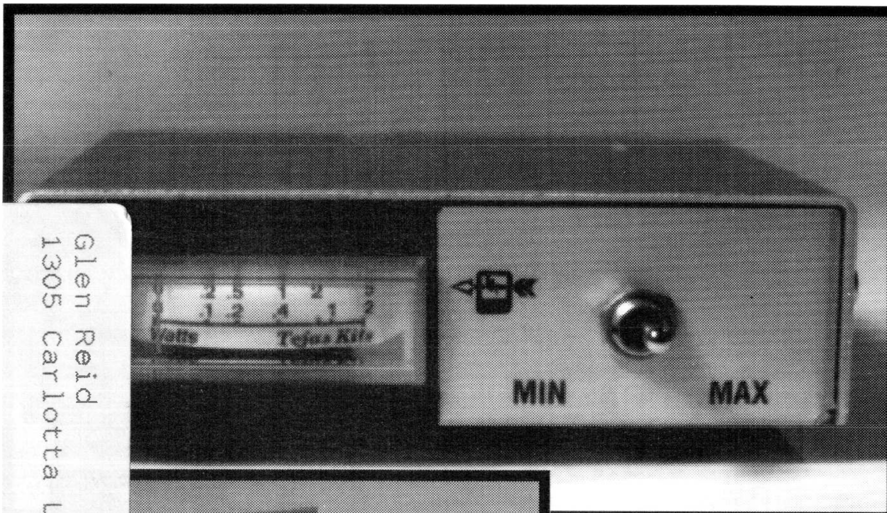
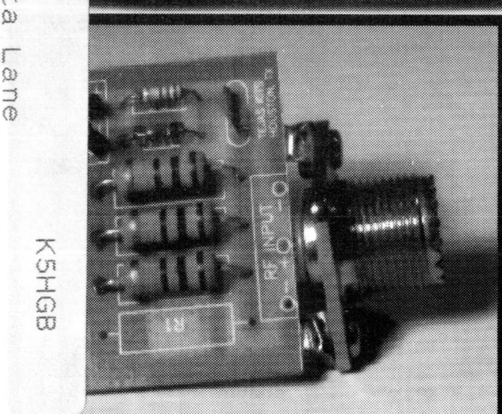
hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS





K5BDZ's Dummy Load and RF Meter/ Sensor

SECOND ANNIVERSARY ISSUE

AUTUMN 1995

SECOND CLASS POSTAGE PAID AT DENVER, COLORADO

Important

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• Contents •

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FOR AMATEUR RADIO DESIGNERS AND BUILDERS

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• LETTERS •

From The Publisher

Might sound corny to some, but the true spirit of the oldtimers lives on when we build. Some of us come to the point where we realize the full meaning of why the hobby was and is so much fun on this level and couldn't ever become boring again. Kudos to the true professionals who have a huge knowledge of the science. Most of us are still amateurs, just like the old-timers, God bless 'em.

It seems that Charlie Whiskey can be a tough guy to get to know, but once you get past the tough part, he becomes your best friend. He 's still around, and a lot of people know him. 'Course he doesn't make much sense if you can't understand him, but there is adventure in finding out what hehappens to be saying tonight, now, when there is noone else around to talk to.

Please note that we now have a back-article service. The info. is on the inside back cover.

Work on the Hambrew Emergenceiver board is underway. We hope to have a kit available from MXM by the Winter issue.

Openings on 6 meters will be few and far between for a while, but we are hoping to keep the information flowing on projects, stuff about the band, and kits. One of these days, 50 MHz will open up again and it would be nice to have some things in place to enjoy the activity. The response to our appeal for projects has been more than expected. I wonder if anyone has a good yagi design for 6m which they would like to share. The formulas are of course available, but it would be great to see some individual interpretations, matching systems, etc. Let us know?

I've lately been appreciating the sense of community that is developing around Hambrew. This is most rewarding, and we have all those who have written and supported us, sometimes anonymously in other publications or on the internet, and all the writers and builders who send valuable information to us for distribution.
Looking back on the past two years, we have made some real goofups in publishing some items, but not too many readers wrote us off as a total loss, and for that faith we have survived and are improving as we go.
GigaThanks.
70's,
Geo.

I have really enjoyed the past issues of *Hambrew*. Like the construction articles. I know it takes a lot of room, but sure would like to see the circuit board layouts. Have had very good luck with Techniks, Inc. Press-N-Peel transfer film. So I make a number of my own circuit boards.
Anyway, fine magazine. Tnx.
73
Marvin Holmes, WØYHE
Newport, MN

Found at least four errors in your "Toroid Turns" article - Summer, 1995 issue:

1. P-23 - Under "example" 28 turns =* 20 turns

2. $100 \times \sqrt{\dfrac{\text{Al of specified core}}{\text{Al of specified core}}}$ =*

   $100 \times \sqrt{\dfrac{\text{Al of specified core}}{\text{Al of substitute core}}}$

3. P-24 substitute toroid
   Amadon (sic)
   T T T T T T
   50-2 37.2

* should be =*
   T T T T T T
   50-6 37-6

D. B. Lones, KC6WZK
Palos Verdes, CA

News From Borneo Island

Hi George,

Just got my summer 95 issue of *Hambrew*. Articles are indeed getting better by the issue. Though most of the construction projects are related to QRP concepts, I think it is natural to go back to the basics. My subscription will be expiring in 1996, and I will sure renew it again. I wonder if any of your readers know of any Multi-band HF antenna designs which can hang up and operate any where in the jungle or portable. Maybe one end tied to a tree and the other end fixed with multi-taps loading coil(sloping), so that one can change band by just clipping to the right tappings.

72/73

Siong, 9M8ST

Borneo Island

Has anyone loaded a sloper in this fashion? Sounds like a good idea!

Received my first copy of **Hambrew** and look forward to future issues. I have invested in all the ARRL books on construction and found them to be informative and a good source of instruction.

So far I have built, from kits in some cases, dummy load audio filter, DC power block, two regen receivers, signal tracer, continuity probe, artificial ground, wattmeter, ATU, CW filter, and marker generator, plus a few more pieces of test equipment.

I have come to the hobby late in life and find study is not as easy as it was years ago.

However, most of my experience has come from building kits. Some instructions are lucid, well explained, and with some effort I'm able to comprehend the why and what from the instructions and schematics. Why not run a series on basic construction, for example, wiring of components, potentiometer, air variables, 12-position switches, etc. — all those not covered in the ARRL books?

Working on my general license — oh, that morse code! — and hope to get on the air soon with my own home-built ARK 40, which is about finished.

Charles A. Fiford

KD4YLG

Longboat Key, FL

I need this like I need a set of dentures, but, to paraphrase my father in one of his less lucid moments, it may be my only source of heat. I'm writing...for a one year subscription to *Hambrew* magazine...I'm not sure if I'll put any of the info in your magazine to use. Since I joined the bifocal league, it takes a h.ll of a lot of effort for me to get the iron and tools out. Still, it is fun--once I get things running -- and besides, that soldering iron may be my only source of heat.

73,

Nils R. Bull Young, WB8IJN

Medway, OH

I don't understand why on earth I didn't subscribe to **Hambrew** sooner. It's the only publication that seems to cater to my particular brand of ham radio. QRP, CW, and a dream builder magazine put new life into what is now a fifty-year hobby. As we are fond of saying here in Arkansas: a big bunch o' fun.

I am currently operating one-watt single-banders on the 20 and 30 meter bands and building one for 40 while looking forward to a low-power transceiver for six. I have never worked this band but it looks attractive. Also spending a bit of time in an effort to make my station commercial-power-independent with solar charging.

Keep 'em coming and think morse.

Robert W. Bowman

AA5V3

Norfolk, AR

MOVING?

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

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 ($8 International), issues published after Fall, '94 are $3.50 ea. ($6 International) mailed in an envelope via first class mail. The Winter and Spring '95 Issue are sold out and are now collectors' items. Supplies of the other back issues are limited.

6 Meter Articles Wanted!

Six meters is a neglected band. We at Hambrew want to encourage building for and use of the 50 MHz portion of the spectrum. If interference is a concern, and in many cases it is, we encourage prudent filtration and operation on QRP levels,all modes. Please help us do our part to preserve the 6 meter band through your input. If you or someone you know has designed or built 6 meter equipment, we want to pass along the information.

(Continued from page 39)

enclosures, connectors, knobs, etc., and you are on the air. The 6 meter transmitter kit is available from Kanga US for $32.

Also mentioned in this article and available are the 6 meter converter ($21), the SUDDEN Receiver ($32), and the dummy load / RF indicator ($12).

A catalog of all the Kanga Kits is available for $1.00 from

Kanga US
Bill Kelsey - N8ET
3521 Spring Lake Dr.
Findlay, OH. 45840

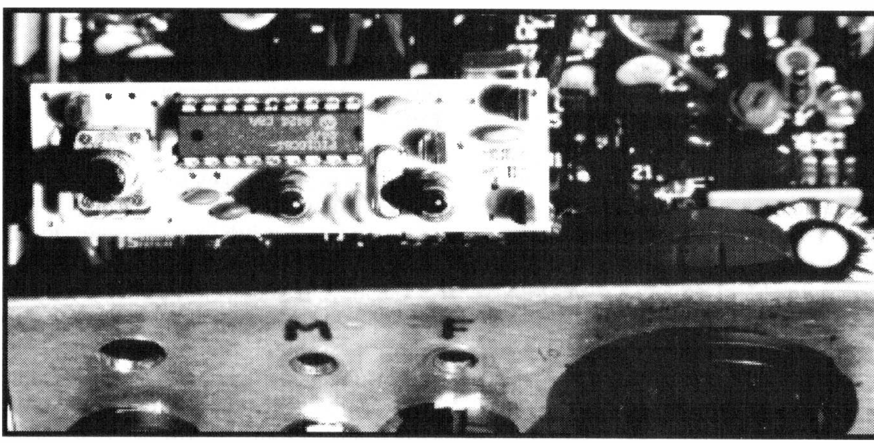
Bill Kelsey - N8ET Kanga US
kanga@bright.net
419-423-4604
HTTP://qrp.cc.nd.edu/kanga

KIT REVIEW

Wilderness Radio KC1 Keyer/Frequency Counter Kit

Stan Cooper, K4DRD

3214 Countryside Drive
San Mateo, CA 94403



Wilderness Radio has combined two valuable accessories for use with QRP transceivers into a small, inexpensive kit. Designed by Wayne Burdick, N6KR, the KC1 Keyer/Frequency Counter kit uses a reprogrammable PIC16C84 microprocessor and some discrete components to function both as an iambic keyer (Curtis A and B modes) with message memory and a frequency counter which, through the use of programmable VFO offsets, is flexible enough to be used with virtually any rig, superhet or direct conversion, single band or multi band. Only three controls are required: the keyer speed potentiometer (SPEED), a memory message play/record momentary pushbutton (MSG), and a frequency read/search momentary pushbutton (FREQ). Except for these three panel mounted controls, all communications between the user and the KC1 is accomplished through the keyer paddles.

Physical Arrangement

All components, including the three controls, are mounted on a single printed circuit board which measures 2.5" x 0.8". The very small size makes the KC1 suitable for installation in just about any transceiver. The KCl has its own onboard 5 volt regulator, and draws about 4 mA of current from a 7 volt to 16 volt DC supply.

The photographs show the prototype KCl mounted in a prototype NorCal 40A transceiver, and this is the configuration tested for this review. Between ten and fourteen connections between the KC1 and the transceiver are required. These include power, ground, keyline, keyer paddle inputs (dot and dash), VFO pick up and VFO ground, audio out and audio ground, and receiver mute output. Additional optional connections include handkey input, an auxiliary logic level output (which might, for example, be used to switch in and out a narrow bandpass filter with a keyer paddle command), and two BAND connections for selecting one of up to four user programmable VFO offsets for use in multiband rigs. Although individual wires routed on top of the NorCal 40A's PC board were used in the prototype, a neater installation could have been achieved using ribbon cable routed between the chassis bottom and the PC board.

The Keyer

The keyer features both Curtis A and B iambic (squeeze keying) emulation modes. For readers not familiar with the difference between these two modes, when both paddles of a type A iambic keyer are squeezed, the keyer produces a string of alternating dots and dashes. If the dot paddle makes contact before the dash paddle, the resulting string will be "di dah di dah di dah..." If the dash paddle leads the dot paddle, the keyer produces a "dah di dah di dah di.." string. When the squeeze is released, the element (dot or dash) being sent is completed, but nothing else follows.

In type B iambic mode, when the squeeze is released during an element (dot or dash), the keyer generates an alternate element following the element being produced. If, for example, the squeeze is released during a "dot", the keyer will generate a "dash" following the dot.

The keyer speed range is from approximately 7 wpm to 50 wpm, but the high end can be changed by changing the value of capacitor C1 if desired. Keyer commands are entered via the keyer paddles after putting the KC1 into Command mode. To put the KC1 into Command mode, both momentary pushbuttons are depressed simultaneously until the letter C is heard in the receiver audio. The KC1 then waits for the user to enter a command, usually a single character, and responds with a confirmation of the new setting. If the user command is not recognized, the KC1 responds with a question mark. To exit the Command mode, the user may momentarily depress either button, or use the D (done) command from the paddle. If the D command is used, the KC1 responds with R as an acknowledgment.

The keyer commands:

I Iambic mode A or B (toggle*). A is the preprogrammed default.

K Key the transmitter continuously (Tune-up); press either paddle to stop.

Qn Set QSK (break-in) to <n>, where n is 0 (no delay) to 9 (about 1 sec delay). De fault is 0.

S Report the current speed in WPM. T Turn sidetone On or Off (toggle*). Default is On.

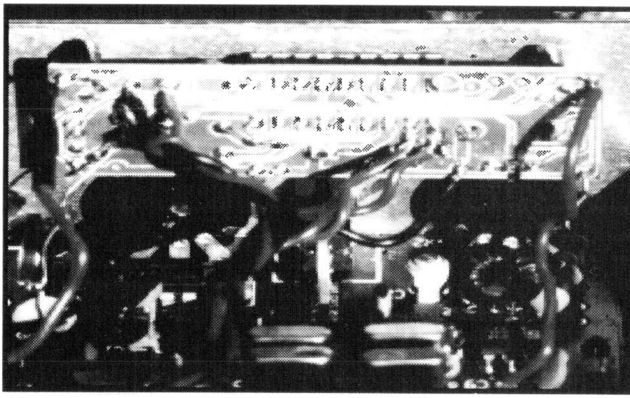
Wn Set the keying weight to <n>, where n is 0 (light) to 9 (heavy); medium weight is about 4. Default is medium.

Where numbers are sent, as in the QSK delay and keying weight, the KC1 interprets 'T' as '0', and 'N' as '9'.

* Toggle means switch from one setting to the other each time command is entered.

The message memory in the KC1 is about fifty characters long, and this may be partitioned into multiple messages using end-of-message markers. To record a message, the MSG button is depressed and held until the KC1 responds with a M. The message is then entered from the paddle. If the message is too long for the memory available, the KC1 reports F for full. When the message has been successfully entered in memory, the MSG button is again depressed momentarily to tell the KC1 the message is complete. To hear the message as it is stored in memory, press the MSG button once more. When multiple messages separated by end-of-message markers are stored in memory, the MSG button is pressed one or more times to skip over prior messages. A "word repeat" macro allows repeated words, such as would be used for CQ and a callsign to be stored using minimal memory. For example, in the message "CQ CQ CQ DE K4DRD K4DRD K4DRD K", the word repeat macro could be used for the second and third CQs and the second and third K4DRD, thus conserving memory.

