hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

FIRST ANNIVERSARY ISSUE

GLEN REID, K5HGB
Sub Exp: 7-95
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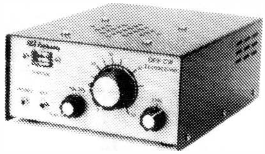
AUSTIN,TX,78733

Noise Antenna Revived

AUTUMN '94

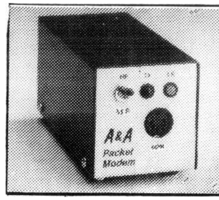
PORTABLE QRP CW TRANSCEIVER

DEC. '90 & JAN. '91 QST BY GARY BREED K9AY



Features: SINGLE-SIGNAL receiver, VFO tuning, AGC for listening comfort, 5 Watts output, Semi-QSK TR switching and CW sidetone. Add a battery, key and antenna and you're on the air. FULL 100% KIT including a custom pre-painted, punched and lettered metal enclosure. 20, 30, 40 Meter available.

Complete Kit Only $159.95



BayCom Compatible

Low Cost Packet for PC / Clones

Features: Software-based PACKET that makes your computer emulate a TNC. Modem connects from serial port to RIG. Watchdog timer & reed relay PTT standard. Operates from 12VDC@100ma, wall power supply included. Uses crystal controlled 7910 chip, VHF and HF. Lock & TX LED indicators. Free copy of Version 1.40 English software included.

Kit. . . . .$59.95 Enclosure $10
Assembled & Tested in Box $89.95

WEATHER FAX

Satellite & HF FAX for IBM / Clones

New!

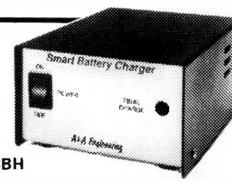
Shown with optional 20 LED Tuning Aid

Features: Processes WEFAX, VIS & IR NOAA, METEOR, APT, 240LPM, 120LPM & HF WEFAX. Connects to Computer Line Printer Port. The software was created by Dr. Ralph E. Taggart, WB8DAT. For details see Chapter 5, Fifth Edition of the *Weather Satellite Handbook*.

Complete Kit Only $159.95
Assembled & Tested $189.95
Optional 20 LED Tuning Aid ....add $ 40.00

Smart Battery Charger

New!



JUN 87 QST
BY WARREN DION N1BBH

FOR GEL-CELLS or LEAD ACID BATTERIES.

Features: Precision temperature tracking voltage reference & three mode charging sequence. Standard kit is for 12V @ 1/2 or 1 Amp, user selectable. Can be connected to the battery indefinately, will not overcharge. Weighs 2 pounds and measures 4"W x 5½"D x 2½"H. Finished enclosure included in kit.

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Adapted from Nov. 85 *QST* article by Al Helfrick K2BLA

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FEATURES: Three digit LED center frequency digital readout. 12 position calibrated scan width 1KHz to 50MHz, switchable bandwidth; wide = 300KHz, narrow = 10KHz. Use your low frequency scope for the display portion. Switchable 10KHz video filter: Variable IF attenuator, LOG output calibrated in 10 db steps.

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FOR AMATEUR RADIO DESIGNERS AND BUILDERS

AUTUMN, 1994 • VOL. 2, NO. 4

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We welcome submission of articles, photos and manuscripts (S.A.S.E. for return)

• LETTERS •

From The Publisher

Behold an occasion for which we had hoped, yet did not dare to assume could come so quickly, yet not without some travail: Hambrew's First Anniversary! In celebration, we present a "heavy" issue, filled with projects in which we hope you will take some pleasure. Congratulations and huge thanks to all who have subscribed and contributed to the cause- from our "iffy" beginnings to this seemingly (though not truly) ripe old age. Without you, we would be just a whiff in the breeze, long gone and forgotten by now.

Time now to shoot for an upgrade, I think. It has been our desire for some months to provide *Hambrew* on a bi-monthly basis. Realistically, this cannot be accomplished without satisfying two basic criteria. We really need (1) a total of one thousand subscribers and (2) a slightly greater article inflow to make it happen. At the present rate, it will take at least a year to achieve the 1k subscriber mark, depending on renewal and new subscriber "velocity".

