capacitance. To a lesser extent we observe the same phenomenon with resistors in the critical parts of the oscillator circuit. Therefore, it is prudent to use capacitors of fairly large geometry in the feedback circuits (such as in a Colpitts oscillator). This minimizes the overall internal temperature change. I prefer 1/2-watt carbon resistors for the same reason. Capacitors of small geometry may be used in parallel to obtain the desired value, and this will increase the internal area to reduce the effects of heating.

NP zero (NP0) capacitors are probably the best choice for the VFO designer. I have found that American made NP0s exceed the imported ones for stability. These capacitors maintain their values over a fairly wide range of temperature. Mouser Electronics in Texas is a supplier of NP0 capacitors.

My second choice is the polystyrene capacitor, which has a slight negative temperature coefficient. This can be advantageous when powdered-iron cores are used in the VFO tank circuit, since powdered iron has a positive drift characteristic. The polystyrene capacitors tend to compensate for this positive drift trait. Furthermore, polystyrene capacitors have a high

Q, which is important in oscillator circuits.

Silver mica capacitors are the least stable of the three types under discussion, especially in circuits that operate above, say, 3.5 MHz. No two equal value silver micas from a given production batch seem to have the same temperature characteristics, according to tests I have performed. Some were very stable, some had negative drift and some showed positive drift at 72 degrees F.

Variable Capacitors

Tuning capacitors with aluminum plates are temperature-sensitive and should be avoided. Try to find variable capacitors with plated brass or steel plates for your VFO. They should be double-bearing types (a bearing at each end of the rotor) so that the mechanical stability is good. The capacitor should turn easily when grasping the shaft with your fingers, and the rotation should not be lumpy. Those units with ball-bearings are the best choice for VFOs.

Trimmer capacitors can be a source of frequency instability in a VFO. If you must use ceramic trimmers (avoid plastic or mica trimmers), be certain they are of the NP0 class. I prefer using miniature air-variable trimmers in my VFOs, if there is ample space for installing them. They should be mounted on the VFO PC board near the tuned circuit.

Coils and Core Material

An ideal VFO would contain a rigid, high-Q, air-wound inductor. It would be enclosed in a proper shield and would be mechanically stable. Unfortunately, in this era of miniaturization, there are few builders who are willing to construct a fairly massive VFO. So, ferromagnetic cores are the rule rather than the exception. Slug-tuned or toroidal coils are the favorites of most of us. Choosing the right core material is perhaps the most important part of the design effort with respect to frequency stability.

Powdered-iron cores are the most stable ones to use. Avoid ferrite cores at all costs. The wrong powdered-iron type will not only increase unwanted drift, but it can ruin the coil Q. No. 6 core material (yellow coding) is made from carbonyl C and is a good choice for stability at HF. this material is used for toroids and slug-tuned forms. Amidon Associates presently has an even better toroid core material (white coding), but my older catalogs do not list this type, so I can't supply the part number.

The photograph on page 18 shows a collection of parts for a VFO I built. The coil is slug-tuned and is a J.W. Miller 43 series part. The coil Q is high and the mechanical integrity of the slug screw and collet is excellent. The latter trait prevents drift from slug movement versus heat and vibration. The small PC-mount coil on the circuit board is in a noncritical part of the circuit (buffer stage), so its quality is not related to drift. The tuning capacitor is of the double bearing type, as mentioned earlier. A miniature air-variable trimmer can be seen at the left end of the PC board. Two large polystyrene capacitors are visible to the right of the trimmer. VFO circuits of this type are described in detail in *W1FB's QRP Notebook* (2nd. edition) and *W1FB's Design Notebook*. Both are available from the ARRL and PC boards for the VFOs are sold by FAR Circuits in Dundee, IL.

If you use a toroid in your VFO tuned circuit, be sure to coat the winding with two layers of Polystyrene Q Dope. This will prevent the turns from moving during vibration or when the ambient temperature changes. Do not mount the toroid flat on the PC board. Rather, install it vertically and affix the bottom of it to the PC board with epoxy glue. If you can't obtain GC Polystyrene Q Dope, you may substitute Elmer's wood glue or the equivalent. I have found it to be very durable and it does not alter the Q of the coil once it has dried.

Mechanical Tips

Do not use double-sided PC board for VFOs. The etched elements, in combination with the ground-plane side of the board, form unwanted capacitors that are (Continued on page 22)

(Continued from page 21)
very unstable. Use only high quality glass-epoxy PC board material. Phenolic boards are not recommended for VFOs.

Enclose your VFO in a shield box and isolate the stages that follow the oscillator by installing a shield partition between them and the oscillator part of the box. This will prevent heat from migrating to the critical oscillator components. Vent the portion of the box that contains the non-oscillator circuitry. Keep all component leads as short and direct as practicable.

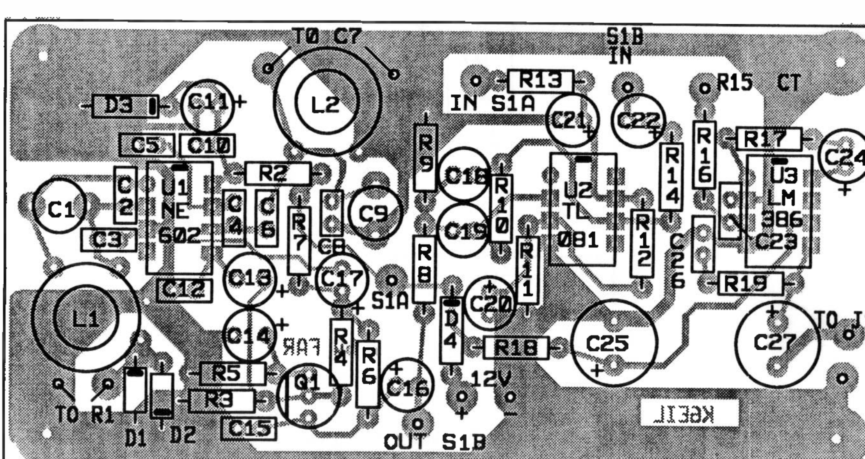
Closing Comments

Short-term drift occurs during the first three minutes after VFO turn on. This is caused by heating of the transistor junction and initial heating of the associated components. Long-term drift is the least desirable of the two conditions, and can last for hours with a poorly designed VFO. It should never exceed 30 minutes, and 100 Hz of drift is the maximum amount you should accept. When checking the drift of your VFO with a frequency meter, be sure to terminate the output of the VFO with a resistor that represents the characteristic load it will look into when attached to your transmitter. Connect your frequency meter across this load resistor.

Avoid using varactors (tuning diodes) in place of air variable capacitors when you build a VFO. The junctions of tuning diodes undergo a significant change in internal temperature during operation, and this causes prohibitive changes in the overall circuit capacitance.

• • •

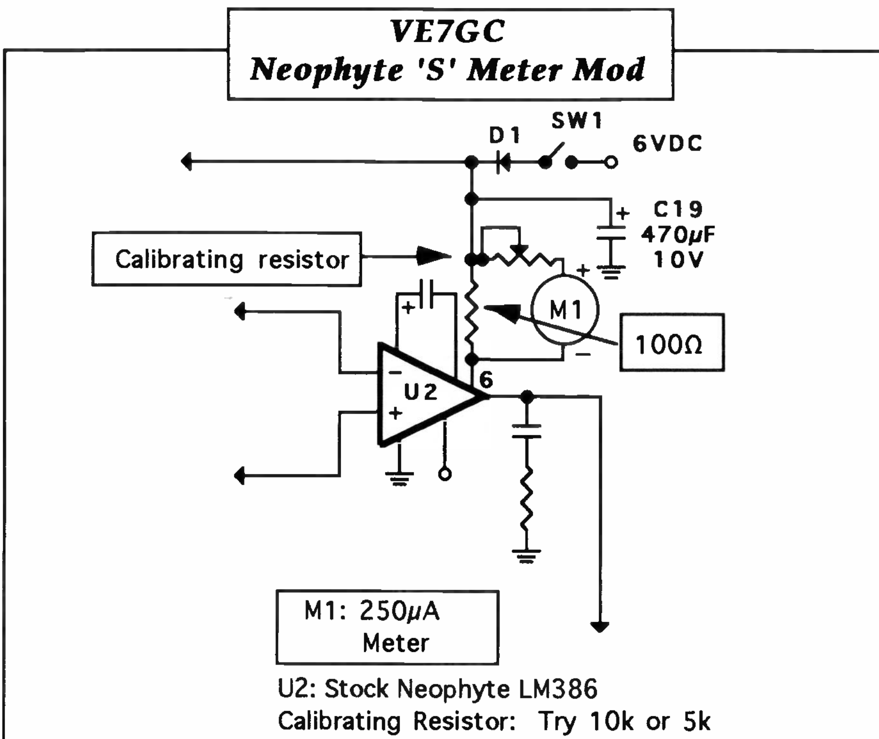
Parts Placement Diagram: K6EIL Receiver (pg.27)



Neophyte Roundup

The Second Report In An Ongoing Compilation Of Neophyte Information

The Neophyte was designed by John Dillon, WA3RNC of Lewistown, PA. A direct-conversion type receiver built around the Signetics NE602N mixer/oscillator IC, and originally conceived for 80 or 40 meter operation, it previewed in the February, 1988 issue of QST, and stimulated much interest in the ham-builder community. Low noise, good sensitivity and lack of hum/microphonics, along with good frequency stability made it a contender to function on a communications level.