As one who has not used memory keyers often in the past, I was surprised to hear word spacing in my played back message when I had intended character spacing. It finally dawned on me that I had been too cautious in recording my message, and that had resulted in erratic spacing in memory. When I relaxed and keyed the message naturally, as if transmitting on the air, the erratic spacing cleared up. The KC1 uses a threshold of 2.0 dot units to differentiate between an element space and a letter space. Standard Morse uses 1 and 3 dot units for spacing between elements and characters, respectively.



The Frequency Counter

The frequency counter reports the operating frequency in the transceiver's audio to the nearest kilohertz as three digits of Morse code when the frequency read pushbutton is depressed. The complexity, cost, panel space, and multiplexer hash noise usually associated with digital frequency displays are eliminated by using this technique.

The KC1 counter counts the transceiver's VFO frequency, then adds it to (or subtracts it from) a three-digit offset entered in the command mode. This technique permits the KC1 to accurately report the precise operating frequency regardless of whether the VFO runs "forwards" or "backwards" with respect to the operating frequency. For direct conversion transceivers, the counter is simply programmed with a "000" offset. Since multiband transceivers can have two or more different band edges as indicated by the 1OO's of kHz digit (such as 1800, 3500, and 7000 kHz), the KC1 provides two BAND inputs to select one of up to four offsets so that the correct frequency will always be reported. With both BAND inputs left open, offset 3 is selected (default for single band rigs). With both BAND inputs grounded, offset 0 is selected. Grounding only BAND1 selects offset 1, while grounding only BAND2 selects offset 2.

The offset for a given BAND is programmed into the KC1 by entering the command mode, then sending the letter "O", followed by a number 0 through 3 (one of four BAND offsets), followed by the letter A (Add) or the letter S (Subtract), followed by three digits representing the number of kHz of the offset. As an example, the NorCal 40A is a monoband (40 meter) superhet rig with an I.F. of 4.915 MHz. The VFO frequency is added to the I.F. to determine the operating frequency on transmit, so the KCl offset is simply the last three digits of the I.F., or 915. Since this is a single band rig, we use offset 3, which is the offset selected when both BAND inputs are left unconnected. The command to be entered for programming the VFO offset for the NorCal 40A is therefore "03A915".

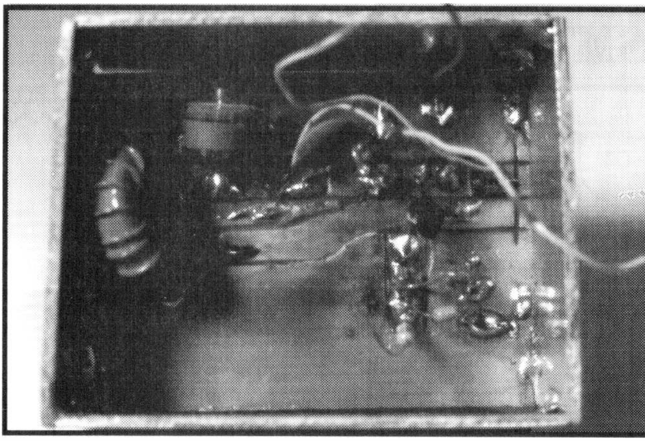
To determine the operating frequency of the transceiver, the user simply depresses the FREQ button briefly. The KC1 responds with a three digit report of the operating frequency to the nearest kilohertz.

A thoughtful feature is the frequency search mode. This is valuable when looking for a net frequency or when wishing to "mark" a band edge. A long press of the FREQ button will put the KC1 into frequency search mode. The KC1 acknowledges by sending an F. The user then sends a three digit frequency (in kHz) to search for. When the transceiver is tuned to within +/- 2 kHz of the (Cont.pg. 39)

MSMT-VFO: Modified Surface-Mount Technique

Kenneth Payton, KB5RQV

Box 400, Groom, Texas 79039



I now refer to this technique as MSMT (Modified Surface-Mount Technique). This installment will show how to build a VFO that can be used from HF through VHF and, with great care, up to UHF. It is not as stable as UHF as when using multipliers that use a lower fundamental frequency, but this is to be expected. All other fundamental oscillators at UHF are unstable, unless it is crystal-controlled; then it is an overtone oscillator.

First, a few things to consider in constructing a VFO:

1. All components need to be solidly mounted. The coil needs to be stabilized by coating with coil dope or something to keep the windings from moving even the smallest bit. Any movement in the coil windings will cause instability.

2. Use regulated voltage to power the VFO. Any variation in the supply voltage to the VFO will cause it to be unstable.

3. Isolate the VFO from the load with a buffer amplifier. This will stabilize the load on the VFO and prevent the load from "pulling," causing variation in the frequency.

4. Isolate the VFO from the other circuitry as much as possible. This will help control the VFO temperature and also any magnetic variations from the other circuits. It is a good idea to enclose the VFO in its own shield.

5. Use only single-sided copper-clad board for the VFO. Double-sided board forms a capacitor which upsets the whole circuitry. When mounting the VFO on a metal chassis, use some form of stand-off to reduce the capacitance, such as 1/4" (minimum) wood.

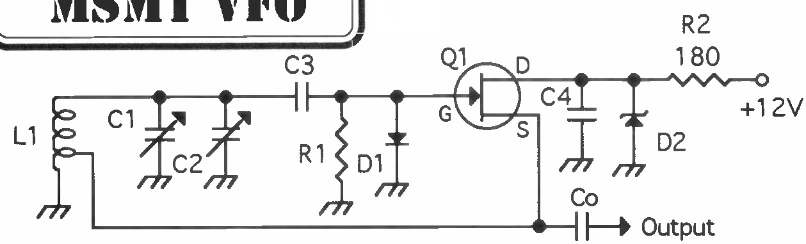
The *ARRL Handbook*, the books by Doug DeMaw, W1FB's *QRP Notebook*, W1FB's *Design Notebook*, and *Solid State Design for the Amateur* are all excellent reference material; all of the above points are from these publications. I recommend that you purchase and study each of these. All of the circuits that I build are from these as well as other references.

Figure 1 shows the diagram of the VFO that we will build this time. It is a standard Hartley oscillator and can be built to the frequency of your choice. I have built this VFO as an oscillator for some experiments in FM on 6 meters and found that the stability was sufficient for my use, but I will next build a buffer with which to follow it instead of going straight to an antenna. Refer to the table in the box below for values to use for various frequencies. The tap on L1 should be at 25 percent from the ground of L1 for all frequencies.

careful because sometimes the component density is too great to work with. Leave room to mount L1 at the mid-left section, mark a line to the right that is about an inch long, then make a mark from the left edge down about 1/4". Extend this line to the right about an inch. What you should have looks like an elongated "U" that is laying on its side.

Now check the size of the coil form, and

MSMT VFO



Tap L1 near ground connection
(see chart)

	L1	C1	C2	C3	R1	D1	C4	D2	Co
80m	51t #26 T68-2 Tap @ 12t	200pF	25pF	200pF	100k	1N914	0.1	6v/1w	50pF
40m	27t #24 T68-2 Tap @ 6t	100	25	100	100k	1N914	0.1	6v/1w	50pF
20m	14t #24 T68-2 Tap @ 4t	100	25	50	100k	1N914	0.1	6v/1w	50pF

Refering to the schematic above, you will see that the circuit is really straightforward and simple now that we know how to keep from working on both sides of the board. You can see how this circuit would be more work by using vector board or by designing a standard foil pattern and etching.

I will go in steps to describe how to make the circuit for the VFO. After this, you should be able to design your own circuits using this technique.

On a piece of paper, draw a 2" x 3" rectangle which will represent the circuit board. This is a bit large for this circuit, but makes it easier to build; after some experience, you will able to build this on a 1" x 2" board. You need to be

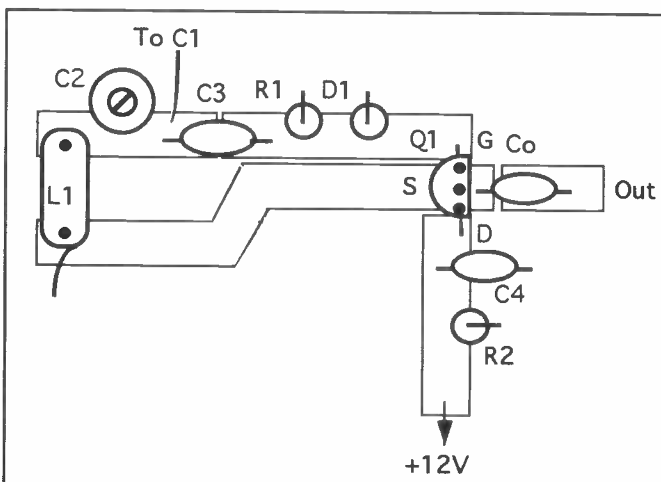
mark another channel just like the first, below the top one but separated by the diameter of your coil form. What you now have looks like "UU" from the side.

Check the position of the padder capacitor C2. Make sure you have enough room for it and to attach a wire to the tuning capacitor C1 before making the separation cut for C3. Make the cut for C3, then extend the upper foil to the right. Make sure you have room for R1, D1, and connection for the gate on Q1.

Now extend the lower lines to the right for connection to Q1 source. Note that I have narrowed the separation between the two conductors to make it easier to mount Q1 due to the limited lead spacing. Draw the lines for the source a bit more to the right of the gate lines so you will have room to mount the output capacitor. Draw lines at the ends of the conductors to isolate from ground.

You now have the connections for the gate and source circuits of the VFO; all we need now is the drain circuit.

For the drain circuit, draw the conductor about 1/4" wide and 1" long toward the bottom of the board; this will give you enough room for mounting C4 and R2 and connection to +12 volts power. Now add the conductor from the source to the right for the output capacitor Co and the output point.



You should have a drawing that looks like that of figure 2. It can look different as long as all of the required parts are present.

Check the drawing carefully and make sure you have all of the required circuit runs and room for all of the parts. Now you are ready to cut the board. Using a sharp hobby knife and straightedge, start making the cuts and grooves to make the isolated pads. Make sure that the foil is removed in all the right places, then put on all the components. Figure 2B shows how the leads are bent for mounting. Remember to use a heat sink on D1, D2, and Q1 so they are not destroyed by heat when soldering. I find it helpful to first tin the leads and the copper where they go; then it takes only a very short touch of the iron to make the connections.

When you are sure that everything is as it should be, apply power and check the output with the RF probe of the first project. You should have at least 1 volt RMS at the output and be able to hear and tune the VFO on a nearby receiver. If not, find the trouble and "shoot it."

After building these two projects, you should be able to build anything you need for your QRP station, etc. This method will work with ICs, too. You need to make smaller cuts to match the lead spacing of the IC; it is a little harder due to that fact, but very workable.

As you can see, it is easy to change components and to measure voltages, etc., when using this method of construction. There is not any real reason to cut the leads of new transistors so that they are short, as they will work very well with the original length. You can also use salvaged components, as the shorter lead length does not prevent them from being used. Just apply a bit of care when working with heat-sensitive components.

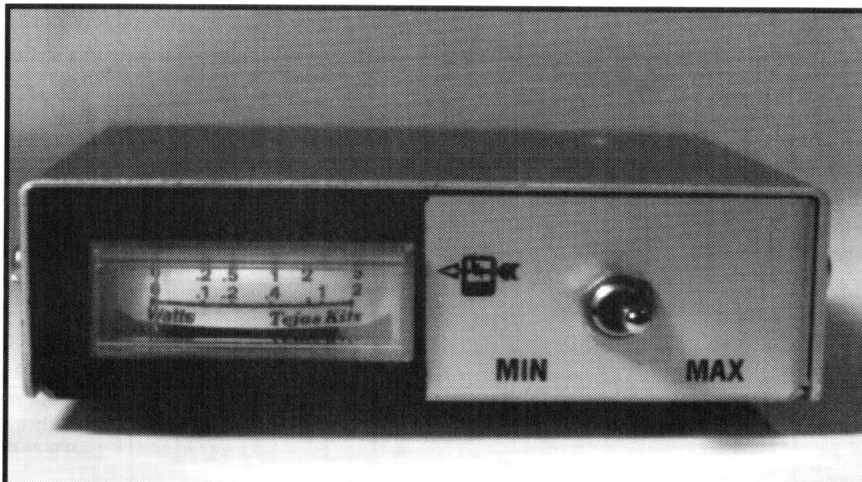
I hope that this helps with your building and that you will try it and see just how easy it is to build circuits. That is the reason that I developed and use this method. I have built a 40-meter QRP transmitter by this method; it is very stable and works like a charm. I had to test different components in order to optimize some of the circuits, and this was a breeze without having to unwrap connecting wire or unsolder leads from standard PC construction.

73 and good luck!

QRP Dummy Load Accessory

Bill Hickox, K5BDZ

Tejas Kits
9215 Rowan Lane
Houston, TX 77036



K5BDZ meter circuit in a modified Tejas Kits case. There is a jack on the back panel to terminate the signal in the dummy load (see photo, page 16).

How 'bout 'nother K.I.S.S. article from'BDZ? No, that ain't Hollywood bar pick-up talk! It's a long standing QRP motto, and stands for Keep It Simple, Stupid.

Tejas Kits originally planned to offer a Dummy Load kit called the Model DL5W. *This kit was not brought to market and is not available*. However, we now share with you the simple design and some of the fun uses, applications and connections of this simple but highly useful piece of test equipment. You can build your own, either perf board, ugly style, or even fabricate your own PC board versions.

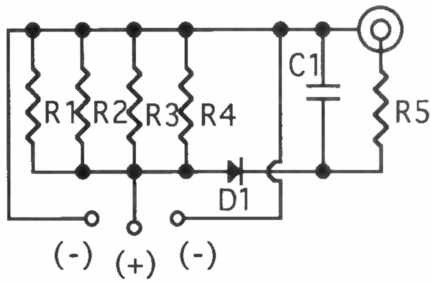
For such a simple piece of equipment, this smart little dummy load has numerous uses. Obviously, it can be used as just a dummy load connected to your transmitter output thru an outboard SWR or Watt meter. It can also be connected to a frequency counter, oscilloscope, DMM, or just a mA meter. Output(s) can be calibrated or not. Output coupling(s) can be varied and multiple, depending on your connected device. Some of the various connections can be found in Figures 1-4.

Power Handling. I use 2 watt film resistors from Mouser Electronics, and have run as much as 20 watts through the dummy load. Resistors R1-R4 get warm, but no more resistor heat than my fingers could stand to the touch. I do mount the resistors about the thickness of a dime off the PC board in order to

Tejas Kits **™**

Model DL5W

Dummy Load / RF Sensor



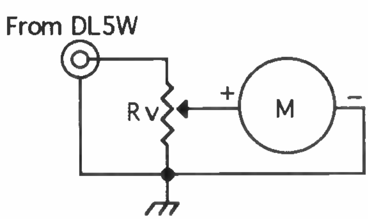


Figure 1

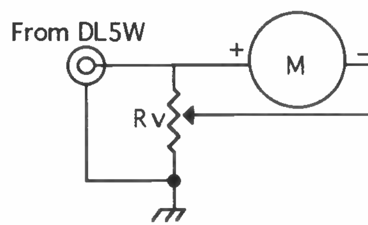


Figure 2

allow air to circulate and cool. Other mounting methods can be used, including mounting against the PC board, with silicon grease between board and resistor to increase heat transfer from the resistor to the board. Keep all resistor leads as short as possible!