Therefore, I would like to propose a big "push" to accomplish bi-monthly status sooner. Here's the idea: If each current subscriber can suggest, coerce, wheedle and/or cajole one new subscriber to take the plunge within a month's time, we can go bi-monthly in very short order... we won't have to wait a year or more. The 1k watermark is not a casual goal. I will confess that so far the monetary motivation to keep the magazine going has been lacking. I have taken no more than a total of $100 as a salary (mostly for gasoline)- for the entire first year! It works out to about 4.5 cents per hour, which can be enough if it is a labor of love and one has another job. So the motivation is solely to get enough capital to afford the production and mail costs for bi-monthly frequency.

How does this sound? Can you stand to do it, or is it unfair? My thoughts are that if you as a subscriber believe in this magazine which you now hold in your hands, perhaps you would not feel like a salesman or a pushy person to strongly recommend it to another whom you feel would also enjoy it. Many of you have already done much to increase awareness of *Hambrew*, and for this we are grateful, yet, in a nutshell, the above is what is needed to publish on a bi-monthly basis, since we did not start out with a corporate-level capital investment. *Hambrew* may be homebrewed, but high quality still costs!

Thanks for a wonderful first year, and thanks for your efforts supporting the bi-monthly push!

George-
I figured it out! If a subscriber builds just one project per issue, and, say, spends twenty hours on the project at $5.00 per issue, this equals $5.00 divided by 20 hours, which equals 25 cents per hour of pure electronics excitement. Most of us have great junkboxes, so parts aren't too costly!
Keep it up, sir!!
Phil Hartzell, KAØKST
Aurora, NE

I like the way your mind works, Phil! And thanks for renewing!

George,
Considering the present trend toward "easy amateur licensing", and considering that some mainstream Ham mags seem to portray Ham Radio as a type of personal telephone service, it is refreshing to have a magazine that takes us back to the basics of our wonderful hobby. *Hambrew* is not only fun and informative, I view it as essential to the preservation of amateur radio in today's environment. Keep up the good work.
Larry Feick, NFØZ
Littleton, CO

What a great magazine! I'm just getting into building. The articles are very informative. Enclosed is a picture of my station. Lectro Kit QRP Transceiver (40 meters) and homemade 12V power supply.

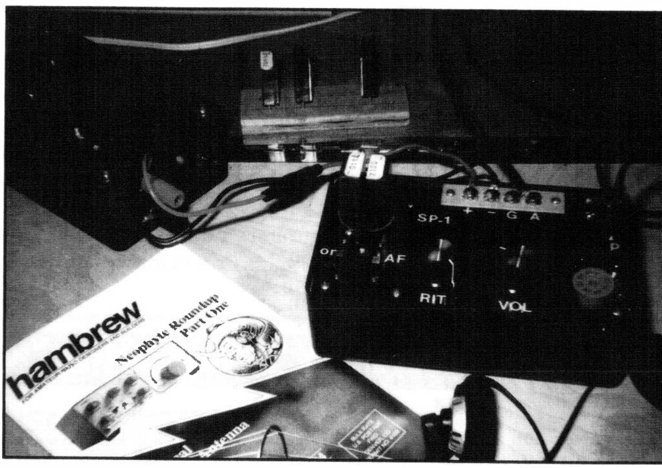
Any recommendations for mobile antennas(working off Mountain Bike)?...

Glad to have found such a great resource for learning about building and stuff.

Sincerely,

Brian R. Olson, NØXFE

Bloomington, MN



NØXFE's 40 M Station, with LectroKit & homebrewed Power Supply (photo by NØXFE).

I have looked at your Summer '94 edition for at least 4 to 5 times over the last month.

1. An excellent publication. 2. You are <u>not</u> overpriced. 3. The W6VAT AC and DC figures to teach theory are a very good concept. I have over 20 years in electronics and this is the first time I have seen this approach.