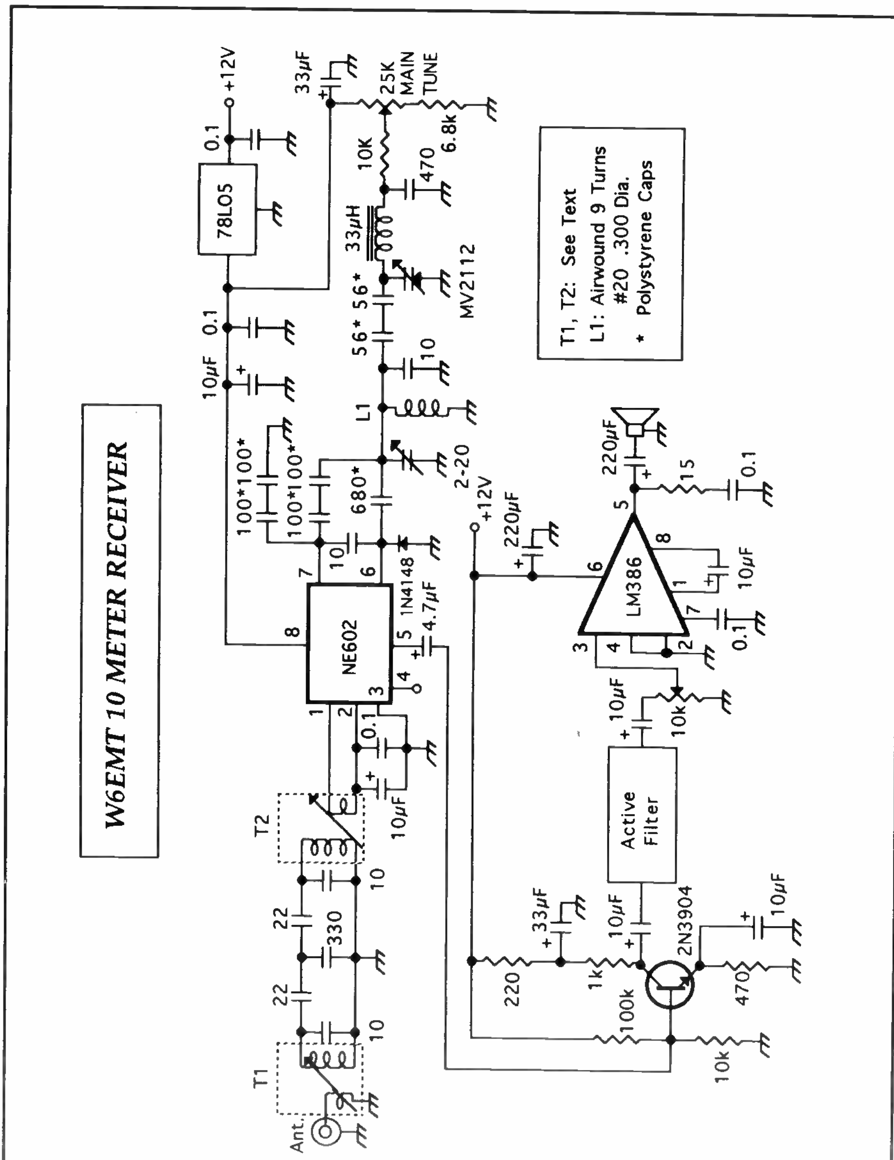


The Dick Pattinson (VE7GC) S-Meter mod incorporates the addition of three elements: a 100Ω resistor in the power line to the LM386 audio amp, a 250 microammeter and a variable calibrating resistor of, say 10kΩ. This would indeed form a kind of signal strength meter and Dick notes the 100Ω resistor acts as a form of AGC, as the current to the 386 is reduced on peaks. Dick says he has carried this further and applied this varying voltage to control the gain of an RF stage ahead of the Neophyte: this will appear in the Summer, '94 Issue of <u>Hambrew</u>!

The W6EMT 10 Meter Receiver

Roy Gregson, W6EMT

13848 SE 10th., Bellevue, WA 98005



When the FCC authorized part of 10 meters to the Novices, a new Novice friend was in need of a 10 meter receiver for listening to code practice in the evenings. The "Neophyte" seemed a simple approach.

Since this was intended to be a "one of", ugly construction was used with excellent results. Stability would be of major consideration in a receiver for 10 meters. The stability comes from series-connected polystyrene caps, an air-wound inductor (no toroids!), good voltage regulation, heat treating in the oven and sticking everything down with Super Glue. The drift is such that after about 1.5 hours listening on one frequency, a slight retune may be required.

The double-tuned front end was necessary to keep the CB'ers out (at least those not on 10 meters). I used Mouser P/N 421F-123 IF cans, and removed the built-in cap on the bottom of the IF cans. It's only necessary to break the thin ceramic cap so there is no connection. The 10pF caps resonate the cans on 10 meters. The 22 and 330 pF caps couple the two tuned circuits together.

L1 is close *air wound* with #20 wire, .300 ID. I used a round wood pencil for a form. Don't space the turns. I formed the end wires for soldering in place, then soaked the entire coil with superglue to hold it together. When dry, scrape the enamel of the ends for soldering. I don't believe superglue fumes are good to breathe, so keep it off the soldering areas. This sure beats winding toroids! And no heating problems with the core material (air)! I used a trimmer cap with a brass screw as used for VHF. I don't know the part number (see notes). You could use trimmer pots on each side of the main tuning pot to set the band limits if desired. Arrange the oscillator capacitors, the 100, 680 and 56pFs to stack like "cordwood". Make the series connections, and arrange leads out of the stack to line up with their next connections. I can't honestly say that this is the "secret" to stability, but it did the job. The 10pF cap between pins 6 and 7 of the NE602 and the padder across L1 are actually two 22pF silver mica capacitors in parallel (11pF).

The audio section uses a 2N3904 for a preamp. An active filter from the *ARRL Handbook* or the Variable Bandpass Filter from page 12 of the Autumn Issue of *Hambrew* would work great for CW selectivity. It can be switched in and out. The popular LM386 AF amp rounds out the receiver.

When complete, alignment and calibration is accomplished using the station receiver. Since this is a direct conversion receiver, the oscillator signal will be quite loud in the station receiver. If desired, adjust the tuning range of the main tuning pot with trimmer pots as suggested. Measure the pot resistance values and solder in fixed resistors of the same values. Set the band edge with the trimmer capacitor. Connect an antenna, find a signal to peak T1 and T2, and be amazed at how well a simple receiver works.

When complete, heat the receiver in your oven at a low heat for a few hours. Low heat means after a quarter of an hour you can hold it in your hand even though it feels quite warm.

With the "heat treatment" finished, recheck alignment and glue down the "cordwood-stacked" capacitors and L1 with superglue. When completely dry, check for final alignment.

My receiver tunes from 28.000 to 28.600 Khz. Sideband signals sound good for such a simple rig. For its original intention, this receiver does a good job and hears all but the very weakest signals when compared with the main rig. • •

Note: All parts are available from Dan's Small Parts and Kits, 1935 So. 3rd West #1, Missoula, MT 59801

Ed. Note: Hambrew will feature a construction article by Roy in the upcoming Summer, 1994 Issue - a great VXO 80 Meter Transmitter project. This VXO really swings - don't miss it!

Improved Neophyte Receiver

Wes Baden, K6EIL

3914 Parkview Drive, Salt Lake City, UT 84124

WA3RNC's "Neophyte Receiver" (February, 1988 *QST*, reprinted in *QRP Classics*) was imaginatively designed and even elegant in its simplicity. However, the receiver suffered from two flaws: low speaker volume and poor signal selectivity. Homebrewers such as Doug DeMaw, W1FB (11-88 Receiver Design Notes) quickly offered solutions to these problems by suggesting the inclusion of an AF preamplifier and audio filter between the product detector and AF amplifier stages.

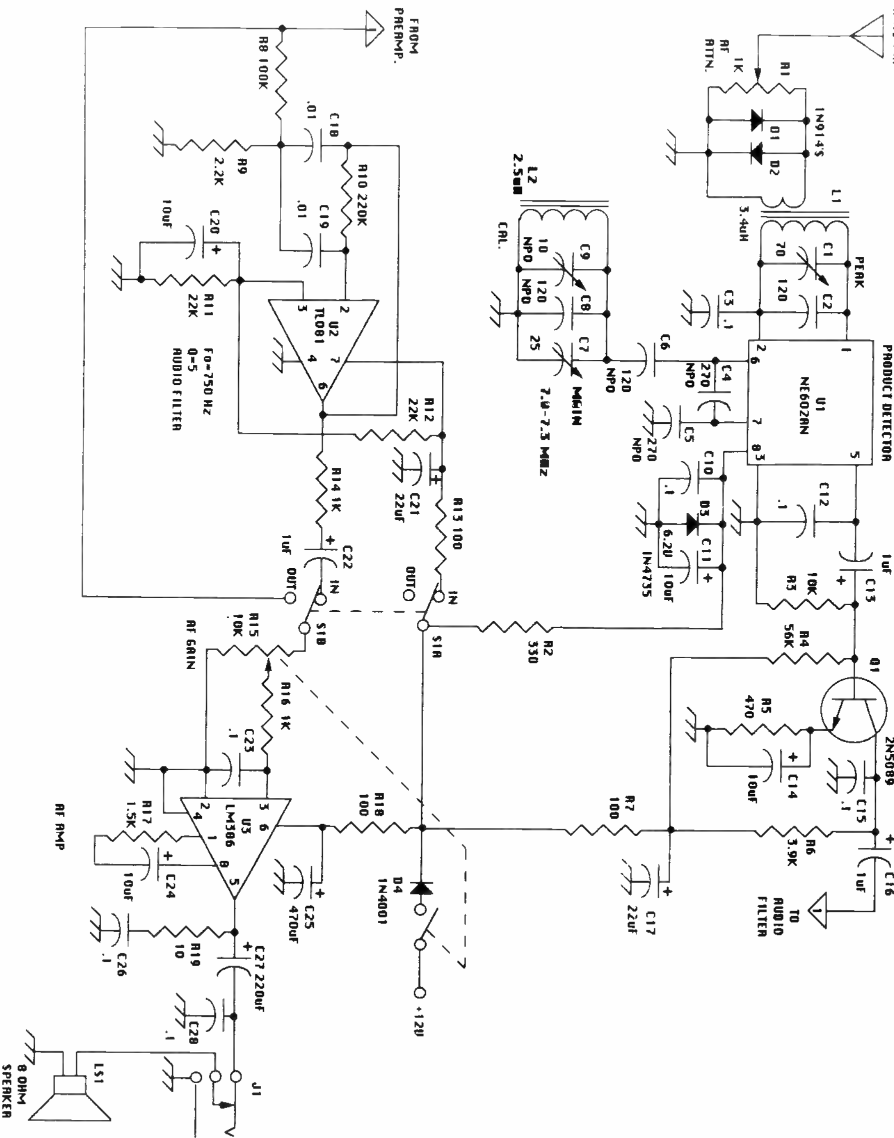
My NE602 receiver for 40 meters incorporates an AF preamplifier and a bandpass audio filter. There now is no problem driving a 2 1/2 to 3 inch speaker to room-level volume. Also, selectivity is significantly improved.

The NE602AN product detector is followed by a low-noise 2N5089 AF preamplifier. R6 sets stage gain and can be experimented with. C15 provides some high AF roll-off even before received signals reach the audio filter. The heart of the filter is a low-noise TL081 op amp. I have found out, by the way, that garden-variety 741 op amps do not work well in this circuit. You will need to spend the extra money and get a TL081 or its equivalent (e.g., Mouser NTE857M).