Now, let's make a simple yet fancy multi-functional, multi-use, multi-output piece of test equipment!

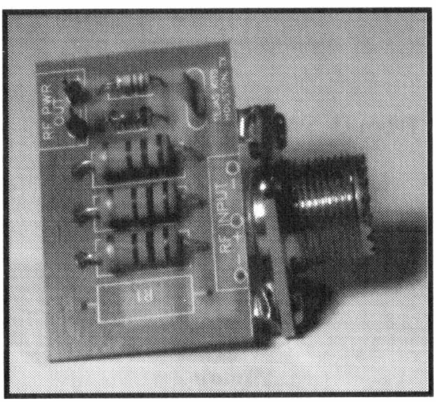
Connections. The original DL5W schematic as well as Figures 1 thru 4 show a few of the connections you can utilize with this circuit. R5 can be a fixed value if only one fixed output level is needed. When variable output is needed, you can replace - or short out - R5 and substitute Rv, as in Figure 1 or Figure 2 (I prefer Figure 2). Figure 3 can be used separately or in addition to R5 / Rv when connecting a 'scope or Digital Frequency Counter. Please note the small value capacitor. In initial testing, I suggest not going above 10 pF unless measuring less than 100 mW levels. If R5 is left in the circuit, connect Ca to the input side of R5, thus bypassing the R5 and later circuits.

Figure 4 is how I connected my multi-scale QRP wattmeter. In figure 4, Rv3 should be adjusted for the minimum power scale, with Rv1 and Rv2 for higher scales. On my mini-wattmeter, I adjust Rv3 for the 2 watt scale, Rv2 for the 5 watt scale, and Rv1 for the 10 watt scale.

Finally, for approximate measurements you can use a panel- mounted pot as in Figure 1 or Figure 2, note on your panel pot settings for different watt levels, and have a continuously variable meter for QRPppp "in-circuit" testing, as well as final transistor output levels.

I have used Tejas Kits 500 μA meters and obtained full scale readings down to the 200 mW levels (I have not tested below this power level), so don't ignore a 500μA-range meter thinking you "must have" a 100 or 200 μA range meter.

Packaging: I built my different DL wattmeter test systems using an edge mount 500 μA meter (*Tejas Kits*) into a *Tejas Kits* Model 13 mini enclosure. When that enclosure was too small for all the front panel controls needed, I



DL5W dummy load sans meter

would then use the slightly larger *Tejas Kits* Model 14 mini-enclosure.

Model 13 mini enclosure (1 1/16" H x 3 1/2" W x 3" D)

Model 14 mini-enclosure (1 5/16" H x 4 1/8" W x 3 1/4" D).

Comments. What is a dummy load? Sure you know the answer. It's a proper resistance termination for the circuit under test! Does that always mean 50 ohms? No. Ever connect a frequency counter to test an unterminated crystal or VFO output circuit? Sometimes the DFC gives an accurate reading, sometimes it "does it's own thing" like a 1969 Hippie, until you remember to terminate the circuit by connecting a resistor - hopefully some value near the range of the circuit output impedance - across the circuit output. As a very general rule of thumb, especially in RF circuits, circuit outputs terminating into other than proper loads prefer to terminate into higher rather than lower output impedances (resistances) with fewer resulting "squirrels" or problems. To minimize problems when testing your circuits, remember to terminate that circuit before testing.

I have used this wattmeter circuit connected thru a 2 foot long piece of RG174 (50 ohm) coax to a home-made terminated RF probe to test various circuit outputs.

Low or no PA final output from your transmitter? Use this DL circuit to test your PA

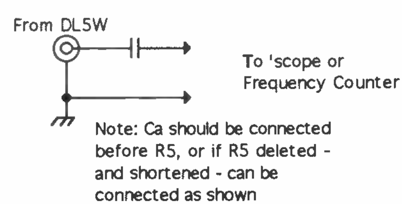


Figure 3

driver output and measure driver circuit power or peak driver circuit for maximum output.

The Dummy Load circuits described in thls article can make smarter builders even smarter. You can even add the pick-off circuits to your QRO (Heaven forbid!) dummy load by simply changing the value of D1 to something like a 1N4007 (1000v, 1 amp) and the increasing voltage rating of C1 to a higher voltage rating. Since you now better understand its uses, you can change the meaning of DL to Calculated Calibrated Output Indicating Device. Ain't no "dummies" here!

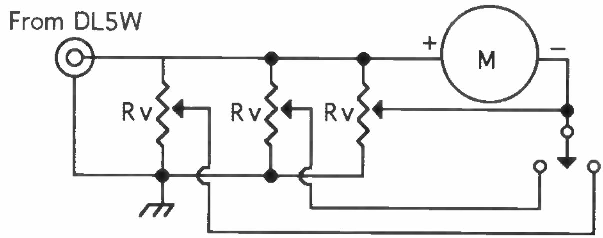


Figure 4

Tejas Kits
Model DL5W

Parts Lists

DL5W

Rl - R4	50 ohm DL5W, use 200 ohm 2 Watt Film Resistors 75 ohm DL5W, use 300 ohm, 2 Watt Film Resistors (Mouser Electronics)
D1	1N34A or 1N270 or US270 germanium doide 1N34A Radio Shack US270 Tejas Kits
C1	.01 μF fixed capacitor, ceramic, poly, etc.
R5	see text (value depending on circuit use)

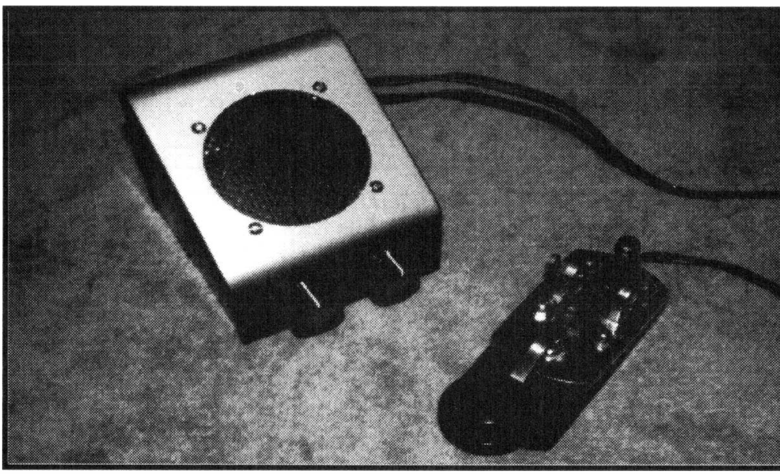
Figure 1, Figure 2, Figure 3, and Figure 4

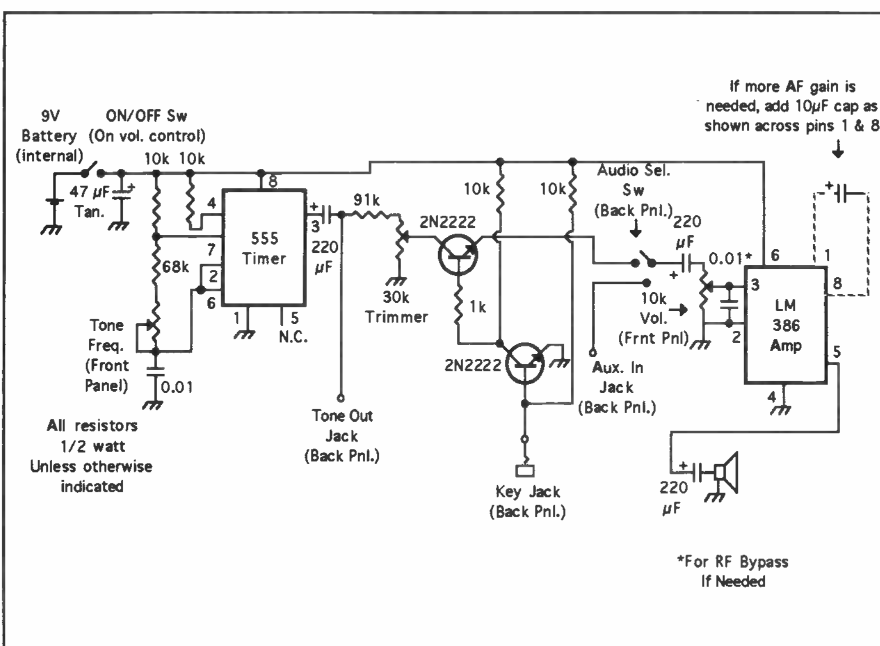
Rv	10 K to 47K pot (panel mount or trimpot)
Rv1 - Rv3	47K trimpot, miniature (Tejas Kits)
M	Meter, 50 μA to 500 μA, builders choice (see text)
Ca	3 pF to 10 pF (see text)
S 1	Miniature Toggle Switch SPDT, center "off" {Mouser Electronics)

A Morse Code Oscillator and Utility Audio Amp.

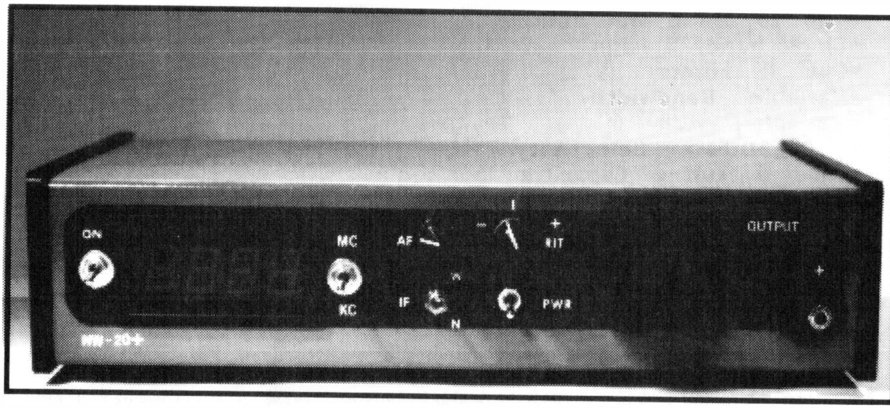
Charles S. Fitch, W2IPI

45 Sarah Drive, Avon, CT 06001

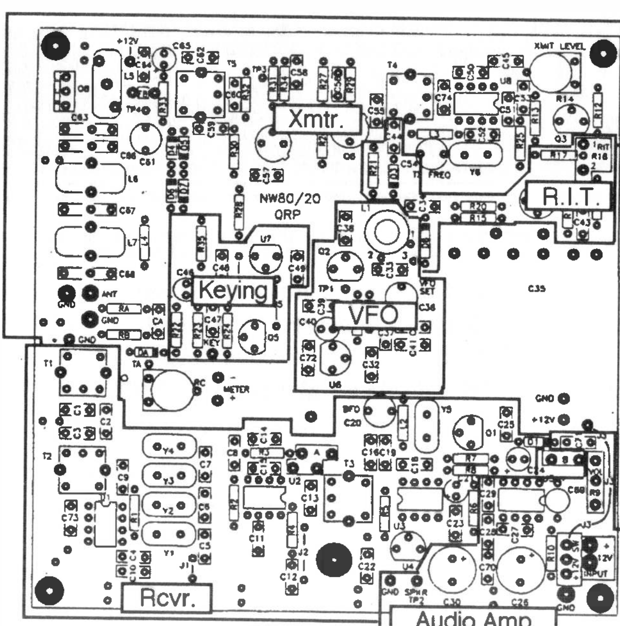




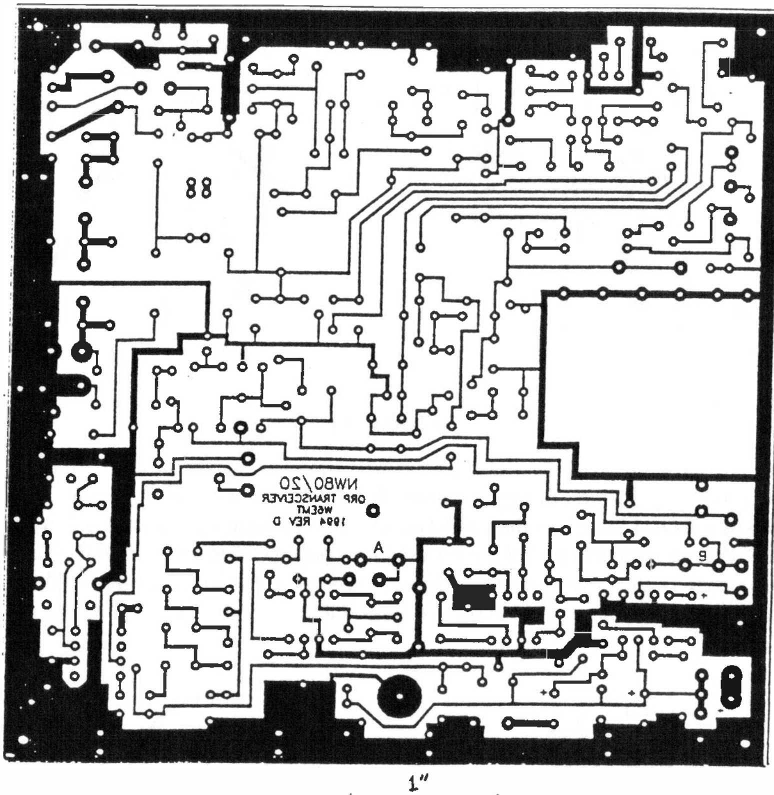
The W6EMT NW 80/20 Transceiver



The Roy Gregson-designed NW 80/20 with digital display added (Hambrew, Summer, '95).

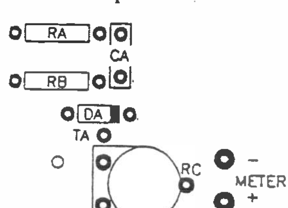


Transceiver Sections

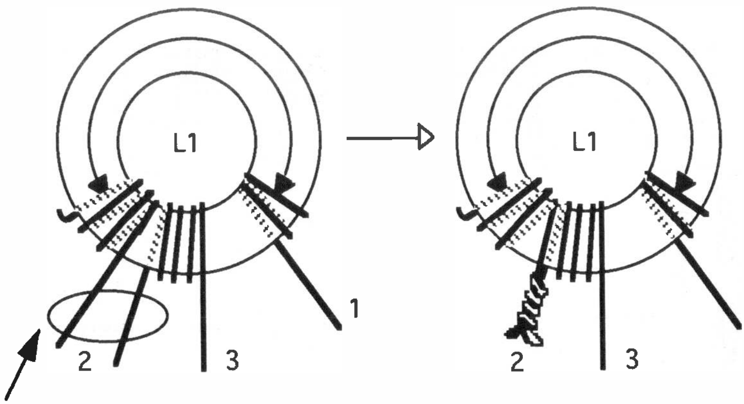


RA, RB: 1k resistors
CA: .01 μF ceramic or mylar capacitor
DA: 1N4148 or 1N914 diode
RC: 50k potentiometer
Solder a scrap wire to test point TA

Temporarily connect the meter to the + and - pads near the pot. Connect a clip lead on test point TA near diode DA to the speaker output. Tune in a steady signal or a signal generator, and peak T1, T2 and T3 for a maximum meter reading. It may be necessary to adjust pot RC for a proper indication. Disconnect the clip lead.