4. If you have an internet address, why not publish it? 5. I hope the Neophyte Roundup will not limit itself to this one rig.

Keep up the good work-

R. Cosma, KD1BF

Framingham, MA

Our Internet address is andromedo@aol.com (for the time being)- we cannot download or upload files or programs, but we can receive and send e-mail, and we will do our best to try to respond to correspondence received via the "highway". Re: #5 above, see the "Sudden" Receiver, this issue. Thanks for your encouragement and positive input!

Dear George:

I just received the Summer '94 issue of Hambrew and see you published my comments to you. So be it. This letter is to inform you of an error in the article "Wires and Pliers" on page 45. A "mechanical" buzzer must not be used. The continual on-off action of this type presents great danger to the items that are on the accessory line, radio-dash electronics and many other items. The huge pulses present may also present danger to the engine electronics. The voltage drop across the buzzer does not eliminate this problem.

I hope this is in time to prevent someone a problem.

73s

Mr. C. W. Bovender, KD4KOX

Greensboro, NC

We do want to hear of any problems or potential problems that might be present in any of the projects which appear in Hambrew. As Don (McCoy, WAØHKC) had mentioned that he has used this particular project for a number of years in his vehicle and it has worked fine with no adverse effects, we felt it was alright to present it to our readers. However, if you have any specific information regarding this circuit (make, model and year of car, truck,etc., tested, amount of voltage drop vs. spikes generated, et al), we would sure love to hear of it. In the meantime, I'm sure Don will have a response to this by the time the Winter, '95 Issue goes to press.

PIPSQUEAK CALLING

This certificate will be awarded for two-way CW contact with The Pipsqueak, which will be on 40 meters at 7.040 MHz +/-4 KHz (generally very near 7.042 MHz) every Sunday evening, operator willing, at 0400Z. The certificate costs nothing and will be mailed postpaid.

It will be awarded based on contact and entry in the WFØK logbook. Allow two weeks for delivery.

Working the Pipsqueak with a homebrewed receiver will count as a Class A certificate; any factory-constructed receiver used will count as a Class B certificate. Class of operation not indicated in the exchange will be awarded a Class B certificate.

This ongoing award began August 7th, 1994; the Pipsqueak will return each Sunday at 0400Z until further notice. Certificate numbers will be awarded in sequence with contacts beginning August 7, 1994. Contacts and numbers will be published in *Hambrew.*

COLORADO QRP CLUB FIELD DAY "SHACK SHOTS"

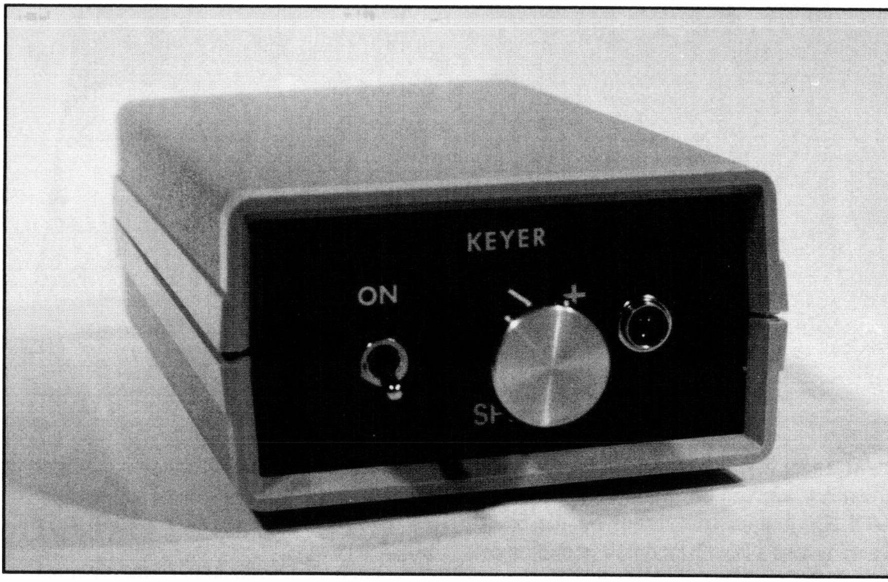
As snug as four bugs in a rug, the CO QRP Club ops and loggers enjoyed a gorgeous mountain setting for their '94 Field Day setup. Prez Rich High, WØHEP, sits before a homebrewed antenna selector/tuner. Great WX all weekend, too!