See N1AL's "Active Filters" (July, 1980 *QST*, reprinted in QRP *Classics*) for a full description of the audio filter. R9 sets the bandpass center frequency (a value of 2.2k ohms equals 750 Hz). Increasing R9 to 4.7k ohms would drop the center frequency to approximately 500 Hz. It is important that C18 and C19 be good quality polystyrene capacitors, with 5 percent or less tolerance (Mouser Me 23PW310 or equivalent). Match the capacitors closely if you can.

Selectivity of the "Neophyte Receiver" was 1 kHz at -3 dB and a full 7.5 kHz at -20dB. With the addition of the TL081 audio filter, selectivity in my receiver increases to 150 Hz at -3 dB and 850 Hz at -20dB. This is a noticeable improvement. However, selectivity will not rival that found in a $150 crystal filter (typically 850 Hz at -60dB). Q in my audio filter is a modest 5. The attenuation curve is not steep. Indeed, filter skirts fall off sharply below -20dB. In hindsight, I would cascade the audio filter, perhaps using a dual op amp, to improve selectivity even further.

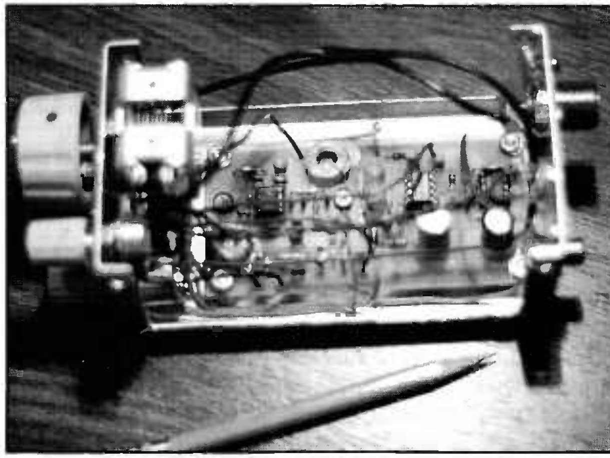
The use of low-noise devices 2N5089 and TL081 makes for an extremely quiet receiver. There is virtually no internal receiver noise during operation. R1 can be used to decrease external receiver noise so that signals often can be listened to with little or no underlying hiss. The inherent sensitivity of the NE602AN is readily apparent. In casual listening the first night that I built my receiver, I was able to hear CW signals from all conti-



ANTENNA
R1 1K
RF ATTN.
D1 D2 1N914'S
L1 3.4uH
PEAK
C1 70
C2 120
C3 .1
PRODUCT DETECTOR
U1 NE602AN
C4 270 NPO
C5 270 NPO
C6 120 NPO
C7 25
C8 120 NPO
C9 10 NPO
CAL.
MAIN
7.0-7.3 MHz
L2 2.5uH
C10 .1
D3 6.2V 1N4735
C11 10uF
C12 .1
C13 1uF
R3 10K
R4 56K
Q1 RF PREAMP. 2N5089
R5 470
C14 10uF
C15 .1
R6 3.9K
C16 1uF
TO AUDIO FILTER
R7 100
C17 22uF
R2 330
S1A
S1B
IN
OUT
R13 100
C21 22uF
R12 22K
FROM PREAMP.
R8 100K
C18 .01
R9 2.2K
R10 220K
C19 .01
C20 10uF
R11 22K
U2 TL081
Fo=750 Hz
Q=5
AUDIO FILTER
R14 1K
C22 1uF
R15 10K
RF GAIN
R16 1K
C23 .1
U3 LM386
R17 1.5K
C24 10uF
RF AMP
R18 100
C25 470uF
D4 1N4001
+12V
R19 10
C26 .1
C27 220uF
C28 .1
J1
LS1
8 OHM SPEAKER

nents except Africa.

KF9GX at FAR Circuits designed the circuit board for my receiver. Etched and drilled boards are available at $6 ppd. from FAR Circuits, 18N640 Field Court, Dundee, IL 60118.

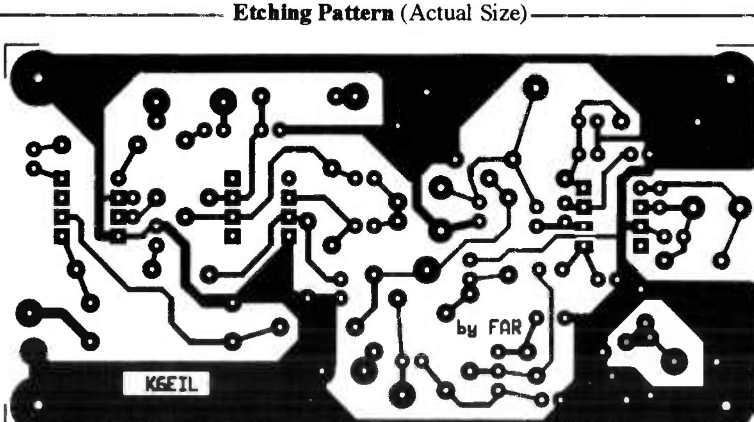


PARTS LIST

C1	70 pF min. cer. trimmer cap (Mouser ME 242-1270)
C4, C5	270 pF NP0 monolithic cer. cap. (Mouser ME 21RR627)
C6, C8	120 pF NP0 monolithic cer. cap. (Mouser ME 21RR612)
C7	25 pF air variable cap.
C9	10 pF NP0 min. ceramic trimmer cap. (Mouser ME 242-2710)
C18, C19	.01 uF 5% polystyrene cap. (Mouser ME 23PW310)
L1	T-50-2 toroid. Sec. 26 turns #26 enamelled wire, pri. 1 turn #26 closewound over bottom of sec.
L2	T-50-6 toroid: 22 turns #26
Q1	2N5089
U1	Signetics NE602AN
U2	TL081 (Mouser NTE857M or equiv.)
U3	LM386

Capacitors are miniature or monolithic unless indicated. Polarized capacitors are tantalum or electrolytic. All resistors are 1/4 watt.

Etching Pattern (Actual Size)



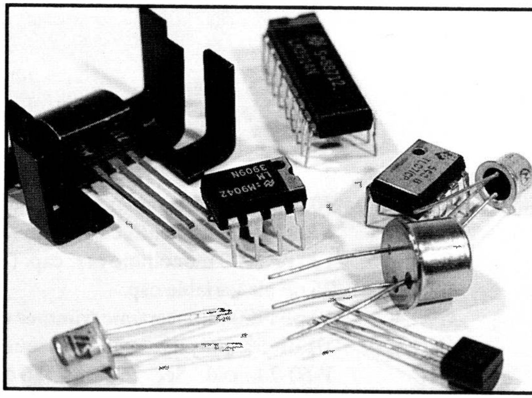
Parts placement diagram on page21

Amateur Radio QRP Design and Construction, Part II

Using Transistors and Integrated Circuits

Bruce O. Williams, WA6IVC

MXM Industries, Smithville, Texas 78957



Last month we discussed the identification of some of the more common types of components we use in the design and construction of QRP equipment. That discussion was certainly not exhaustive, and we will refer to identification of components more in the future. This installment will discuss the use of transistors versus integrated circuits. Don't expect a lot of theoretical discussion - the theoretical aspects of transistors are covered nicely in several different tomes. I recommend the *ARRL Handbook* and any of several works written by Doug DeMaw, W1FB, also available from ARRL.

Early Use of Transistors

The transistor was invented in the late 1940s, but didn't appear for use by hams and experimenters until the late 1950s or 60s. Why? Because they were not very good in terms of frequency capability, and they were horribly expensive! I can remember, in 1958, that the so-called experimenter's transistor (2N107) and the HEP series of transistors cost more than a vacuum tube. The architects of history proclaimed that transistors would never find a place in Amateur Radio, and the American Amateur Radio Industry believed them! Fortunately the Japanese electronics industry either never heard THE WORD, or else they ignored it - they went right ahead and started using transistors, depending on the development of better and better transistors as time passed. They were eminently successful, as you all know, and as a result the U.S. lost its radio industry and its electronics capability. Today, there are transistors readily available at reasonable prices to allow us to do anything we desire with low-cost solid state circuitry.

Transistors Today

Today, transistors offer many advantages for the QRP designer and builder - they are small, operate at low voltages, develop very little heat, and are very adaptable in circuits. They may be used in many different types of construction, such as printed-circuit boards, "dead-bug" assembly, and point-to-point wiring on perfboard.

What does this mean to us "fiddlers"? Well, for a few bucks we can lay in a supply of solid-state devices to allow us a wide latitude of choice for out designs. Transistors are available at many parts houses for literally pennies. Digi-Key has a large line of transistors available, as does Danny Stevig (Dan's Small Parts and Kits). Prices vary from five cents each to anything you feel you want to spend. I recommend that your basic "junk box" should have at least a handful each of the general-purpose bipolar PNPs and NPNs. Bipolar transistors, such as 2N2222s (NPN), 2N3904s (NPN), 2N2907 (PNP) and 2N3906 (PNP) and countless other types are usually available in lots of five to fifteen for a dollar. Spend a couple of bucks and have them available rather than having to make a trip to the Shack, where the price may be over a dollar each! *Remember* - a PNP type has the collector to the negative power supply pole, and the NPN uses the positive on the collector. You can remember this by looking at the diagram for the device - current flows in the direction of the arrow.

There are many uses for discrete components, to be sure. When you need an oscillator there is no substitute for a transistor. Field-effect transistors provide an easy way to get an oscillator cheap and fast. Put a few JFET transistors in your junk box. Try the MPF102 or 2N5486.

Again, the market provides us with the chance to get JFETs at the price of bipolars. There is a different problem with dual-gate MOSFETs, however. Like most dual-gate MOSFETs, the old reliable 40673 is apparently out of production, but that may be considered somewhat of a blessing by many designers. Its main application was as a mixer, but there are several better devices available now as integrated circuits (ICs). If you find a few 40673s, grab them! They may be useful at some time.

Integrated Circuits (ICs)

I once attempted to build a kit furnished by a company that was based in Australia. It was a transceiver and the design was all discrete components. The audio output stage took up about 4 square inches of board space, and had about 10 different transistors in it. Today, this entire stage could be replaced with an 8-pin DIP (dual-inline package) with only about 5 discrete components. (I never did get the thing to work!)