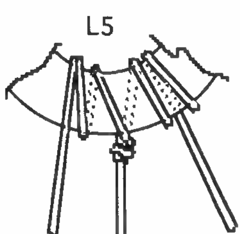


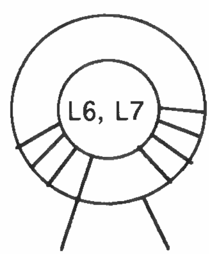
Meter Option



Winding L1

Per the band table, select the core and wind the number of turns for the specified band using #30 wire with a tap at 4 turns from ground end. Wind all but the last 4 turns. Trim the remaining wire leaving about 1 inch from the #2 end on L1. From the wire just trimmed off, cut a piece about 5" long and strip about 1" of the varnish from it and the 1" from the #2 end of L1. Twist these two ends together. Remember that the wires must go through a PCB hole. Solder lightly. Wind the remaining 4 turns on L1. Trim the wires at the start and finish of L1 #1 and #3. Strip off the varnish.



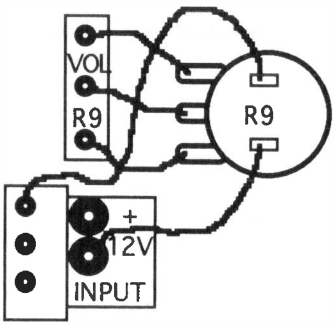


L5: Twist together two 14" lengths of the #24 wire to about 5 turns per inch. Wind 7 turns on the black FT50-43 core evenly spaced for the 80, 40, 30 meter bands. For 20 meters wind 5 turns on the small black FT37-61 core. Trim the wire ends to 3/4", untwist, and strip off the varnish close to the core. With an ohmmeter, find one wire on the start and finish of the winding where no continuity is shown. By connecting the remaining wire ends you should observe continuity. Prepare as shown.

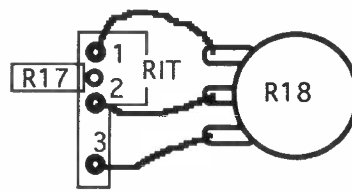
L6, L7: Per the band table, wind turns evenly on the red T37-2 cores and strip the wire ends as above.

T1 through T5: The transformers are modified per the Band Table by removing the internal capacitor if required. The cap is located on the bottom of the transformer and is easily removed or disabled just by breaking it, as it is thin ceramic.

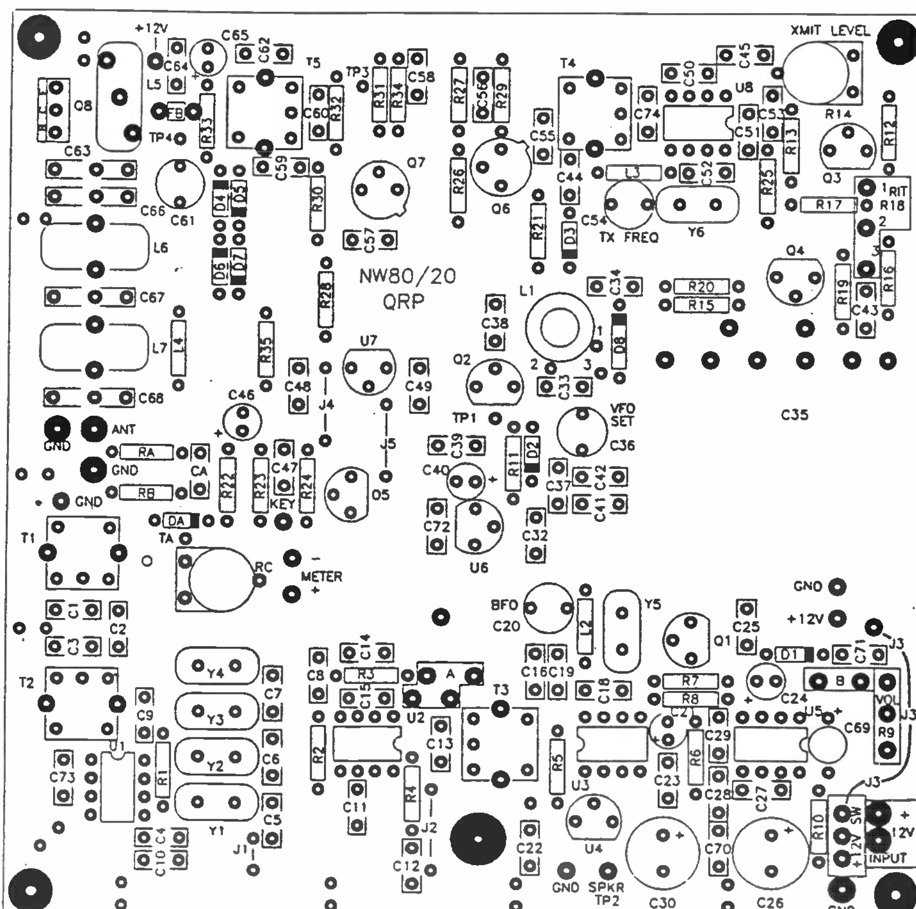
AUDIO AMPLIFIER



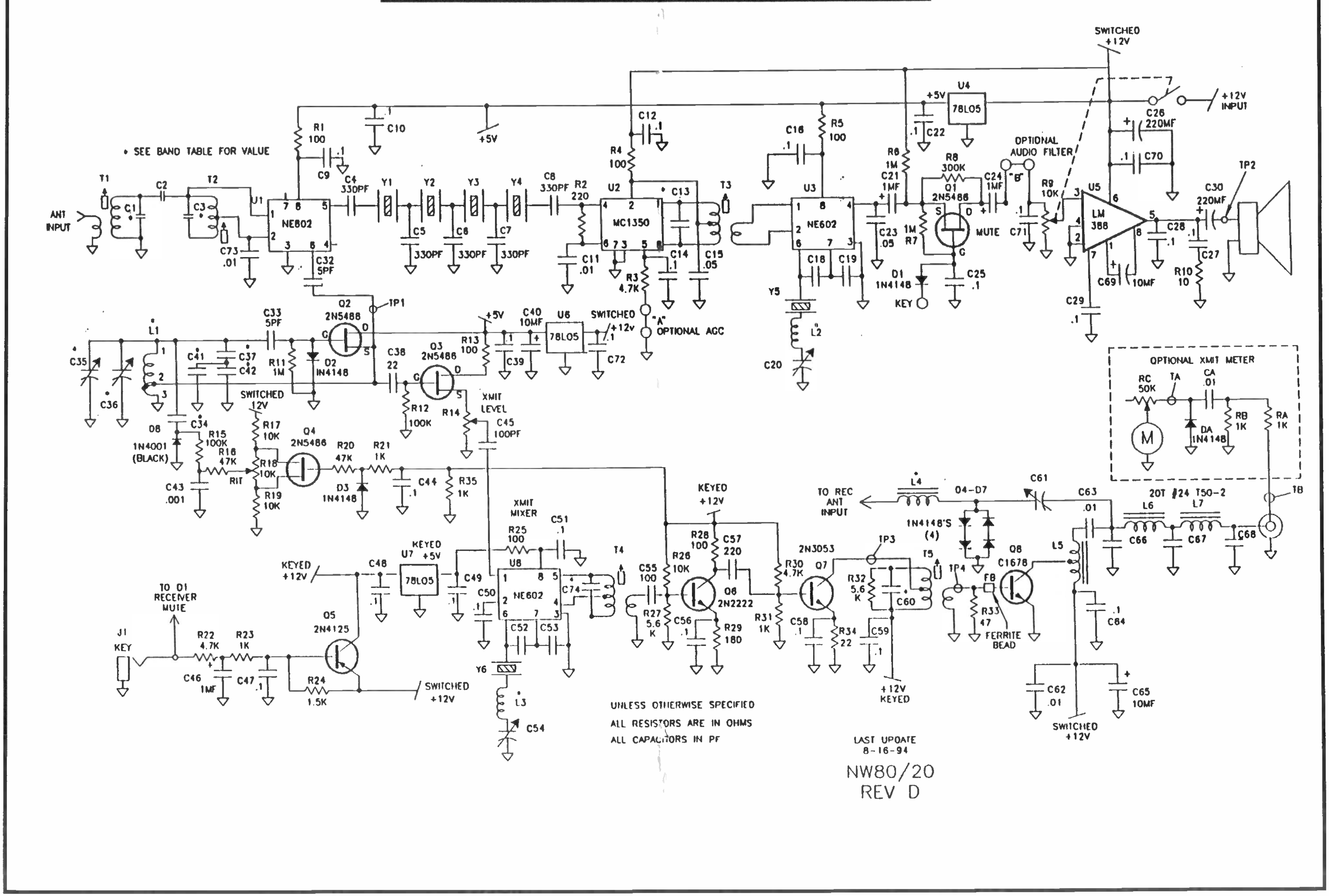
RIT CIRCUIT



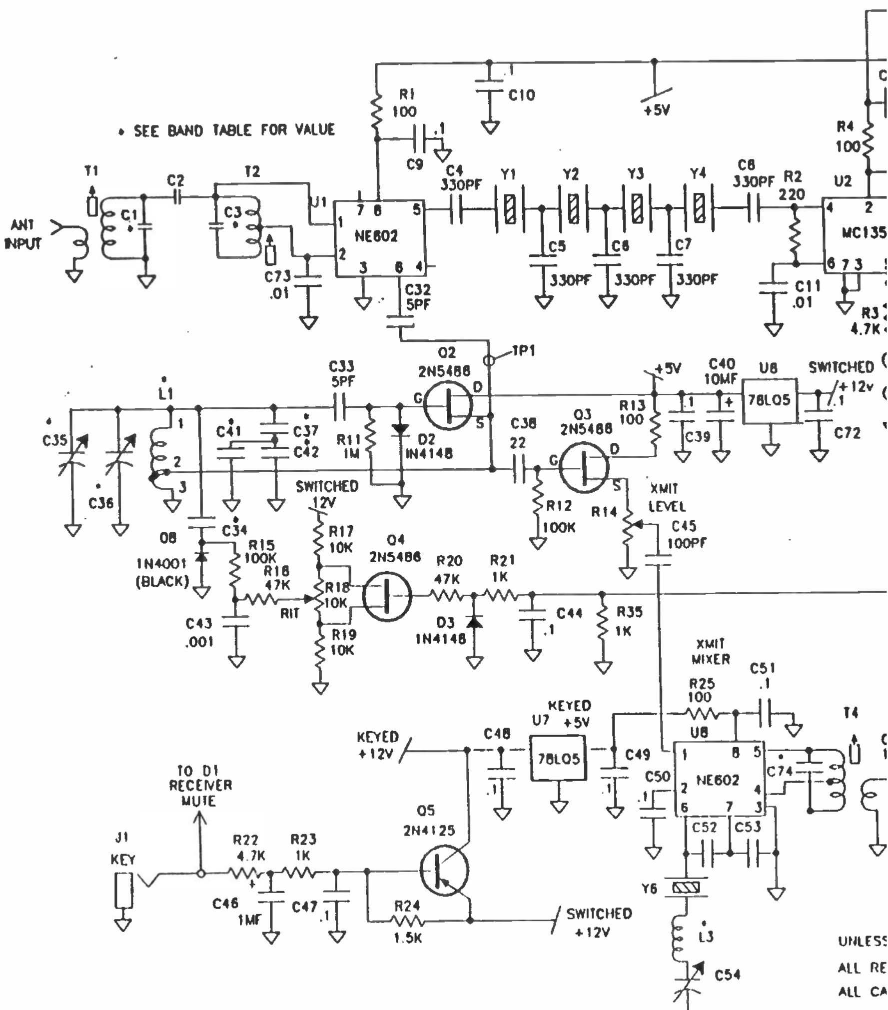
Parts Placement



W6EMT NW 80/20 XCVR

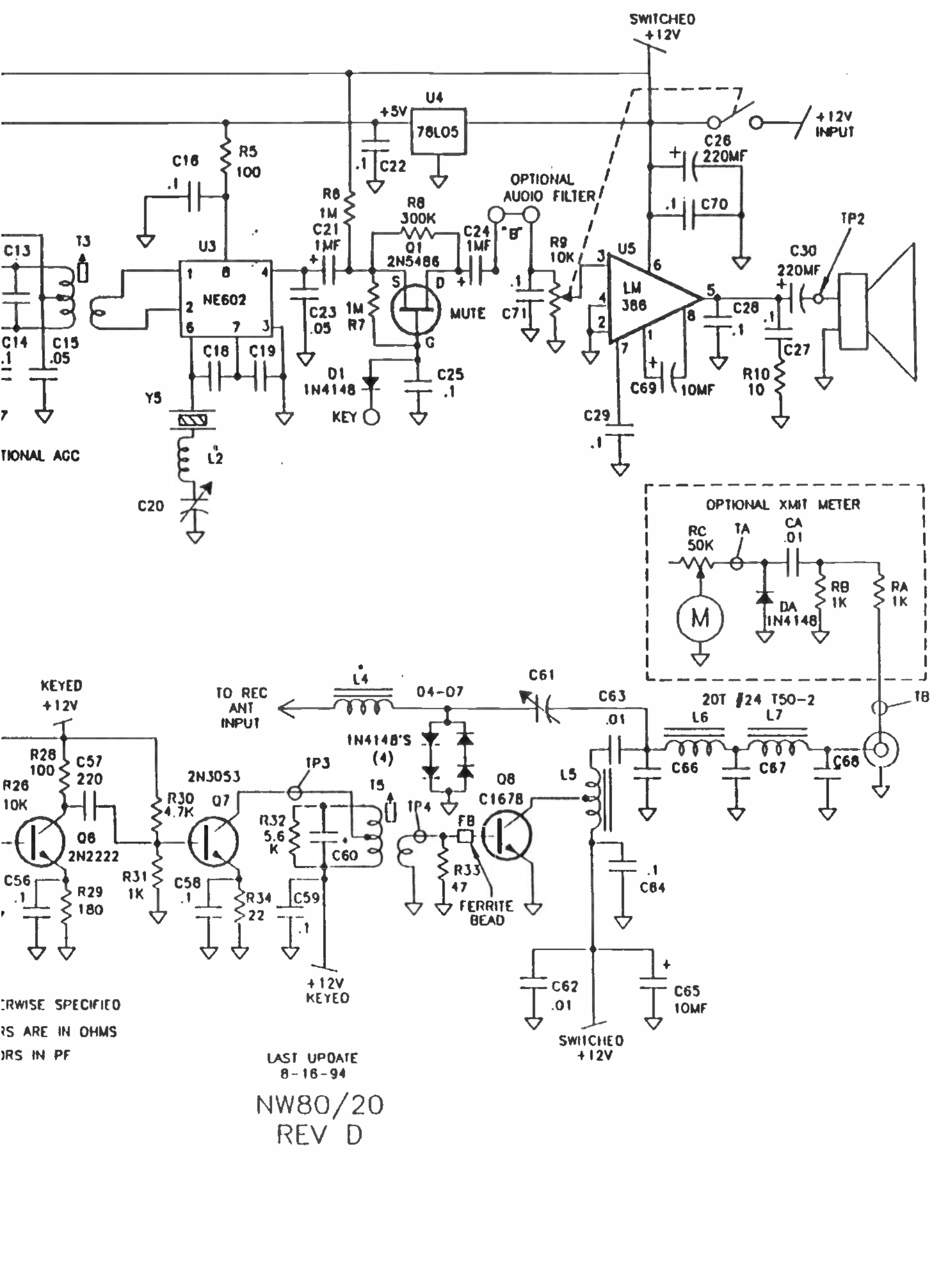


W6EMT NW



• SEE BAND TABLE FOR VALUE
ANT INPUT
T1
C1
C2
T2
C3
U1
NE602
C73 .01
R1 100
C9
.1
C10
+5V
C4 330PF
Y1
Y2
Y3
Y4
C5 330PF
C6 330PF
C7 330PF
C8 330PF
R2 220
R4 100
U2
MC135
C11 .01
R3 4.7K
C32 5PF
TP1
Q2 2N5486
C33 5PF
L1
C35
C36
C41
C37
C42
R11 1M
D2 1N4148
C38 22
Q3 2N5486
R13 100
+5V
C40 10MF
U6
78L05
SWITCHED +12v
C39
C72
R12 100K
R14
XMIT LEVEL
C45 100PF
D8 1N4001 (BLACK)
C34
R15 100K
R16 47K
RIT
C43 .001
SWITCHED 12V
R17 10K
R18 10K
R19 10K
Q4 2N5486
R20 47K
R21 1K
D3 1N4148
C44 .1
R35 1K
XMIT MIXER
R25 100
C51 .1
T4
KEYED +12V
C48 .1
U7
78L05
KEYED +5V
C49 .1
U8
NE602
C50 .1
C74
C52
C53
Y6
L3
C54
TO D1 RECEIVER MUTE
J1 KEY
R22 4.7K
R23 1K
C46 1MF
C47 .1
Q5 2N4125
R24 1.5K
SWITCHED +12V
UNLESS
ALL RE
ALL CA