That's the beauty of ICs. They work very well and can replace several transistors and their associated discrete components. I don't like, and refuse to use the LM386 in any of its variations. It is noisy (death to a receiver), can oscillate at audio frequencies, and requires lots of attention to grounding. The LM380, either in the 14-pin configuration or the 8-pin configuration does a much quieter job if you can get by with 34 dB gain. If you need an audio device with more gain, or variable gain, I guess you might be stuck with the LM386. The problem with all, or almost all of the audio chips is that they are included in the design at maximum gain. Along with maximum gain goes maximum internally generated noise. This means that the device is pumping along generating maximum noise no matter what the level at the input.

If someone would come up with an audio chip with electronically controlled gain, what a good thing that would be. Well, Signetics has done it! Their TDA7052A/AT is an 8-pin DIP with DC volume control. They are not widely available, but I cot my hands on a couple of samples. I'm still working on using them, and they show a lot of promise. Until they're widely available, however, we're stuck with the present selection.

Invest in a few audio amplifier chips for your junk box. It doesn't make much difference which you use, but any of them will save you a lot of headaches in designing audio circuits. Try the 14-pin LM380 (2W), the 8-pin LM380N-8 (0.6W), the LM386, the LM394 (5W), or the LM389 (18-pin DIP with three general-purpose bipolar NPNs in the package). I've been playing with the LM389 with a view toward a one-chip transceiver. Try it! It only has about 250mW output, but that's enough for 'phones.

There are several other interesting 8-pin ICs for other applications. The Signetics NE602AN has been a favorite of designers for a long time. For every devotee of the 602, there's at least one detractor. Most criticism of the 602 has been because of its "low dynamic range". This may be true in part, but properly used the 602 is a fine (Continued on page 44)

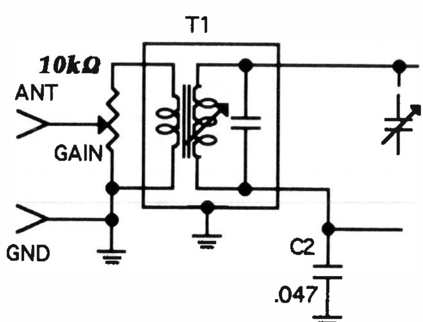
20/20 Hindsight

Looking Back Into Past Issues • Updates & Elaborations

Fred Bonavita, W5QJM, pointed out that the capacitor values sidebar in the Winter, '94 Issue on page 12 lacked a value marking in one section. The values were in microfarads as below:

2n2 = .0022μF
102 = .001μF
472 = .0047μF

Fred also mentioned the lack of a value on the input (gain) pot in the Neophyte schematic. It is 10kΩ:



Autumn, '94 Issue

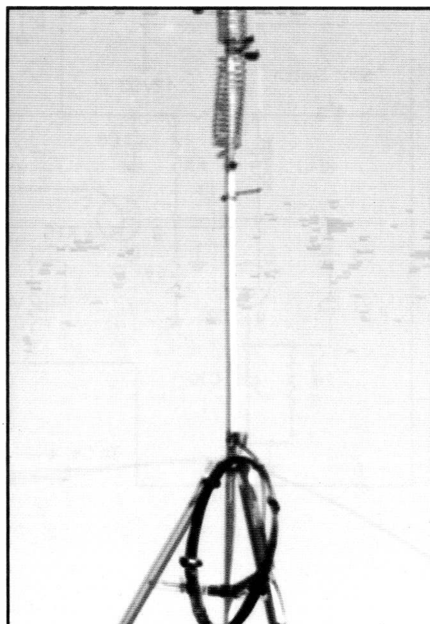
With the passing of Wes Farnsworth, KEØNH, we lost a good friend and fine mind. During the final course of his illness he was unable to continue his series of articles on counterpoise and antennas. In his first article Wes asserted that the decoupling loop which he showed us would accomplish an isolation of the antenna from earth ground, and by doing so the antenna would be able to act more as a pure radiator, unaffected by surrounding objects which might detune it. Wes's claim in this regard has probably provoked more reactive response than anything we have published thus far, especially his comment that radials could be eliminated from a vertical antenna which has a decoupling loop attached. Some readers are already pursuing an investigation of this claim, in order to gain a greater understanding of the effect the decoupling loop has on the radiator in relation to it's surrounding objects and it's (Continued on page 30)

(Continued from page 29)
angle of radiation. Certainly if the assertion is true, it has a major impact on how we think of counterpoise and how it can be applied to antennas which we construct.

Experiment 1: NØKEP, Bill Mason's dipoles, constructed per directions of Wes Farnsworth, did not lack a counterpoise in that the negative ("ground or "shield") side of the dipoles were retained (*Hambrew*, Autumn, '93).

Experiment 2: Jane Wodening, KBØHPH: Zepp antenna described in *Hambrew*, Winter, '94 Issue as constructed with decoupling loop per Wes's direction by Larry Feick (NFØZ) and Bill Mason. Result: Jane, who had not made a contact with her QRP station in over a year's time due to a ring of mountains around her cabin, achieved DX contacts on the first effort with the new antenna, and enjoyed stronger signal reception.

Experiment 3: WFØK installed a decoupling loop at the feedpoint of an HF6V Butternut vertical roof-mounted antenna. Instructions from the antenna manufacturer required roughly a six-foot length of 75 ohm coax as a matching device connected between the antenna feedpoint and the 50 ohm line to the transmitter. This was removed, and no noticeable difference (i.e., increase) in standing wave was experienced. Radials were retained for this experiment (one per band). Operation on 30 meters, previously impossible to match to lower than 1.5:1 with a transmatch, went to a flat 1:1 with the antenna tuner. The first contact with the decoupling loop installed was with a station in New Mexico, and after contact was established at 500 milliwatts, power was reduced and transmission of CW at 100mw was copied by the receiving station.



WFØK HF6V with decoupling loop

Signal reports of 569 were received from both KM6YA, Eureka, CA and KL7S, Seattle, WA at power levels of 500mw, with 100mw copy also (all were on 40m) .

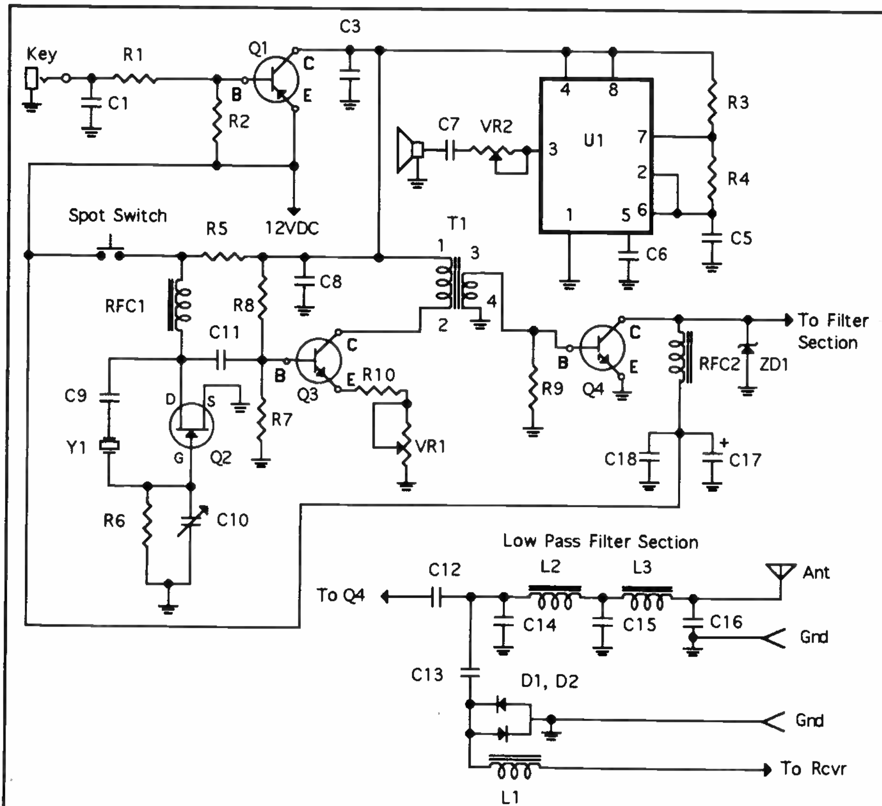
Yet more experimentation is needed. We welcome reader feedback in this regard.

In the Bingo! sidebar in the Winter, 1994 Issue in which was shown a power lead of extra heavy RG58 coax from battery to mobile rig, Bill Mason had a very useful idea for shielding engine noise. George Franklin (WØAV) writes to caution: "...using RG58 as a shieldedDC power lead is an excellent idea, however take an old ham/two-way radioman's advice and fuse the positive lead *right at the battery*. Almost all coax (except teflon-insulated types) will be damaged by heat in the engine compartment, resulting in a short circuit between the inner conductor and the shield. If the lead is not fused at the battery, no harm will result. If not, call 911 without delay."- A wise precaution which takes nothing away from Bill's fundamentally great idea.

Rig O Rama

The TwoFer III - Salvation

John P. Christopher, NG7D



The best way to describe the Two-Fer III-Salvation transmitter in one word: Slick! Having built several differently-designed Two Fer transmitters in past years, I have come up with a version that incorporates something missing from a lot of small QRP transmitter designs by most home brewers: a sidetone oscillator circuit. The addition of a sidetone oscillator within the circuit will add flexibility to your QRP operating fun by allowing you to work split frequency operation on the band. That is, you remain on your crystal or VXO frequency to transmit, but you can now QSY up or down the band on your receiver to copy contacted stations if the need arises. Your contact zero beats your signal in on his receiver, but he transmits on another frequency, for example up the band 15 Khz, having you zero beat him in on your receiver. It works, and can salvage your QSOs from total disaster during periods of heavy QRM. The best feature is that this maneuver does not require two VFOs for success.

The Two-Fer III-Salvation transmitter is a

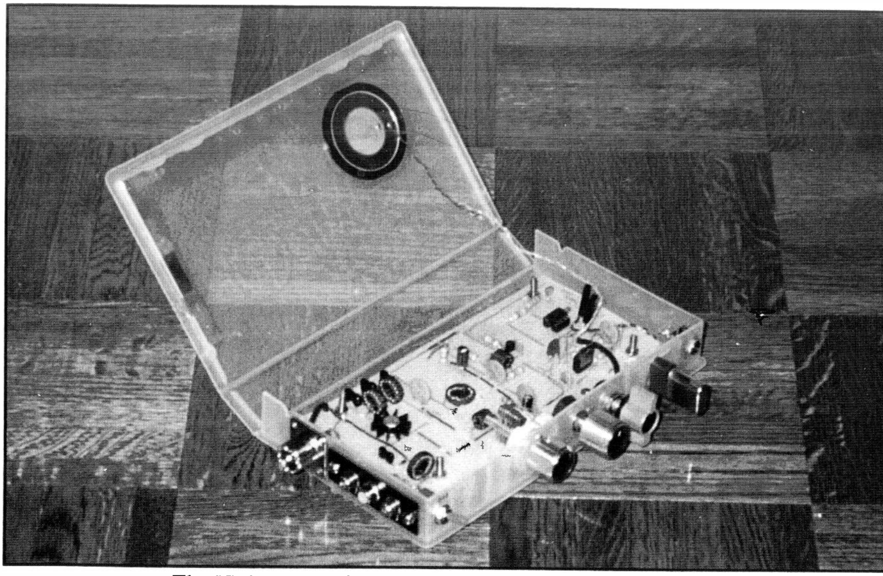
Component List: TwoFer III Salvation

R1	1.5K 1/2 Watt Resistor
R2	1K 1/2 Watt Resistor
R3	10K 1/2 Watt Resistor
R4	1.5K 1/2 Watt Resistor
R5	1K 1/2 Watt Resistor
R6	100K 1/2 Watt Resistor
R7	470Ω 1/2 Watt Resistor
R8	2.2K 1/2 Watt Resistor
R9	33Ω 1/2 Watt Resistor
R10	47Ω 1/2 Watt Resistor
C1	0.1uF Ceramic Disc Cap 25v DC
C3	.01uF Ceramic Disc Cap 25v DC
C5	.022uF Mylar Cap 25v DC
C6	.01uF Ceramic Disc Cap 25v DC
C7	0.1uF Ceramic Disc Cap 25v DC
C8	0.1uF Ceramic Disc Cap 25v DC
C9	.01uF Ceramic Di sc Cap 25v DC
C10	50-100 pF variable Tuning Cap
C11	39pF Ceramic Disc Cap 25v DC
C12	0.1uF Ceramic Disc Cap 25v DC
C13	47pF Ceramic Disc Cap 25v DC
C14	470pF Silver Mica Cap 500v DC
C15	1000pF Silver Mica Cap 500v DC
C16	470pF Silver Mica CaP 500v DC
C17	10uF Electrolrtic Cap 25v DC
C18	0.1uF Ceramic Disc Cap 25v DC
D1	1N914 switching diode
D2	1N914 switching diode
ZD1	1N4752(33V)1wattZenerDiode
U1	NE555 Timer Chip

Q1*	TIP 30 PNP Switching Transistor
Q2	MPF102 FET Transistor
Q3	2N2222A NPN Transistor (Heat sink recommended)
Q4	2N3553 NPN Power Transistor *(TO-5 Heat Sink required)
VR1	500 ohm potentiometer-RF Control
VR2	100K potentiometer-Side tone
X1	HC6/U or HC33 Fundamental Crystal for 7 Mhz band. (7040 KC)
T	FT50-61 Toroid Core Transformer. Wind 25 turns #26 enamelled copper wire for the Primary points 1 and 2. Wind 5 turns #26 enamelled copper wire over center of primary winding, points 3 and 4, for secondary winding.
RFC1	Ferrite Bead FB73-801: Wind 13 turns # 28 enamelled copper wire through center of bead.
RFC2	Ferrite Bead FB73-801: Wind 13 turns # 28 enamelled copper wire through center of bead
L1	T50-2 Toroid Core: Wind 45 turns #28 enamelled copper wire.
L2	T50-2 Toroid Core: Wind 14 turns #24 enamelled copper wire.
L3	T50-2 Toroid: Wind 14 turns #24 enamelled copper wire.

*TIP 41 may be substituted for Q1

Note: C2 and C4 were eliminated from this schematic and component list



The "Salvation", showing placement of controls and jacks

transistor-switched, Pierce Crystal VXO-controlled oscillator. The crystal oscillator is activated whenever the transmitter is keyed to ground by Q1, or the spot switch is closed. The oscillator frequency can be varied by the use of a 50 to 100pF air-variable capacitor (VXO) within the oscillator circuit.

The signal from the oscillator (Q2) is then fed into a Driver/Amplifier stage (Q3), where the RF output may be adjusted with the use of the VR1 500 ohm pot. It is important to note that it is a must to include the R10 resistor (47 ohm) from the emitter lead of Q3 to the VR1 pot for biasing. Without this resistance, Q3 will destroy itself upon key down. An impedance-matching toroidal transformer (T1) is included within this stage, increasing RF power output. The signal is then amplified further by being fed to a broadband class C RF amplifier stage at Q4. From here, the signal proceeds into a two-stage lowpass HF filter for harmonic suppression before transmission.

A QSK receiver input line is attached to the input of the lowpass filter stage to enable transceive operation with an external receiver. With the transmitting antenna attached to the output of the lowpass filter, signals flow to the receiver connected to the QSK input line during non-transmit periods. The QSK circuit consists of a capacitive/ inductive resonant circuit for 40 meters. Reversed switching diodes prevent damaging transmitted RF from entering the receiver front end.

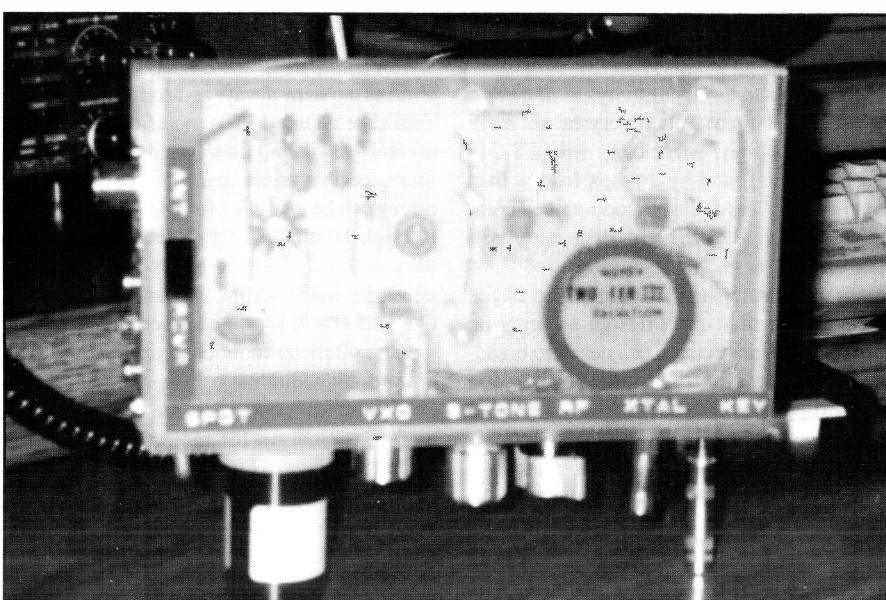
The added sidetone oscillator and associated stages are controlled and powered through a TIP 30 switching transistor. When powered by 12 to 13.8 volts DC and keyed to ground, the switching transistor opens with necessary voltage to circuits, acting as a switch: key down = ON, key up = OFF. VR2 is a 10k potentiometer that will allow adjustment of the audio output from the sidetone oscillator during transmissions. This audio can be monitored by an 8 ohm speaker, a piezo speaker element (a pretty amazing device in itself) or headphones.

A 33 volt 1 watt zener diode is placed on the output of the final amplifier stage and ground to prevent excessive VSWR damage or voltage spikes to the final transistor, should a short circuit or open line condition on the antenna occur. The transmitter is capable of producing an average of 2 to 3 watts RF output, and is fed into a 50 ohm load at the antenna. It is advisable, though, to keep the power to a 1.5 to 3 watt RF output maximum limit to protect the final transistor and to keep thermal heating of the device to a minimum. VR1 should be able to drop the output power into QRPp ranges for further fun and excitement, if you desire. The use of a TO-5 or similar heat sink will be required, as could be expected.

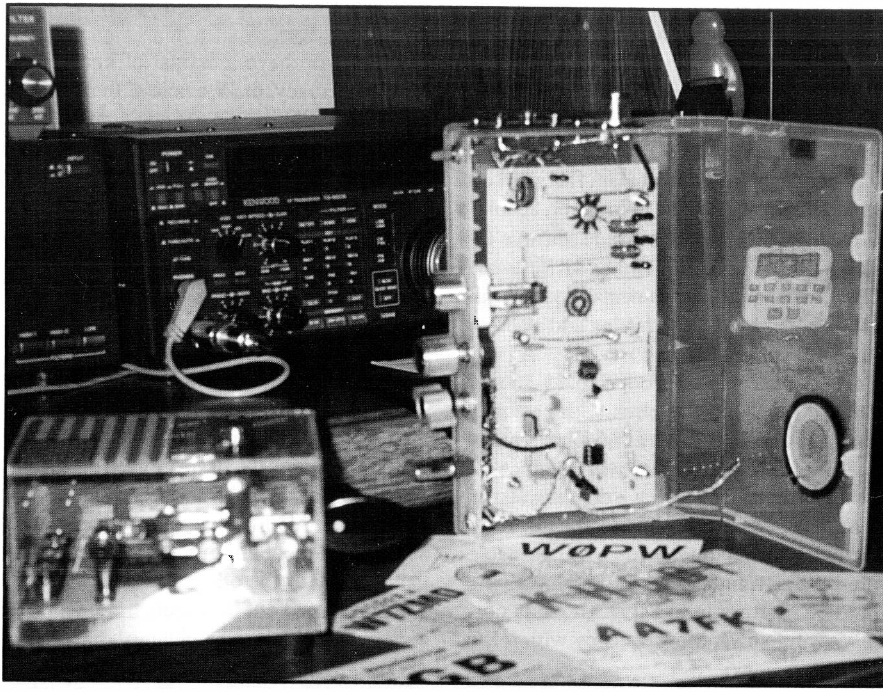
FT-243-style fundamental quartz crystals may be used with this transmitter. These are still pretty common for 40 and 80 meters, and are not difficult to obtain at Ham flea markets and crystal manufacturers. However, according to the ARRL Handbook and various articles written by Doug DeMaw, HC6/U-and HC33/U-type quartz fundamental crystals will provide better frequency shifting and stability with VXO control than the FT-243s. AT-cut HC6/U-types can shift from 5 to 15 Khz or more at 7 Mhz. In some circuit designs, they are known to shift as much as 45 Khz or more. Usually a swing this great will produce an unstable oscillator, which we do not want on the air. It is desirable then to shift the frequency a small amount to keep things stable within the oscillator, so a 3 to 5 Khz swing would be reasonable to have. Crystals normally swing upward in frequency with VXO control from my past experience, but some lowering from the crystal frequency could also be possible, so beware if you are working near band edges.