80/20 XCVR


SWITCHED +12V
U4
78L05
+5V
C22
+12V INPUT
C26 220MF
C70
R5 100
C16
OPTIONAL AUDIO FILTER
R6 1M
R8 300K
C21 1MF
Q1 2N5486
C24 1MF
"B"
R9 10K
U5
LM 386
TP2
C30 220MF
C13
T3
U3
NE602
C23 .05
R7 1M
MUTE
C71
C28
C14
C15 .05
C18
C19
D1 1N4148
KEY
C25
C69
10MF
R10 10
C27
Y5
C29
L2
C20
OPTIONAL XMIT METER
RC 50K
TA
CA .01
RB 1K
RA 1K
DA 1N4148
M
KEYED +12V
TO REC ANT INPUT
L4
D4-D7
C61
C63 .01
20T #24 T50-2
L6
L7
TB
R28 100
C57 220
1N4148'S (4)
R26 10K
2N3053
TP3
Q7
Q6 2N2222
R30 4.7K
T5
Q8 C1678
L5
C66
C67
C68
R32 5.6 K
C60
TP4
FB
C56
R29 180
R31 1K
C58
R34 22
C59
R33 47
FERRITE BEAD
C64
+12V KEYED
C62 .01
C65 10MF
SWITCHED +12V
ERWISE SPECIFIED
RS ARE IN OHMS
ORS IN PF
LAST UPDATE 8-16-94
NW80/20
REV D

CAPACITORS	(CER= CERAMIC- ELECT= ELECTROLYTIC)
5PF NP0/COG	C2,3-2,33
12PF NP0/COG	C34
22PF NP0/COG	C38
47PF CER	C18,19,52,53
100PF CER	C45,55
220PF CER	C57
330PF CER	C4,5,6,7,8
30PF TRIMMER	C36
50PF TRIMMER	C20,55,61
.1μF CER	C9,10,12,14,16,22,25,27,28,29,39,44 47,48,49,50,51,56,58,5g,64,70,71,72
.01 CER	C11,62,73
.01 CER	C63
.05 CER	C15,23
.001 CER	C43
1μF ELECT	C21,24,46
1OμF ELECT	C40,65,69
22OμF ELECT	C30,C26

RESISTORS	(IN OHMS ALL 1/4 WATT)
10	R10 (BROWN,BLACK,BLACK)
22	R34 (RED,RED,BLACK)
47	R33 (YELLOW,VIOLET,BLACK)
100	R1,4,5,13,25,28 (BROWN,BLACK,BROWN)
180	R29 (BROWN,GRAY,BROWN)
220	R2 (RED,RED,BROWN)
1K	R21,23,31,35 (BROWN,BLACK,RED)
1.5K	R24 (BROWN,GREEN,RED)
4.7K	R3,22,30 (YELLOW,VIOLET,RED)
5.6K	R27,32 (GREEN,BLUE,RED)
1OK	R17,19,26 (BROWN,BLACK,ORANGE)
47K	R16,20 (YELLOW,VIOLET,ORANGE)
100K	R12,15 (BROWN,BLACK,YELLOW)
300K	R8 (ORANGE,BLACK,YELLOW)
1M	R6,7,11 (BROWN,BLACK,GREEN)
500 OHM	R14 TRIM POT XMIT LEVEL
10K POT	R18 RIT CONTROL
10K POT	R9 W/SWITCH VOL CONTROL

SEMICONDUCTORS			
NE602,NE612	U1,3,8	2N3906	Q5 (OR 2N4125)
MC1350	U2	2N3053	Q7 (OR 2N2219,2N5109)
LM386	U5	C1678/MRF472	Q8
78LO5	U4,6,7	1N4148	D1,2,3,4,5,6,7
2N5486	Q1,2,3,4	1N4001	D8 (BLACK PLASTIC)
2N2222	Q6 (OR 2N3904)		

OTHER
5 MOUSER 421F-128 GREEN CORE 10.7 MHZ IF'S Tl-T5
1 FERRITE BEAD FB
1 FINNED HEATSINK (Q7) TO5
2 HEATSINKS TO220 TYPE
5 8 PIN IC SOCKETS

Bands Table

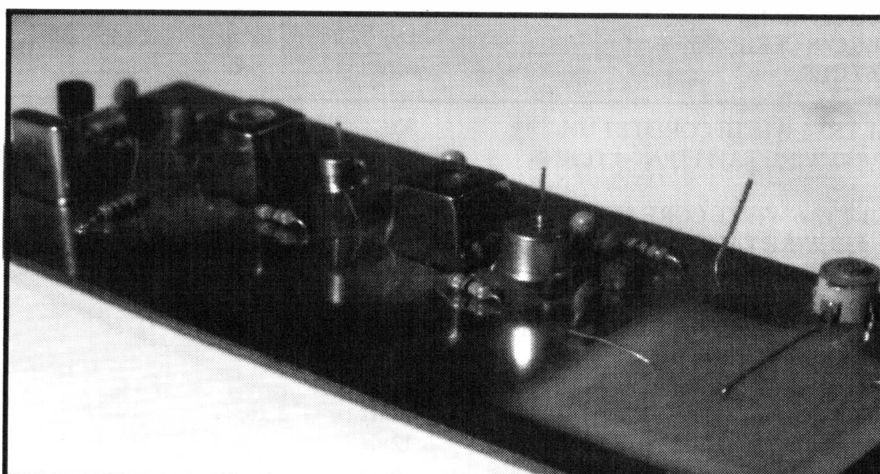
COMPONENT (80M NOT AVAILABLE YET)	40	30	20
Cl,C3,C60 CERAMIC	47	22	15
C13 CERAMIC	None	39	15
C34 NP0 CERAMIC	12	22	5
C35 MAIN TUNE	40	40	25
C37 NP0/COG	270	JMP	820
C41 NP0/COG	150	56	470
C42 NP0/COG	470	820	82
C74 CERAMIC	50	22	27
C60 CERAMIC	50	15	27
C66,C68 CERAMIC	330	270	150
C67 CERAMIC	820	560	330
L1 T50-7 WHITE CORE 11.1 UH #30 WIRE TAPPED AT 4 TURNS	50t	-	-
L1 T37-6 WHITE CORE 48 TURNS #30 WIRE TAPPED AT 4 TURNS	-	48t	-
Ll T37-7 WHITE CORE 3.58 UH 31 TURNS #30 WIRE TAPPED AT 4 TURNS	-	-	31t
L2 MOLDED CHOKE (SEE * BELOW	12μH	18μH	18μH
L3 " FOR COLOR	12μH	18μH	12μH
L4 " CODES)	18μH	8.2μH	8.2μH
L5 FT50-43 BLK CORE 7 TURNS #24 BIFILAR 5 TWISTS PER INCH	Same	Same	-
L5 FT37-61 BLK CORE 5 TURNS #24 BIFILAR 5 TWISTS PER INCH	-	-	Same
L6,L7 T37-2 RED CORE #24 WIRE	18t	13t	11t
Yl-Y6	10MHz	12MHz	9.6MHz
Tl,T2,T4,T5	None	None	Remove Cap
T3	None	Remove Cap	None
VFO RANGES (APPROX)	2.81 - 3.0	1.85 - 1.90	4.40 - 4.48

* MOLDED CHOKE COLOR CODES	8.2uH: GRAY,RED,GOLD,SILVER
"	12uH: BROWN,RED,BLACR,SILVER
"	18uH: BROWN,GRAY,BLACK,SILVER

Kanga 6m CW Transmitter Kit

Michael Hopkins, AB5L

Box 226841, Dallas, TX 75222



A very tidy board. Note the tapped coil etched directly into the board (see text).

British electronics have come a long way since 1950s automotive systems earned the Lucas firm the title "Prince Of Darkness." Consider Kanga's $32 6 Meter transmitter: It goes together in a couple of hours, has just four active devices, and puts one on a band where the DXers seek out small signals.

Kanga's 2 1/4 x 5 1/2 inch board populates promptly once you realize the British say "1 nF (Nanofarad)" for what we call .001 uF or 1,000 pF. Two JFETS drive a 2N2222 and a 2N3866 final.

The transistors are familiar to any student of Doug Demaw, but the oscillator, a Butler, may not ring a bell. See Carr, Mastering Radio Frequency Circuits, TAB Books (1994) p.276. This version of the Butler would tolerate no inductance whatever in an attempt to VXO its band edge straddling 50MC crystal, but a parallel 50pF variable warped it into safety. Every 12 and 8MC crystal tried worked including FT-243s liberated from Eisenhower Era AM rigs.

The board is pleasantly uncrowded and

visitors always comment on the novel output circuit that uses a 1 1/4 inch helix.

On the band the 200MW is routinely copied beyond 10 miles by groundwave in the RFI heavy Dallas environment using just a 1/4 wave ground plane, and the first kit has sounded nationwide by Sporadic E since going into service as a beacon signing AA5ZD at 50.067MC in February. High power addicts may want to add the 3W amp from the ARRL Handbook's 6M Transverter, which is easily driven by the Kanga.

Mr Hopkins, first licensed as WD5GMP, holds a commercial General Radiotelephone License, G-QRP #669, QRP ARCI #4400, SMIRK #3002, and was first to qualify for the Arizona Cactus Patch 6 Meter award using CW only. With a wife, WD5IEZ, and son, KC5FDL, available for traditional ham activities, he has limited his activity almost exclusively to 6 Meter QRP CW using a much modified 1961 LaFayette HE-45a.

Addendum by Bill Kelsey, N8ET

The kit comes as a bag of parts and the PC board along with four pages of documentation. Two of the pages are text - consisting of a circuit description, assembly guidelines, alignment instructions, and a parts list. The remaining two pages are the schematic and the parts layout diagram. The PC board is 5.5" x 2.25" and is double sided - one side for the traces, and the other side mostly unetched ground plane.

The board does not have a silk screened parts layout. The circuit itself consists of four transistors (2 x 2N3819, 2N2222A, and 2N3866), two slug-tuned coils of the IF can type, miscellaneous small parts, a ceramic trimmer capacitor for the final tank circuit, and a 25.0 Mhz crystal. A unique feature of this circuit is that the final tank inductor is etched on the PC board - you can not goof that one up!

Note that the crystal is 25.000 Mhz,and the circuit doubles to 50 Mhz. The circuit is such that the oscillator pulls DOWN in frequency, which means that if the crystal is used for anything other than tuning into a dummy load, you will be out of the band - don't use the crystal supplied for anything other than tune up into a dummy load! I understand from one of the early purchasers of the kit that you can use 6, 8, or 12 Mhz crystal in the circuit and they will multiply up to the 6 meter band.

The board is well laid out, and is large enough that even with my aging eyes (I use reading glasses to read the numbers on the capacitors, and to better see the ocassional tight spot on the PC board). I was able to have a working board less than an hour after I dumped the parts onto the work bench. That included time taken to make a few notes to send to Kanga UK on things that need to be changed or improved in the documentation. (I will include those changes in any kits I ship from Kanga US until Dick works them into the production cycle in the UK).

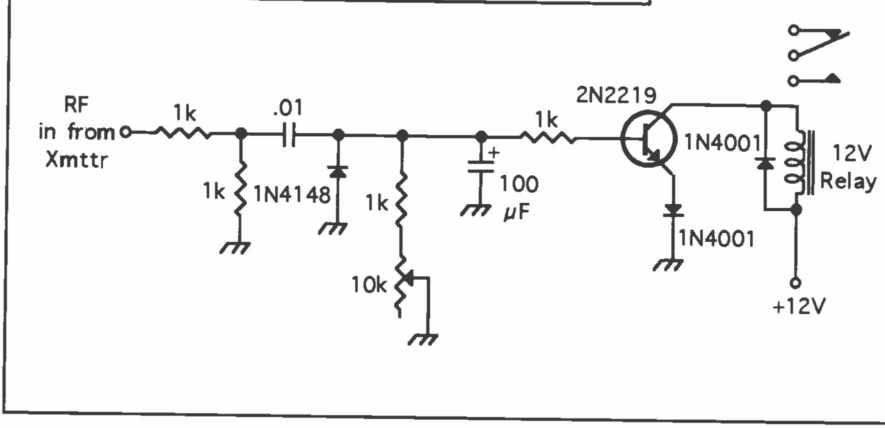
Assembly was very straightforward - just follow the parts layout provided. I build my boards by mounting the lowest profile parts (resistors, etc.) first, progressing to the high profile parts (IF cans, transistors) last. This worked well for the 6 meter TX. The only part of the assembly that required anything unusual was the modification of one of the inductors.

One of the cans (the shield) has to be carefully removed from the coil, and a ferrite "cup" removed from the inside of the can. I found that could be done by slipping an Exacto knife between the can and the plastic body of the coil. This bends out the retaining dimples used to hold the can to the body, and the assembly came apart. The "cup" was glued inside the can, and I removed it by crushing it with long nosed pliers. The can is then slipped back over the coil, and the coil mounted on the PC board. Alignment was as simple and as straightforward as any kit I have put together in some time.