Once you have a crystal of known frequency accuracy, make a note of the shift that the VXO produces and use one or more crystals according to your needs. HC6/U-and HC33/U-types will more than likely have to be manufactured for you by a crystal manufacturer, since these types are not very common on the surplus amateur radio market. FT-243s are still fun to play with, and will suffice until better crystals with which to operate can be found. New crystals cost a few dollars, but they will give better performance and flexibility in the long run.

I picked the 40 meter amateur band for which to design this transmitter for several reasons. First, there is more band activity per 24 hour period. I believe that 40 meters will net the QRP operator more QSOs per period than on any of the other amateur HF bands when averaged out in a years time, working stations during day and nighttime hours. There



NG7D selected label tape for control labels



The Two-Fer III Salvation: Neatly Laid Out!

always seems to be CW activity on 40 meters. Second, fundamental quartz crystal are more available for the 7 MHz band with FT-243 crystals often found by the box load at ham swap meets. Third, the less odd-valued components required by the circuitry: most parts used on this transmitter design can be obtained at any electronic parts shop or Radio Shack store. Since the circuit design presents no problems in construction, it is easy to breadboard on a piece of 6" x 4" perfboard, using point-to-point wiring techniques, a notable characteristic of a homebrewed project.

A side benefit of this transmitter design is the fact that it is not limited to use only on the 40 meter band. This basic circuit can be adapted for use on other amateur HF bands with simple conversion modifications to the Low Pass Filter Stage, the Receiver Input Line Stage, changing the fundamental crystal and some parts. That's it! The rest of the circuit remains the same always and no further changes should be required. The modification process involves rewinding filter toroids and changing four capacitor values in the circuit. The transmitter can be designed for use on 160 meters through 10 meters. RF output though, will vary as the frequency bands are increased upward in the spectrum. However for the Rig-O-Rama event, I have confined my design to just the 40 meter monoband design, and will not present additional coil-winding data.

By the way, video cassette cases do make perfect enclosures for radio projects, especially if you own a Dremel hand tool. It drills and cuts through the plastic material just like butter, if used properly. My radio-building tools aren't complete without one.

So, fellow builders, has my project created some interest and curiosity within you? Like all things in life, there is always room for improvement, and my design is no exception.

Any further ideas on how to improve on it are always welcome. Get those soldering irons hot, raid those junk boxes for parts, get the parts orders in to the QRP parts suppliers and get ready for a true adventure in QRP building.

72 for now, and happy building De NG7D • • •

• Neophyte Roundup, Summer,'94 Issue: Adding a bandspread to the Neophyte •

Add Narrow Band Sweep To Your Signal Generator

John Pivnichny, N2DCH

3824 Pembrooke Lane, Vestal, NY 13850

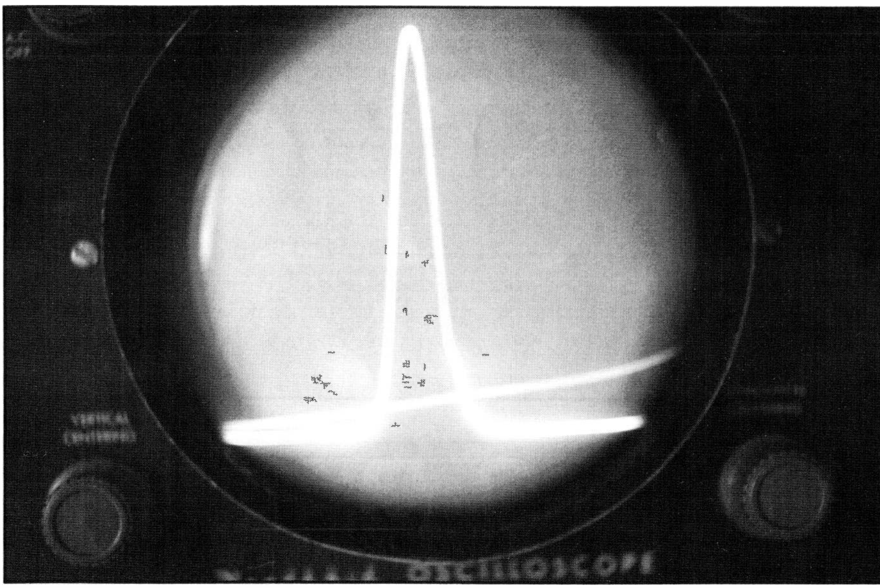


Photo A: Frequency Sweep of 8 MHz Crystal Filter

A minor modification to practically any signal generator will let you look at frequency sweeps of your narrow band IF filters or transformers. Any oscilloscope will do for the display, even my ancient Heathkit OM-1, since the required bandwidth is under 100 kilohertz. Photo A shows an actual sweep of my 8 MHz crystal filter described in reference [1].

Use A Varicap

You will need to add the circuit of figure 1 to your signal generator. The most important part is the voltage variable capacitor diode, VVC, which changes its capacitance as the voltage across it changes. When connected to the oscillator tank of your signal generator, this capacitance change causes the frequency change needed to display a frequency sweep. If the sweep is kept narrow, then nonlinearities in the frequency vs voltage characteristic will be minor and can be neglected for amateur accuracy.

Inductor Ll, a radio frequency choke, isolates the rf circuit from the control voltage. Potentiometer Rl provides a sweep width control. Resistors R2 and R3 set the steady state bias on the WC at 2 volts, so that a +/- 1 volt sweep signal will not drive the diode into conduction.

I added all the components to the back panel of my homebrew signal generator [2], as shown in Photo B. For other generators you will have to locate the oscillator tank circuit and find a nearby point to mount the potientiometer and phono connector. The 40 pF coupling capacitor can be increased or decreased as necessary to set the maximum sweep width. With my generator, 40 pF produces over 30 kHz sweep width.

Sweep Signal

Where does the sweep signal come from? To keep things easy, the sweep signal is taken from a sweep output terminal on the oscilloscope. On the Heathkit scope there is a 1 volt peak to peak 60 Hz sinewave available on the front panel near the vertical input. This makes an ideal sweep source. Most scopes will have something similar, just make sure it's peak to peak amplitude is in the range of 1-2 volts and the frequency down below 100 Hz.

The sweep signal is the same signal used to move the spot horizontally across the face of the scope. There is no problem syncing the trace since the signal frequency motion and spot motion occur together.

Detecting the Signal

Many older scopes have a greatest vertical sensitivity of about 0.1 volt per inch of vertical deflection. If you want to check out crystal filters, you don't want to put anywhere near a 0.5 volt signal through them (for a 5 inch display). The crystals can't take that kind of power. What's needed is additional amplification. In addition, an rf detector circuit is needed to convert the signal level into a dc voltage.

The circuit of figure 2 does the job of amplifier and detector. A single MC1350 IF amplifier gives a gain of 10-100 (20-40 dB) allowing you to put less than 10 milivolts through your crystal filter for a full screen vertical deflection. A full wave detector using germanium diodes doubles the output providing another 6 dB gain.

The circuit should be built up on a 2" x 2" piece of single sided circuit board and mounted in a metal enclosure as shown in Photo C. A suggested parts placement and hole pattern is given in figure 3, however modifications are permitted as long as pins 3 and 7 of ICl are grounded directly to the foil ground plane.

The amplifier-detector can be tested simply by feeding a steady rf signal into the input jack and reading the output voltage on any voltmeter. (Continued Next Page)

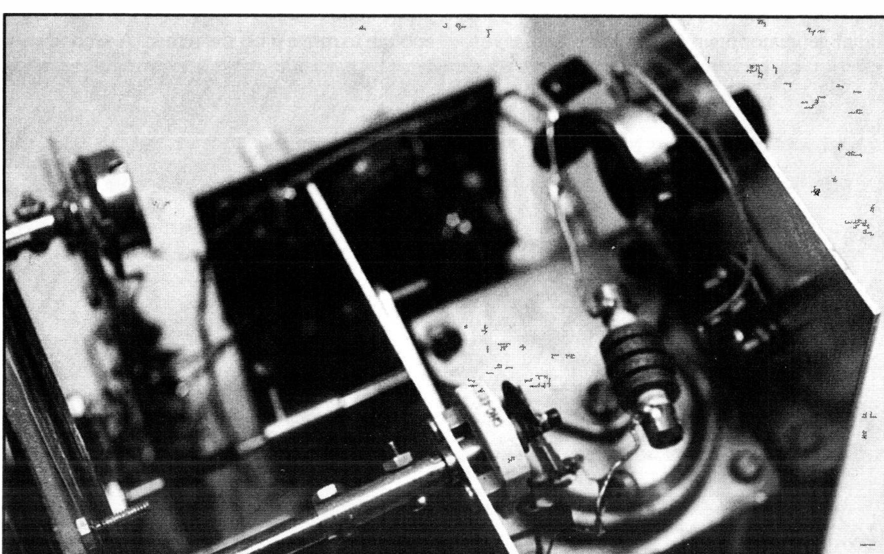


Photo B: Component Installation of Signal Generator Back Plate

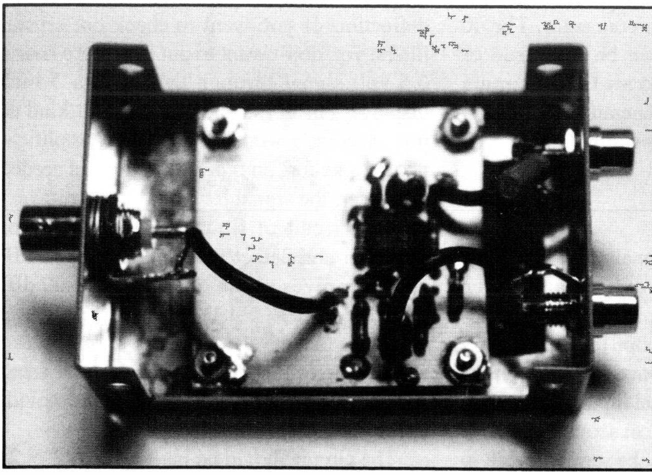


Photo C: Amplifier-Detector

You should be able to vary the output voltage from zero to plus 1 volt dc by adjusting the amplitude of the input rf signal.

Typical Setup For Crystal Filter Sweep

Figure 4 shows how to connect up the equipment to observe a frequency sweep. My test bench is shown in Photo D. The center frequency of the sweep is set by adjusting the signal generator main tuning knob until a vertical blip appears. With this setup you will actually get two traces, one as the frequency is swept low to high, and another as the frequency sweep comes back down, following the 60 Hz sinewave sweep signal. The two vertical traces can be made to coincide (almost) as shown in Photo E by adjustment of the phase control on the oscilloscope face.

There are two ways to get rid of one of the two traces. First, you can just advance the phase control to move one trace off to the right enough to move it off the screen. A second way

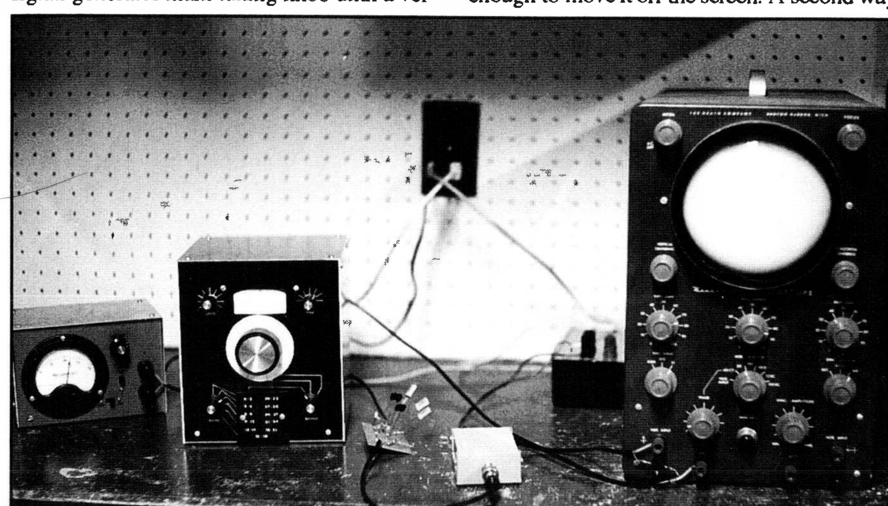


Photo D: Test Bench

is to use the oscilloscope sweep generator to move the spot across the scope face. Again shift the horizontal position so the second vertical blip is off to the right. The sweep generator will return the spot to the left hand side rapidly, before another vertical blip occurs. This is how the trace of Photo A was generated. There will be some distortion of the frequency axis with this method because the frequency is being swept with a sinewave and the spot with a sawtooth. But a sinewave is fairly linear in the central region and that is the part of the sweep that should be used.

Two Filters

I was able to use this setup to verify the passbands of the two crystal filters (upper and lower sideband filters) described in reference [3]. Using the first technique (phase control) I moved one blip off to the right and took a photo. Then without touching any controls I unplugged the lower sideband filter and plugged in the upper sideband filter. Voila, there it is shifted to the right just as expected, and I took another exposure without advancing the film. This double exposure photograph is shown in Photo F. A camera tripod is needed for such a double exposure.

Undoubtedly you can think of more things to look at with this home shack capability. IF transformers, IF null circuits, and adjustable bandwidth features are some that come to mind.

What's Next

The vertical scale on the oscilloscope display is given in milivolts per inch. For some applications, especially crystal filters, a dB scale is more useful. What's needed is a log amplifier instead of the MC1350. Two possibilities are the NE604 and MC3356. Perhaps some amateur out there will try one or both of these and publish his results. How about it experimenters? Let's see what we can do with our amateur equipment. • • •

References

1. J. Pivnichny, N2DCH, "Switchable Bandwidth Crystal Filter", *Ham Radio*, February, 1990, pp 22-29

2. J. Pivnichny, N2DCH, "Calibrated Signal Generator", *73 Amateur Radio Today*, July, 1992, pp. 26-30

3. J. Pivnichny, N2DCH, "Twin Crystal Ladder Filters", *73 Amateur Radio Today*, January, 1993, pp. 32-35

See additional figures and photographs, continued page 42, 43

All photos in this article by John Pivnichny, N2DCH

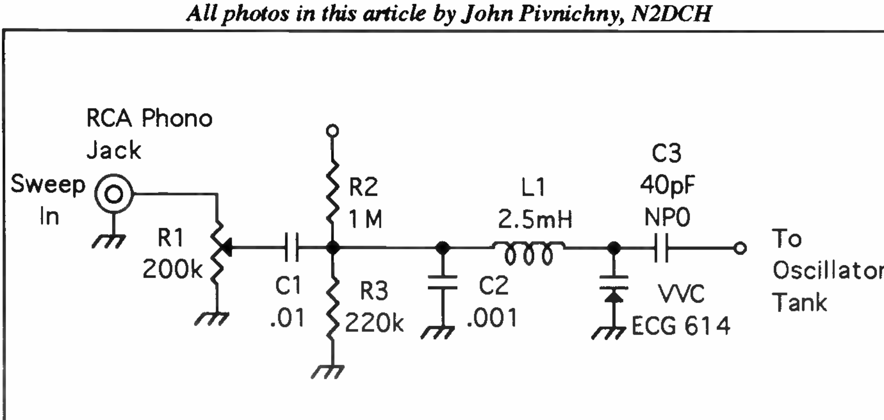


Figure 1: Sweep Circuit

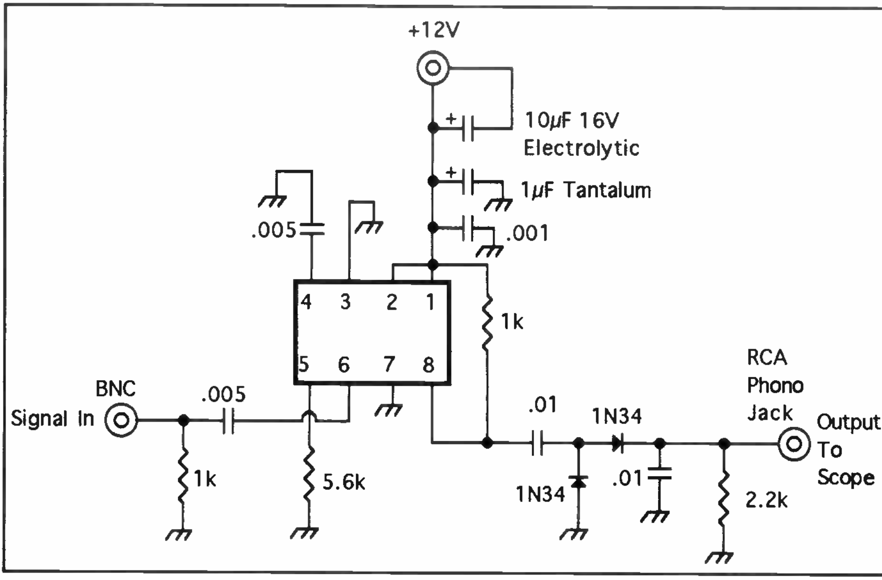
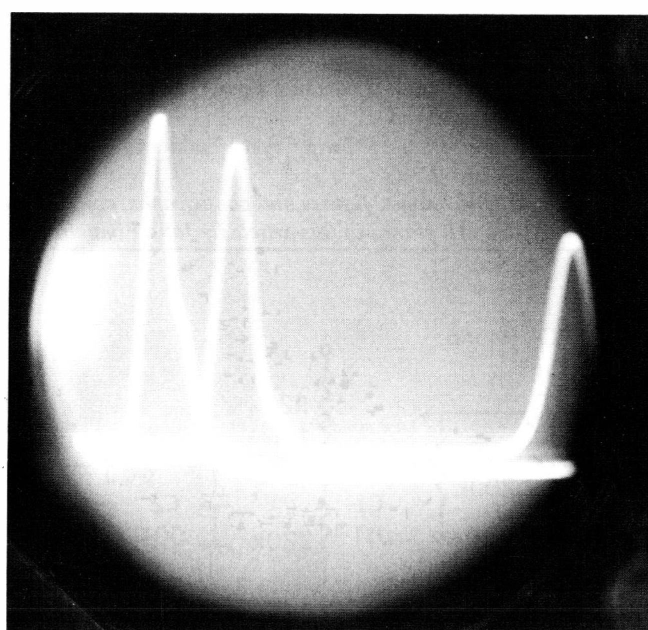