There are two test points on the PC board. A volt meter is connected to test point 1, and the first coil is adjusted for maximum reading on the voltmeter while the transmitter is keyed. I found the adjustment to be sharp but easily found, and the reading was as (Cont. pg. 39)

Autumn, 94

RF-Sensing Relay
for the Noise Antenna



If you built the Noise Antenna featured on the cover of the Autumn, 94 issue, and would like something less forgetful than a manual bypass switch to avoid transmitting into the noise antenna device, this RF-sensing relay circuit may just be the ticket.

Roy Gregson, W6EMT, the designer of the circuit, says " I tried it with a small reed relay and a large relay that drew over 100 MA of current. It takes at least 3.5 watts to operate the circuit, but I suppose if more sensitivity was necessary, an additional transistor could be added. Or maybe changing some of the resistor values.

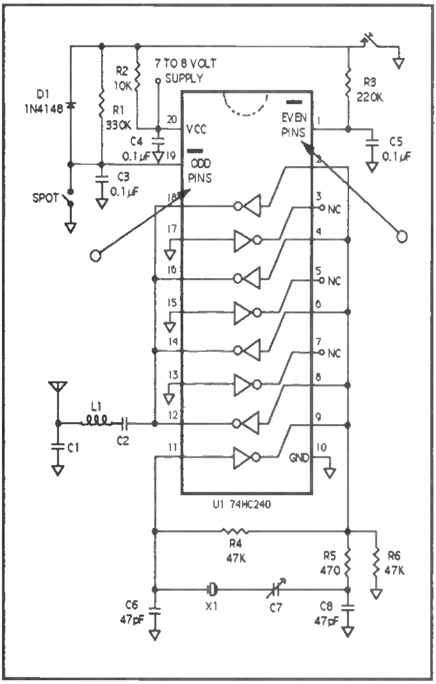
The delay is nice because you don't have to listen to a clattering relay, except at initial pull-in. It can be adjusted to please the user's keying speed. A longer delay can be had by changing the pot to, say, about 50k.

If it is to be used with a 100 watt radio, maybe the 1k resistors at the input should be changed to about 10k. It should work with SSB too, just set the delay for maximum and it will hold in during normal speech, and drop out with a pause.

The 2N2219 transistor can be any NPN that will carry the relay current. A 2N2222 may also work, it's certainly not critical.

The diode in the emitter is to make sure the transistor "lets go" of the relay, and, of course, the diode across the relay keeps the back-EMF down."

N7KSB 1/2 Watt
Single-IC Transmitter
(Summer, '95)



The "Even" and "Odd" IC pin designations on the schematic were reversed and should read as in the schematic at left (where indicated by arrows).

Thoughts On Theory
(Continued from page 45)

100–300 when operated at various current levels. Here, even if you design using the median ß value of 200 for the 2N2222A, you can still have changes of up to ±100 in ß.

So it helps to have an idea of the value of ß for any transistors you want to use. You can get an idea of the value of ß from transistor spec sheets provided by the manufacturers. Transistor testers — which allow you to make a small known change in base current and show you the corresponding change in collector current — provide you with the DC beta. You can even build your own simple tester, and in a future column I might show an example of one.

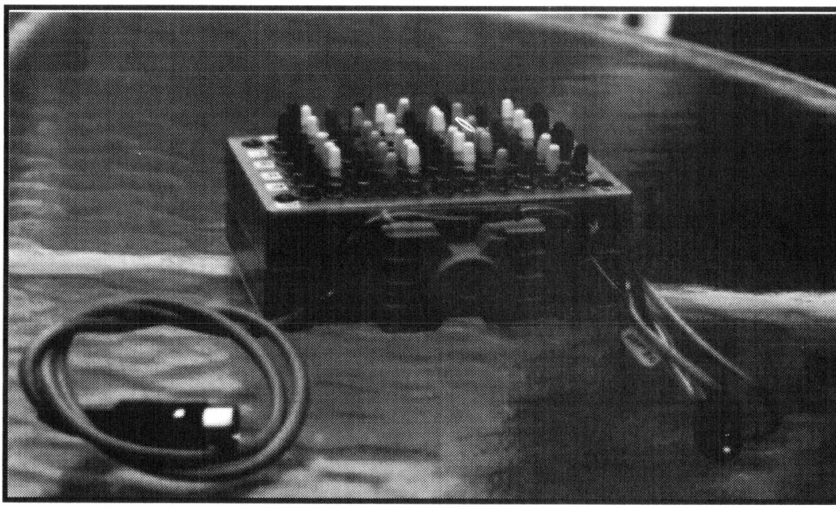
For ß = 100 in the base bias example above, you can increase the size of the bias resistor, RB, to 1.5 Megohm to reduce the base current by one-half to 16 µA. This reduces the collector current back to about 1.6 mA, but this also restricts the amount of input signal to about one-half its previous value before clipping or saturation occurs. You'll see this more clearly when I talk more about "load lines" as a means of amplifier biasing.

Next time I'll discuss the best possible method to bias a transistor. The method essentially eliminates ß from the calculations and greatly reduces the shift in operating point due to temperature changes.• • •

Nine Bands, One Antenna, No Tuning

Mike Branca, W3IRZ

2880 Camary Place Dr., Conyers, GA 30208



Decoder rear view showing octal socket for cable to relay box (all photos, this article: Mike Branca, W3IRZ).

Well almost! Having an Icom IC 735 provided me with an opportunity to derive band change information from the radio itself. The Icom actually only has a 7 band output and shares 17 meters with 15 meters and 12 meters with 10 meters. I handled these minor problems with external switches as you will see later. Actually I am getting way ahead of myself by bragging about the features before I describe the antenna arrangement that makes it all possible.

The antenna system was arrived at empirically from on the air tests and comparisons. Technical information came from various editions of the ARRL handbooks and antenna books as well as many magazine articles. All I did was put it all together. When I started this project I was using a 160 meter (500 foot) loop with 30 feet of open wire feed and a differential "T" antenna tuner. As I band hop frequently, the antenna tuner knobs were getting quite a workout. Even though I had made frequency charts so I could prescription set the tuner, it was still a pain. My 160 meter buddies WB4NPT and WA4GEG had been pushing me for awhile to skip the tuner and just match the loop with a 1/4 wave of 75 ohm coax (called a 1/4 wave transformer). They felt that it would save the tuner losses (?) and realize the broadbanded characteristics of the loop antenna. So I simply coiled the 75 ohm coax on the floor, connected one end to the openwire feed and the other end of the coax to the radio. Lo and behold! My loop was now flat (a rig happy SWR less than 2:1) all across the 160 meter band with no tuning.

Now back to the antenna books. Lets see - - the loop is resonant on all harmonics. That is

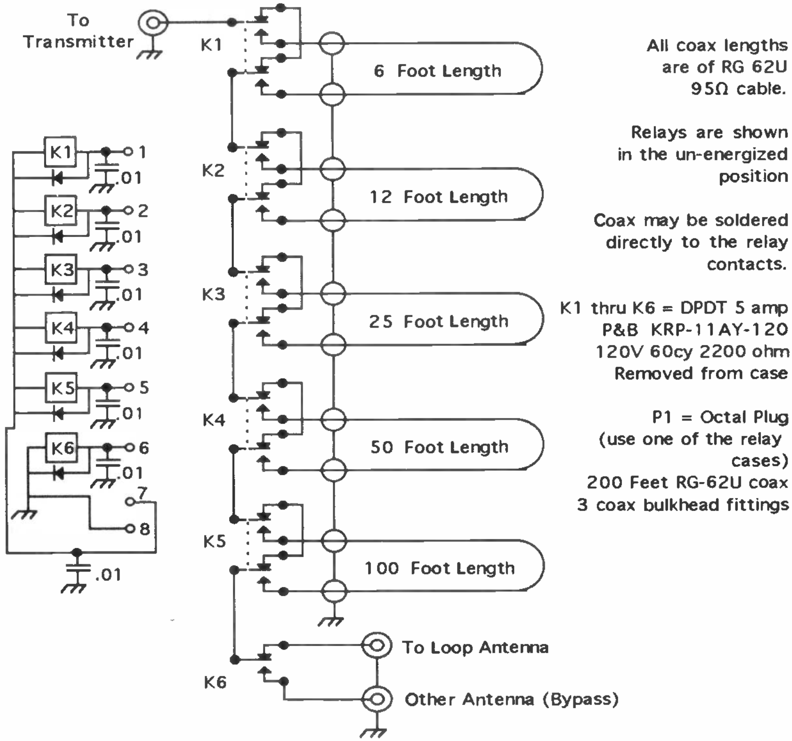


Figure 1: Relay and Coax Circuits

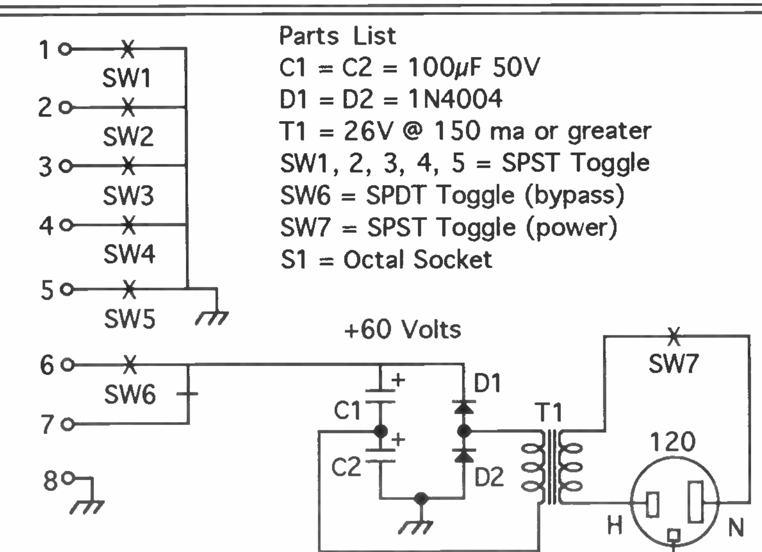
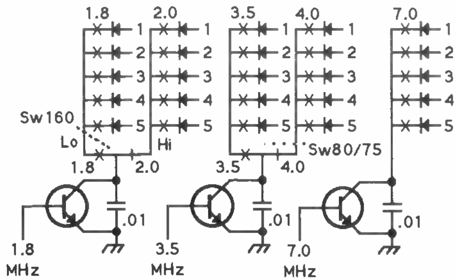


Figure 2: Relay Power Supply and Simple Control Switch



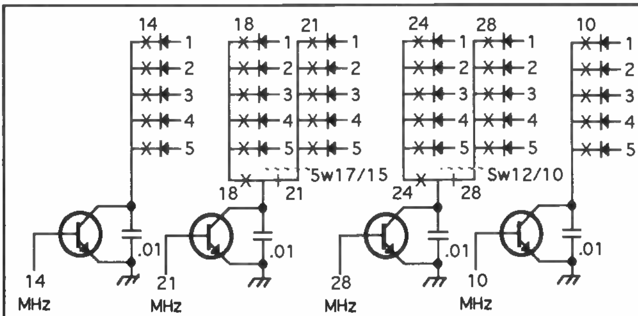
Note: The transistors shown are mounted on the FAR circuit board designed for the IC 735 antenna-switching relays.
Be sure to not use the diodes D1 through D7 specified on the FAR board.

X = SPST switch, one for each relay for each band position (55 needed)

= SPDT switch for transfer within IC 735 selection

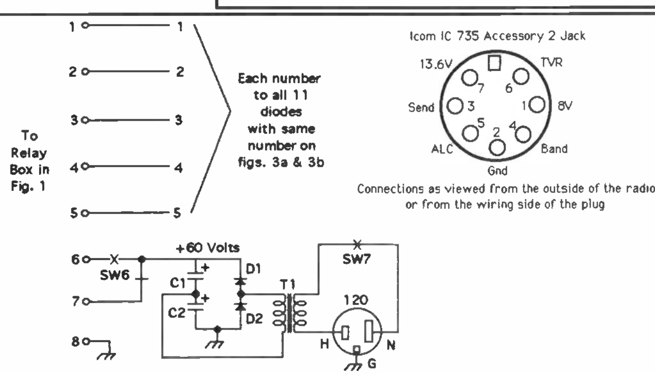
= 1N4004 diode for each SPST switch (55 needed)

Figure 3a: Switch and diode matrix for band presets



Note: The transistors shown are mounted on the FAR circuit board designed for the IC 735 antenna-switching relays.
Be sure to not use the diodes D1 through D7 specified on the FAR board.

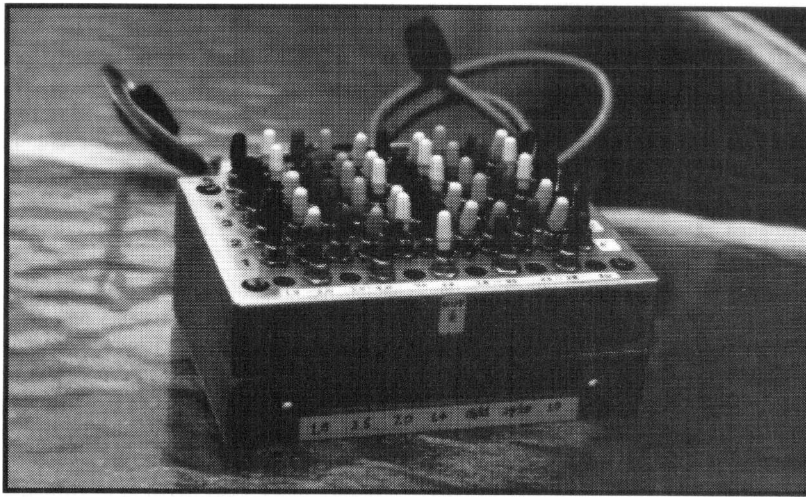
Figure 3b: Switch and diode matrix for band presets.



S1 = Octal relay socket
C1 = C2 = 100µF 50v
D1 = D2 = 1N4004
SW6 = DPDT Toggle (bypass)
SW7 = SPST Toggle (power)
T1 = 26 Volts 150ma or more

Note: The transistors shown are mounted on the FAR circuit board designed for the IC 735 antenna switching relays.
Be sure to not use the diodes D1 through D7 specified on the FAR board.

Figure 3c: Switch and diode matrix for band presets.



Icom-controlled switch matrix (FAR Decoder, switches and diodes)

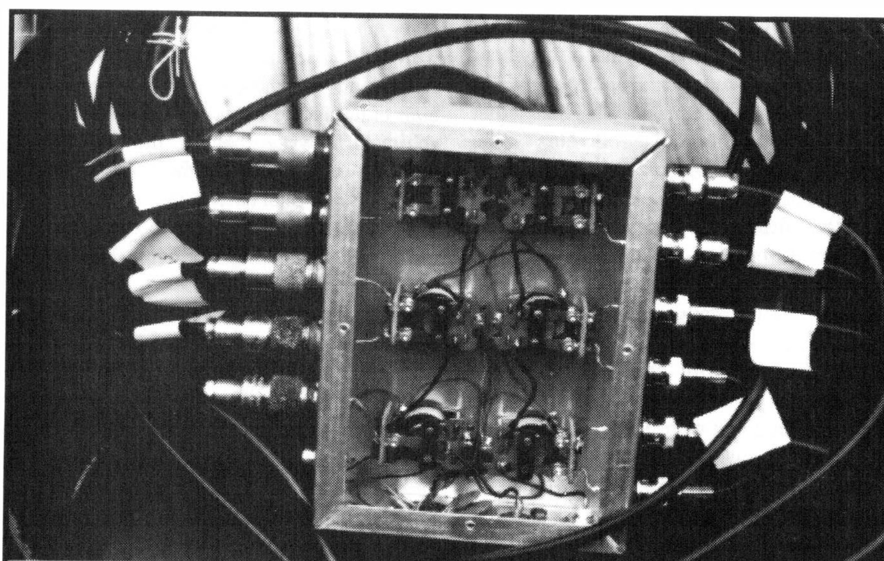
2,4,6,8,10,...14,...30 MHz and then I verified this with my grid dip meter. The books also mentioned impedances stating that it was about 100 ohms at the fundamental and roughly 125 to 150 ohms on the harmonics. This meant that I should use coax of around 100 ohms on the harmonics. My junk box just happened to have five 50 foot hanks of 95 ohm RG62U coax with BNC fittings on the ends that was left over from the removal of some now unknown computer system. I cut a 1/4 wave of this 95 ohm stuff but this time for 75 meters. Wow, it was flat across 75 meters. The same thing was tried on 20 meters with the same results.

Now I was on to something. I fashioned a relay switching box with 5 coax loop switching relays and one bypass relay. The relays used were 120 Volt AC DPDT 5 Amp Octal based ones that I got at a hamfest for a dollar each. After removing the relays from their cases and I found that they functioned reliably with 60 volts DC at about 27ma. Coax fittings were attached to the box to match the cables on hand, so I used both BNC and UHF types. The following stub lengths all of RG62U coax were used: 100 feet. 50 feet, 25 feet, 12 feet and 6 feet as illustrated in figure 1. A remote relay control and power box was fashioned with separate SPST toggle switches for each relay as shown in figure 2. To my surprise I found that I could also match 40 and 15 meters by manipulating the switches even though they were not harmonically related to the loop. Each band was matched (at low power) by manipulating the switches till a match was achieved. If we go back to the books for a moment we will note that the 1/4 wave length of coax is a special case of the coaxial matching transformer. All my relay box does is give me an adjustable length of coax. Thus it acts like an antenna tuner to match an unknown impedance as long as it is relatively low. The loop antenna is known to have a low impedance even on the harmonics. Although I did not measure it, I feel that from my results on the higher frequencies the loop exhibits a low impedance even between harmonic frequencies. I ended up with a control box having five switches that enabled me to tune nine bands. A tuning chart was made for fast QSY's and I noticed that in some cases when I changed the feed line or antenna that the arrangement would not be flat across the whole 160 or 80/75 meter bands. Therefore high and low settings were made for both of these bands.

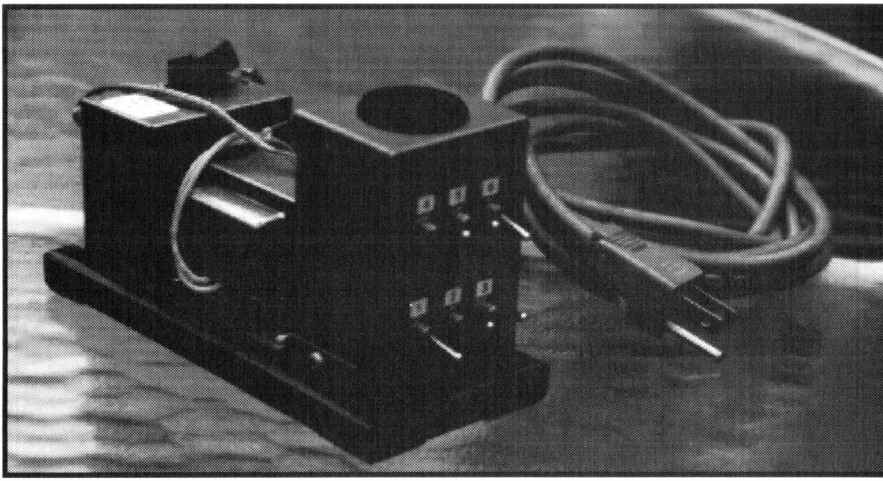
The events just described were done in September of 1992. Then just to make sure that these results were not just a quirk, I decided to see if a different loop would still have a nine band match. I put up a temporary 500 foot loop about 10 feet from the ground and ran the ends directly to my relay box. It matched also, but with different switch settings. On a couple of bands I had RF in the shack since I could get RF burns from my key frame. The cure was simple: a choke balun was made with 12 turns of 14 gauge zip cord (speaker wire pair) around a T 200-2 core. One end of the pair connected to my antenna (or open wire feed line) and the other to my relay box. Good bye RF burns!

My plan was to eventually use the band change information from the IC 735 to select the right combination of relays. Before I got to this, QST published an article in April 1993 p32 for "A Remotely Controlled Antenna Switch" for the Icom. I sent to FAR for the circuit board so I could complete the last part of this project. The board was OK but the circuit had to be changed slightly. Since high voltage (60V) was used for the relays I had to also use high voltage transistors. I initially used MPSL01 transistors but with the possibility of all five relays operated at the same time I was pushing the current rating so I changed them to 2N5551 transistors. To keep RF out of the circuit board .01uf 600v disc ceramics were added from the collectors to ground and .01uf 25v disc ceramics were added from the Icom +8v and band control leads to ground. A snap on ferrite choke was also necessary on three turns of the Icom cable as it entered my box. Also be sure to not install diodes D1 through D7 on the FAR circuit board as they were intended for use on 12 volt relays. Figure 1 shows the new diodes connected directly across the relay coils where they belong.

For the actual construction I used a couple of diecast boxes that were in my junk box that were a bit bigger than the FAR circuit board. In the lower box the Icom decoder circuit board was mounted with the LED's visible through a slot. In the upper box I mounted 11 rows of toggle switches, plus five other switches: a bypass switch, a 160 meter hi-lo switch, a 75/80 meter hi-lo switch, a 20 -17 meter switch and a 12 - 10 meter switch. The diodes were wired to the switches per figure 3. The boxes were bolted together and an octal relay socket (to connect to the relay box) was attached to the back. The switches were salvaged from junked equipment and if I had to do it over again and put a value on my time I would have made a PC board for the switch-diode network



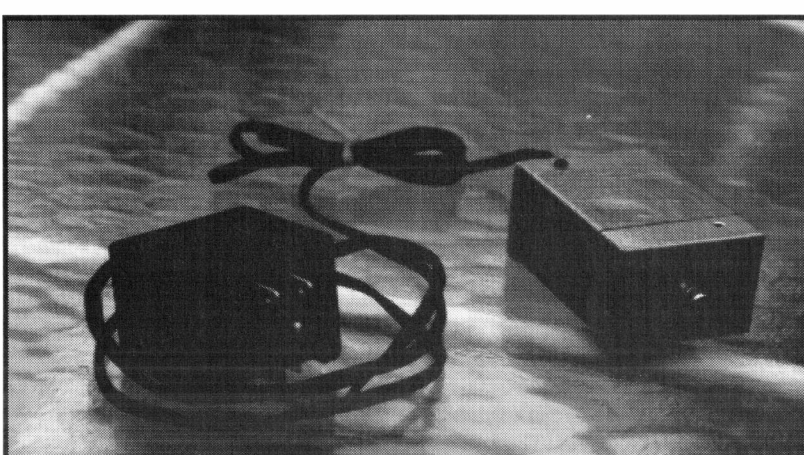
Relay box with coax attached.



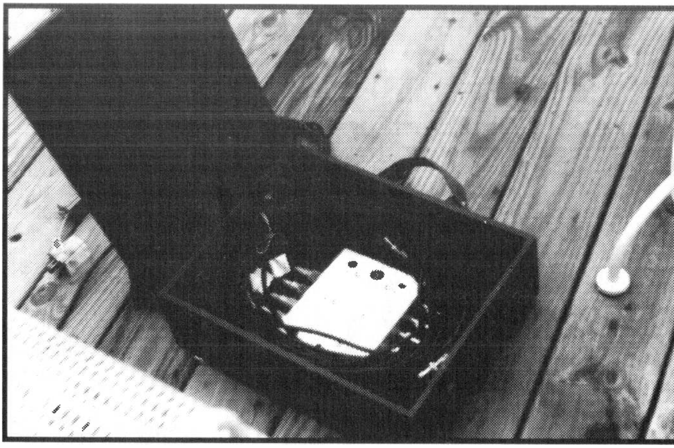
Manual Relay Control switches and power supply.
Note octal plug on top for cable to relay box.

and used six dip switch assemblies each with 10 switches.

With completion of this project I can now exhibit the ultimate in laziness when band hopping. Hams all over the world have been worked with this combination. I am sure at this point that you are wondering what I did with all that coax (almost 200 feet). The stuff was coiled in an old metal box of unknown origin that measured 15" X 12" X 5". My relay box is located in the middle of the coiled coax. This coax box now serves as a footrest under my operating table. An old attaché case or small suitcase would serve equally as well. The only other thing that I would do differently would be to not use coax fittings on my relay box or the 95 ohm cable. They were needed in the beginning because I didn't know what cable lengths or types I was going to end up with. If I were to build another I would wire the RG62U coax center conductors directly to the relay contacts and bond the shields together and to

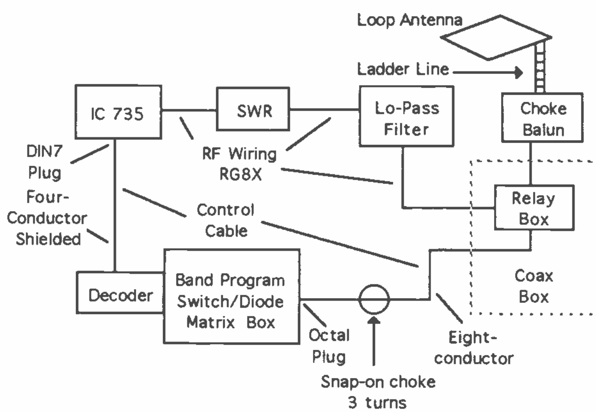


Relay power supply for Icom Decoder



Relay box and cables inside storage box.

Figure 4: Block Diagram of completed arrangement



ground. Your advantage is that you already know what you need so there is a time savings in not fooling with all those coax fittings.

The only comparison that I can make with my device is to compare it to an automatic antenna tuner. Obviously the automatic types are costly and they take a moment to tune and they have to retune with every QSY whereas this coax job could be done for almost nothing if you are able to scrounge for the coax and the relays as I did. As a matter of fact in the first trial 75 ohm RG59U was used for the 100 foot piece and it worked OK so you can keep up the ham tradition of experimenting. There should be no problem with this project in obtaining any hard to find components. Any relays with contacts rated at 5 Amps and good insulation should work and the relay windings will determine the power supply and transistor requirements.

It only takes about 15 minutes to set this arrangement up for the 11 sets of switches that I used. Simply pick a quiet frequency near the middle of the band and exercise the 5 associated switches to find the combination for the best match at low power. A quick check at full power will verify this as well as a quick check at the band edges. In my original tests I found that I needed two switch positions to cover the whole 160 meter band but in the final version all I needed was one but I left the extra position in case I changed the antenna or the feed line.

A final comment on the relays: The specified relays are available at Newark for about $17/ ea., but I got mine as hamfest bargains for $1 each, so I was willing to make a suitable power supply. Another choice would be to use 12VDC relays (DPDT @ 3A), so that the station supply could operate them. The following list denotes availability and low cost:

Radio Shack	275-206	5.99	DPDT
All Electronics	4PRLY-12	4.00	4PDT
	RLY-11	2.50	DPDT 10 amps
Mauser	433-2411	6.99	DPDT 5 amps
Hosfelt	R14-11D10-12	7.89	DPDT 10 amps

•••

(*Cont. from pg. 9*)target search frequency, the KC1 will report the current frequency and then exit the search mode.

Summary

The KC1 is a very handy accessory for installation in any of the current crop of QRP transceivers. Its small size, reasonable cost, and adaptability to just about any rig give it a degree of utility rarely seen. The confidence of knowing one's operating frequency to the closest kHz when using small rigs without accurate frequency dials is something this operator greatly values. It is easy to build and operate, and requires only minimum practice to become proficient. The microprocessor is socketed, so as firmware upgrades become available, it may be reprogrammed to the latest version.

The instruction manual is complete and well written.

My thanks to Wayne Burdick, N6KR, and to Bob Dyer, KD6VIO, for letting me borrow the prototype KC1 for this review.

For further information, please contact the manufacturer.

Wilderness Radio
P.O. Box 734
Los Altos, CA 94023-0734

KC1 Keyer/Frequency Counter Kit
$44.50
KC1-IC Partial Kit
$24.50

(415) 494-3806

(*Cont. from pg. 29*) the instructions indicated -between .5 and 1.0 volts. Then the meter was connected to test point two, and the second coil was adjusted for maximum reading on the meter. I found this to be a bit broader peak, but again it was easily found, and was as the instructions indicated - between 1.0 and 1.5 volts. The final trimmer was then adjusted for maximum output on an RF indicator and dummy load that I have as a piece of test gear in the shack (another Kanga kit!). This was also a nice single peak adjustment.

I did not measure the current consumption of the rig, because as tested it was an unshielded board, and my VOM seemed to respond quite well to the 50 Mhz RF, so I was unable to get an accurate reading. The current meter on the power supply used indicated less then 100 MA at 12volts. The RF output meter used to peak the final was also uncalibrated, so I do not have a good number for the RF out power either.

I am not a six meter operator (yet), so I can not tell you I worked anything on the new transmitter- I was not even able to listen to the keyed signal. However, I do know that one of these kits has been in use as a low power 50 Mhz beacon in Texas for the past year. (*Note previous commentary - Ed.*)

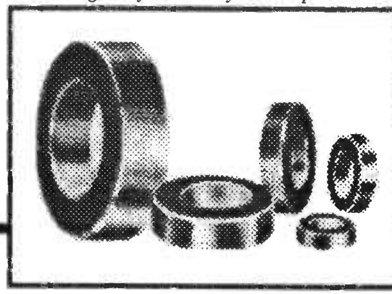
This little rig would make an ideal first kit for a beginning builder, and could be used as a low power cw transmitter, a driver for a higher power amplifier, a beacon, etc. Provide your own T/R switch, use the Kanga 6 meter converter with your IF receiver, or even the Kanga SUDDEN Receiver, and you have a complete 6 meter rig for $90. You supply the antenna, power supply, crystal, (*Article concl. on pg. 6*)

Ed. Note: Don Callow, VK5AIL, is the highly regarded editor of the Lo-Key, the publication of the CW Operators' QRP Club of Australia/New Zealand. Information regarding membership is available on the inside back cover of this issue.

Toroid Materials

Don Callow, VK5AIL

Originally in Lo-Key # 11 Sept. '86



Notes:

- Iron powder has much better temperature stability than ferrite and is preferred for tuned circuits.
- Amidon Associates suggests you use larger sizes of iron powder cores for lower frequencies in the range and smaller sizes for the higher frequencies.
- High permeability gives high inductance or fewer turns for a given amount of inductance.