Figure 2: Amplifier - Detector Circuit

Photo F: Double-Exposure Showing Two Filters



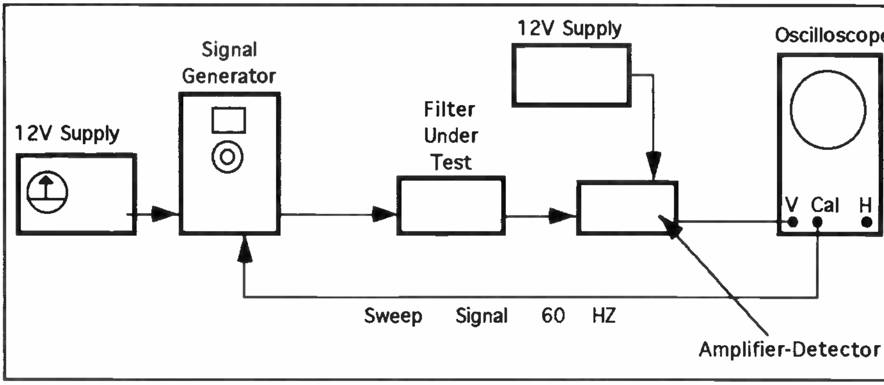


Figure 4: Measurement Set-Up

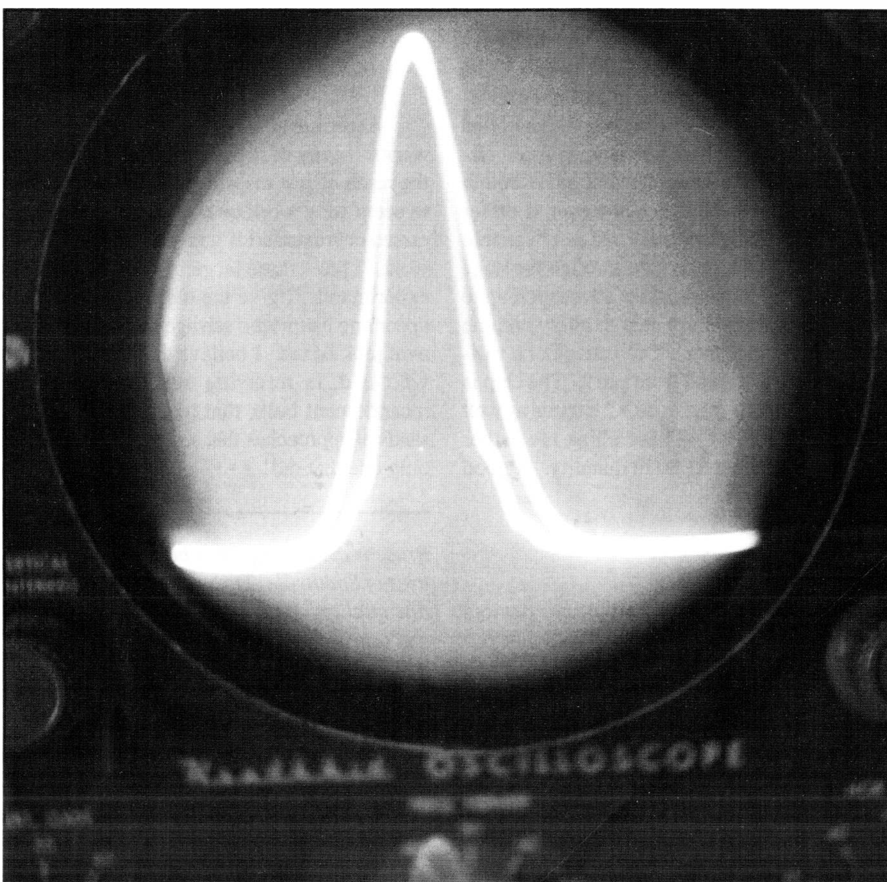


Photo E: Two Overlapping Traces

(Continued from page 29) little mixer chip. Used in a Hartley oscillator configuration, it provides a very low-cost solution to the mixer problem, and it is operable well up into the VHF part of the radio spectrum.

The 602 may seem like a pricey solution at about $2.50 each in small quantities, but it does an awful lot of good things. Get a few! There's hope on the horizon, however. Signetics also makes the NE612AN - identical to the 602 except for 1 dB difference in conversion gain and at a price about two-thirds of the 602. I've tried them in all of my 602 circuits without finding any difference in performance. The next time I buy mixers, they will probably be 612s.

Intermediate frequency (IF) amplifiers for superhets is another area in which the use of ICs can save a lot of time and trouble. The MC1350 is readily available and not expensive. It is an 8-pin DIP with voltage-controlled gain. Many designers use it with AGC circuitry to provide a steady level of gain through a receiver. It can be noisy, however. I prefer the MC3340, which is described as a "variable attenuator". Maximum gain through the stage is 13 to 18 dB, but it provides attenuation up to 80 dB below maximum gain to allow volume control through either a DC voltage or a variable resistor to ground from pin 2. The chip is quiet, and can be used in AGC circuits as well as an IF amplifier. These chips are rather expensive at about $1.60 in quantity. A good value, however.

Data

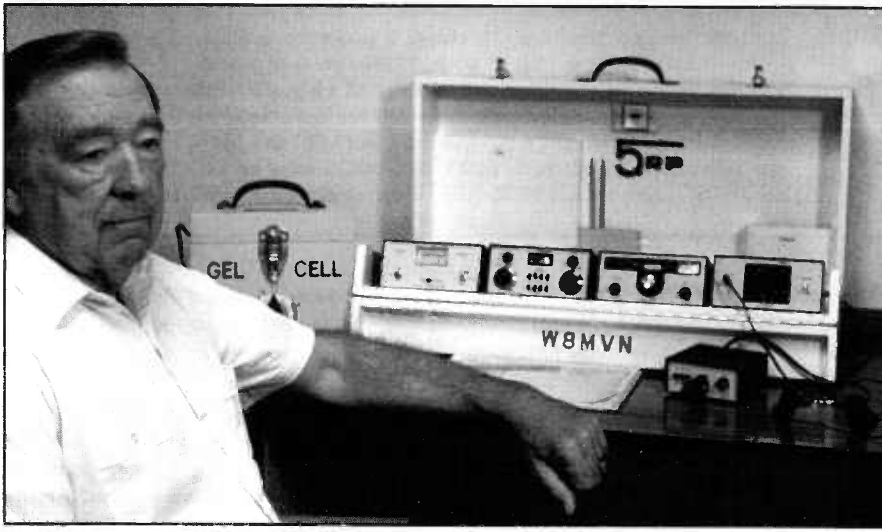
I've described several solid state devices that I'm familiar with. You will find that you need many references to allow you to pick and choose which devices you may want to use. Always ask for supporting data when you buy components. Try to find data and reference books in flea markets or hamfests. The shelfroom that they take is a small price for the convenience of having readily available data. My reference library contains several old reference books - you never want to throw them out! Several manufacturers will provide reference material on all of their products without charge, although some of them ask a nominal fee for their books. Best bets? National Semiconductor's Linear Applications Handbook, Signetics (Philips Semiconductors) Data Handbook, and Motorola Linear Data Handbook are all worth their weight in gold. There are many other sources also. The American Radio Relay League (ARRL) publishes several good reference books you need in your library. Write for a catalog to ARRL, Newington, CT 06111. Digi-Key offers a catalog - write to Digi-Key, 701 Brooks Ave. South, Thief River Falls, MN 56701-0677. Dan's Small Parts and Kits offers a catalog of reasonably priced parts: Dan's Small Parts and Kits, 1935 So. 3rd W. #1, Missoula, MT 59801.

Conclusion

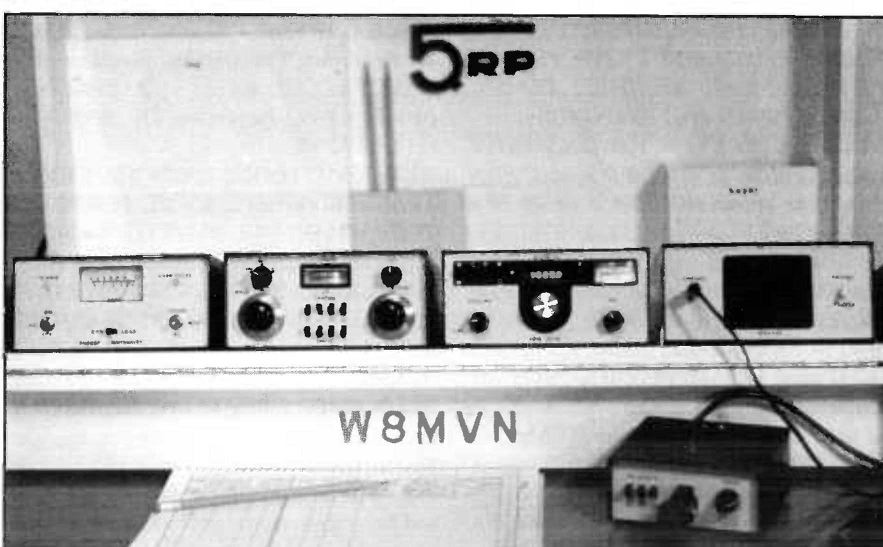
Experiment! Try it! Find out if your idea works. Many of my commercial designs are the result of just messing around with circuits to see if they work or not. Don't be embarrassed or frustrated if your experiments don't work. I have three large boxes full of failed experiments. I give the old boards to young upcoming hams who salvage the parts for their own junk boxes. I believe that it was Edison who said, in referring to his work on the incandescent bulb, that he discovered thousands of approaches that would not work - and only one that did! • • •

Bruce is the driving force behind MXM Industries of Smithville, Texas, and is a designer of fine quality ham kits: transmitters, receivers and transceivers. His advice on designing and building comes from years of practical experience in the field. In the Summer, '94 Issue, Part III: Construction Techniques.

SHACK SHOTS



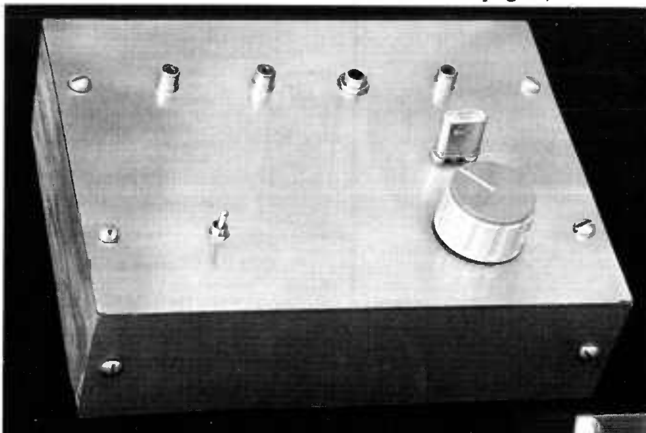
Here's a guy who knows how to homebrew - par excellence!
Ernie Helton, W8MVN, of Franklin, Ohio provides us a glimpse
of an all h/b station, including power supply and tuner. In addition, Ernie has
just built a station in a briefcase! There's one we'd also like to see...
Hearty congratulations on a beautiful station, Ernie!



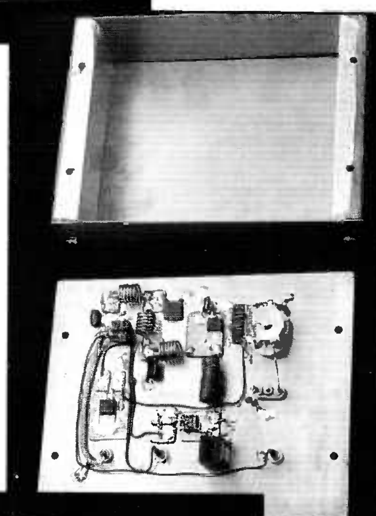
CLASSIFIED ADS

A Reader Service of **Hambrew - No charge to subscribers** to place one ham-related ad per issue, limit 15 words, 25 cents per word thereafter. Commercial or non-commercial subscribers, no minimum. All ads must be related to amateur radio. **Hambrew** does not vouch for nor guarantee the reliability nor legitimacy of any item or company represented herein. Deadlines: Sept.1 (Autumn), Dec.1 (Winter), March 1 (Spring) June 1 (Summer). We reserve the right to deny publication of any ad. Copy To: PO Box 260083, Lakewood, CO 80226-0083. Sorry, no phone orders on classified ads. Prepay only.

N7KSB 5/15 Watt Transmitter: Additional photographs
(Article on page 9)



N7KSB 5/15 Watter



Completed transmitter shown next to homebrewed case; interstage shield not shown

Completed transmitter showing interstage shield