Materials

Brand	Mix ID	Color Code if coated	Initial Permeability μ_i	Useful Frequency Ranges (MHz)	
				Tuned Circuits	BroadBand Transformers
MATERIAL GROUP: IRON POWDER					
AMIDON	2	Red	10	2 - 10	0.5 - 30
"	(E)				
	6	Yellow	8	10 - 20	2 - 50
	(SF)			? 90	
MATERIAL GROUP: FERRITE					
AMIDON	43	(none)	850	0.01 - 1	1 - 50
"	61	(none)	125	0.2 - 10	10 - 200
NEOSID	F14	Red	220	?	0.1 - 5
"	F25	?	50	?	1 - 50
PHILIPS FERROX-CUBE	4C6	Violet	100	?	0.1 - 50

Deep Six

Fred Bonavita W5QJM

*Editor's note: With this issue, **Hambrew** begins a quarterly roundup of news and items about 6 meters, a neglected band, but one which offers challenges and excitement. **Hambrew** will be in the forefront of the emerging effort to "repossess 6 meters," as one source so succinctly put it.*

*Since there is no nationwide publication focused on the so-called "gentlemen's band" exclusively, **Hambrew** will attempt to fill that void. This effort began with the Spring 1995 issue and the article on a 6m antenna tuner by Bill Shanney, KJ6GR, and continues in this issue.*

*Readers are encouraged to submit construction articles on transmitters, receivers, antennas and accessories to Fred Bonavita, W5QJM, at P. O. Box 2764, San Antonio, TX 78299. In addition, **Hambrew** will publish news about 6m operating and operators plus occasional pieces on commercially made products and new developments for the band. This will be done at no sacrifice in the quality or quantity in general-appeal articles that have made **Hambrew** a success with homebrewers worldwide.*

The success of this effort depends, in large part, on help from our readers, so shower down the material, gang!

A 6m Primer

For those new to 6m, interested in catching up on the status of the band, or looking for some informative reading, try *Six Meters: A Guide to the Magic Band,* by Ken Neubeck, WB2AMU.

While it does not qualify as an earth-shaking offering, *Six Meters* nonetheless is an interesting perspective of where the band is, how it got there, and where it could go. He seems to be on target on all counts.

However, Neubeck's discussion of equipment is solely on what is and was available from the commercial market. He all but kisses off the build-it-yourself rig; the closest he gets to the subject is to reprint two 1960s-vintage schematics with no elaboration. It it's not a vintage U.S.-made rig or a recently minted ricebox with a kilo-buck price tag, Neubeck has nothing to say about it. More's the pity.

Despite some sloppy editing and repetitions in the text, *Six Meters* is an inexpensive place to renew or begin an association with this neglected band. Send $12 ($2 postage) to Worldradio Books, Box 180490, Sacramento, CA 95818.

Easy Start

Those interested in getting on 6m without it costing an arm, a leg, or another part of the anatomy should look into a transverter available from the T-Kit division of Ten-Tec. The kit is $95, and the assembled and tested model is $159, plus shipping. This is far less than the asking price for most used 6m gear these days.

This transverter, which will be the subject of a review in a subsequent DEEP SIX, is about the size of a book. It requires a drive of 5 watts or less from a 14 MHz source and kicks out about 8 watts CW (with QSK) or ssb.

A catalogue can be had from T-Kits, 1185 Dolly Parton Parkway, Sevierville, TN 37862-3710, or by calling 1-800-833-7373.

Stealth Six: Since not everyone wants or can have a beam for 6m (some killer models boast six elements on a 30-foot boom, for instance), a good antenna is not an impossibility. Here are two suggestions:

• The newly released *ARRL Antenna Compendium, Vol. IV*, describes an extended double Zepp, whose designer hangs it vertically from the side of a tower. Obviously, it can be adapted for other locations. The overall length is 23 feet, and it's fed with co-ax via a 450-ohm matching section. This piece, too, suffers from some sloppy editing. The diagram says the antenna is offset from the tower about 5 inches; the text makes it clear that's at least 5 feet.

• A 6m J-pole is being marketed by Jade Products, Box 368, East Hempstead, NH 03826-0368. This is a low-profile antenna made form 14 feet of 450-ohm twin-lead and fed with 50-ohm co-ax. It's available in kit or assembled-and-tested form from the factory. J-poles are good performers.

Hot Receiver: In case you missed it, grab the June 1995 issue of *CQ*, and read carefully the lead article on a DX-grade receiver for 6m. Mac Chapman, KI6BP, built this one from scratch and turned out a professional-looking rig in the process. (Ken Neubeck, take note.)

One word of caution: Mac says NP0 caps, PIN diodes, and other parts are available from Oak Hills Research, but shortly before his article appeared, Dick Witzke began closing out the component side of OHR. He will continue his line of HF kits, however.

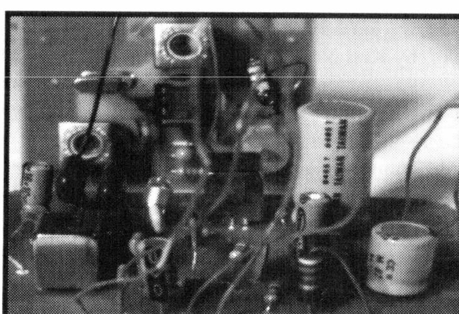
Other sources of components remain, including Ocean States Electronics, Mouser, and DigiKey, so don't give up on building this receiver.

Smirk Lives: Information about Six Meter International Radio Klub (SMIRK) is available from Pat Rose, W5OZI, Box 393, Junction, TX 78649-0393. While the club still sponsors contests and promotes 6m operating from foreign countries, Pat says it had abandoned its quarterly newsletter.

6m Receiver Update

G. De Grazio, WFØK

A while ago, during construction of the Ten-Tec 6m Downconverter for a *Hambrew* review, it occurred to me that the 22 MHz oscillator in the converter would be an ideal element for converting 28 MHz to 6 MHzwith a Neophyte receiver lowered from 7 to 6 MHz. Since the Ten-Tec converter mixed 50 MHz with 22 MHz to arrive at the receiving frequency of 28 MHz, a second converter could be chained with the first to yield a two-band receiver for 6 and 10 meters. The Neophyte seemed a logical choice, since it is a very frequency-stable circuit, and would provide a very firm platform for reception of the higher two bands.



6MHz Neophyte (larger board) mixes it up with a modified Kanga 6m converter to get 10m!

As of this writing, the Neophyte receiver section has been built and tuned to 6 MHz with no change in components other than a (preliminary) substitution of a 12-66 pF air-variable for C4 (front-end tuning), and elimination of C11. A Kanga 6m downconverter kit (also a 22 MHz scheme) was constructed, and the front end was modified by substituting a tapped toroidal transformer with a higher-value variable in the tuned input circuit. This was done to tune it to the 28 MHz band. This results in a receiver for 10 meters that is extremely stable.

Tests are in progress to chain the two converters and to fine tune all elements for maximum sensitivity. We plan to present the completed receiver in the Winter, '96 issue.

DESIGN BASICS SERIES

Thoughts On Theory

The Concept of Duality

James G. Lee, W6VAT

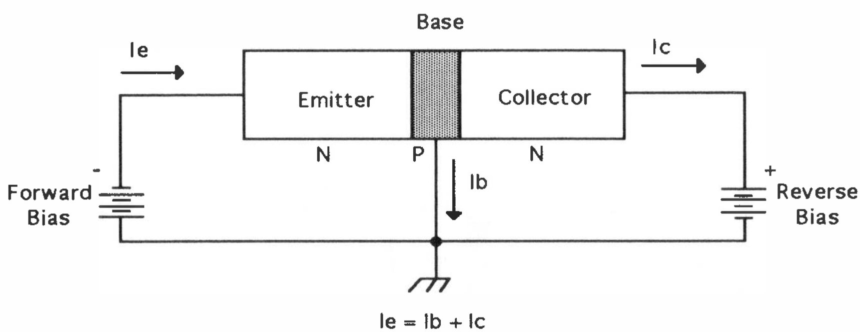


Figure 1: NPN Transistor with Proper Bias

Transistor Biasing — Part I

Often a newcomer to home-brewing is puzzled by seemingly complicated biasing schemes used in transistor circuitry. This is particularly true if they are trying to do a bit of design on their own. But by making certain simplifications concerning the transistor, it is possible to calculate all of the necessary resistances to properly bias the transistor. The results you get will be "approximations," but they will put you in the right neighborhood.

There is nothing wrong with this approach since many of the more exact formulas often provide you with resistance values which lie between the so-called "standard" values of resistance, and you have to pick the standard value nearest the calculated one. Add to this the variability between transistors of the same type, and you see that it is often "cut and try" in the engineering world as well. So let's begin by reviewing how a transistor works and the minimum conditions which must be maintained for it to work properly.

The Transistor Itself

Figure 1 shows a composite picture of an NPN transistor with appropriate bias voltages applied. Transistors are made by alloying, diffusing, or growing pieces of N-type and P-type semiconductor material together in a particular order. In the figure, the larger end pieces are the emitter and collector, made of N-type material. They are joined together by a very thin base region made of P-type material. The transistor is very similar to two back-to-back diodes, although you can't make a transistor by putting two separate diodes together.

The base-emitter diode must always be forward-biased, and the base-collector diode must always be reverse-biased, for the transistor to work properly. These are the minimum conditions necessary for it to work. The forward bias on the base-emitter diode causes current to flow, since it provides a low-resistance path from the battery to ground. Reverse-biasing (back-biasing) the base-collector diode allows only a tiny amount of current to flow, since it provides a high-resistance path from the battery to ground.

The base-emitter diode resistance is only about 50 ohms, while the base-collector diode resistance is on the order of 100,000 ohms due to the back-bias. How, then, does the transistor provide amplification? It is due to the very thin base region. Most of the electrons which flow into the base region from the emitter do not recombine with atoms in the base region, but are attracted by the positive collector region and diffuse directly into the collector itself. There they are attracted toward and flow directly into the collector battery. Recall that the alpha (α) of a transistor is a measure of how much of the emitter current does not recombine in the base region but flows into the collector region instead.

If you put a small signal into the emitter and a load resistor (RL) in series with the collector (such as in *Figure 2*), then the current in the collector develops a voltage across the load resistor resulting in signal amplification. What I show in *Figure 2* is a common-base amplifier, which is characterized by a low input impedance and a high output impedance. Thus the CB amplifier is useful when you want to step up a low impedance to a higher one. Note, however, that this characteristic does not lend itself to cascading CB amplifiers, and that's one reason they are not seen in circuitry very often.

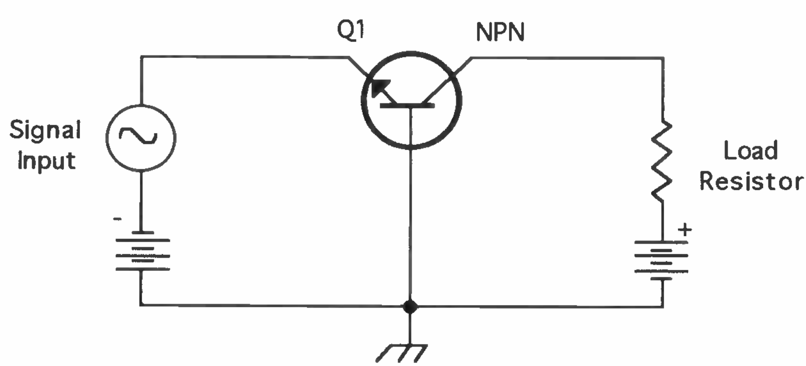


Figure 2: Common-Base Transistor Circuit

Base Bias

The most common transistor configuration is the "common emitter" one. Sometimes called the "grounded emitter" configuration, it is the one I'll use most often in this series. *Figure 3* shows an example of an NPN common-emitter stage using base bias. Here I'm talking about a Class A amplifier. Without going into great detail, a Class A amplifier is one in which current flows all the time, whether a signal is present or not.

When you apply a signal to an amplifier, you don't want the signal to back-bias the base-emitter diode, which causes clipping to occur. Nor do you want to drive the transistor into "saturation," which also causes the signal to be distorted. So by applying "operating bias" to the transistor, you set its operating point — i.e., collector current — somewhere in the middle of its permissible range. In *Fig-*

ure 3, it is normal to bias the transistor so that, with no signal, the collector-to-emitter voltage (V_{CE}) is half the total supply voltage (V_{CC}). This allows the peak-to-peak collector voltage swing to go from V_{CC} to almost zero volts.

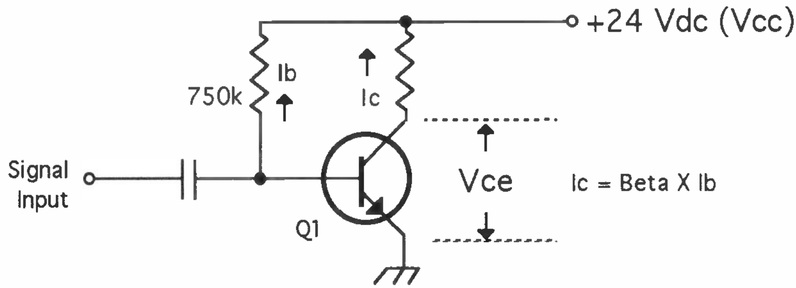


Figure 3: Base Bias of Common-Emitter Stage

This means that the voltage across the load resistor, R_L, must be 12 volts, or (by Ohm's Law):

$V_{CE} = V_{CC} - I_C R_L$

The DC collector current, I_C, is given by:

$I_C = ß$ times I_B

where I_B is the base current. By Ohm's Law, the base current is 24 volts ÷ 750K ≈ 30 μA, neglecting the small base-emitter voltage drop, which is 0.7 volts for silicon transistors.

If ß = 50 for this particular transistor, then the collector current, IC, is 50 times 30 μA = 1.5 mA. The load resistor, RL, is then 12 volts ÷ 1.5 mA = 8000 Ω. In this case, you would choose a standard value 8.2K resistor for RL. Thus our operating point, with no signal, is set at 12 volts and 1.5 mA. The total power dissipated at this operating point is only 12 volts times 1.5 mA = 18 milliwatts.

A signal coupled into the circuit now causes the collector current to vary about the operating point. If the signal is not too large, the base-emitter diode remains forward-biased, and the collector-base diode remains back-biased throughout the AC period of the signal. This is Class A operation. But what happens if, for some reason, a large temperature variation or replacement of the transistor causes ß to increase to 100? The base current, I_B, stays the same, but the collector current now becomes 100 times 30 μA = 3.0 mA. The drop across R_L now is 8.2K times 3.0mA = 24.6 volts, which is more than the supply voltage, and so V_{CE} = 0 volts.

The collector-bas diode is no longer back-biased, and the transistor cannot amplify. The transistor is said to be "saturated," and any signal applied to the base will be severely clipped at the output. Thus base bias is the poorest possible method of setting a stable operating point.

Where can you get large variations in operating temperatures? Mobile operation is one place that large temperature excursions can occur. When you back out of your relatively cool garage into bright sunshine, for example, temperatures can change over a large range.

In a previous column, I talked about "beta spread" in transistors of the same type due to manufacturing tolerances. For example, the popular 2N2222A NPN silicon transistor has a DC beta spread of (Continued on page 31)

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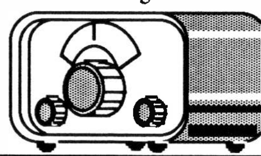

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