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. We're told it's already a collector's item. Back issues are $6/each in the U.S., mailed via first class mail. Supplies are limited.

KIT REVIEW

A&A's Low Cost C-MOS Iambic Keyer



Low current drain is a big plus of this kit (the enclosure is not included)

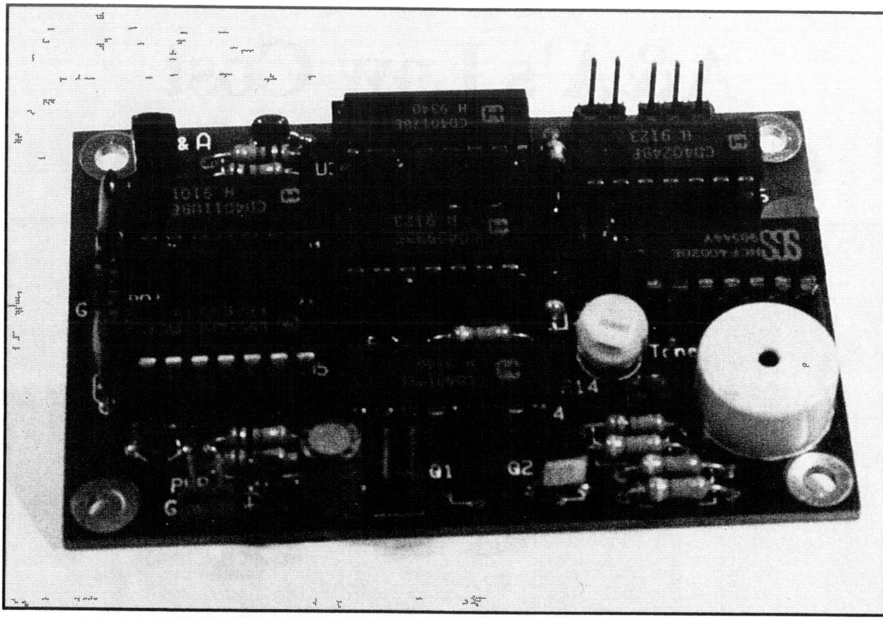
A&A Engineering of Anaheim, California offers this small and very high quality iambic keyer kit, part of a larger line of kits that run the gamut from WEFAX terminals to QRP transceivers. If the quality of the other kits are on the same level as this one, and there is no reason to assume that they are not, builders should feel safe to order from A&A.

The dimensions of the board are only 2" X 3", small enough to mount inside the enclosures of many rigs. It is double-sided, plated through, solder masked and silk-screened for parts placement. We chose to mount the board in a $2 surplus enclosure which is far larger than necessary for a minimum-size case. A&A does not supply an enclosure for this project.

Although the keyer will operate on less than 5V and up to 20V, it has been optimized to run on a 9V or 12V battery. The current drain is low enough that no ON/OFF switch is required nor provided. When not being keyed, the device draws less than 1/10 micro amp, and battery life is essentially the shelf life of the battery, A&A claims.

The circuit utilizes seven ICs, two 4017s, and one each of 4011, 4093, 4081, 4024 and 4002, accomplishing (not in order) Dot Memory, Dash Memory, Dot Counter, Dash Counter and Clock Divider, among other functions. Sockets are provided for the ICs. There are two transistors also incorporated into the design. The only panel-mounted control is a pot for speed adjustment.

A sidetone oscillator utilizing a transducer is also provided, the use of which is optional to the builder. While it generates a low-level



The PCB is only 2" X 3" and is of the highest quality

audio tone, it should be sufficient for most situations, and can be disabled by removing a MOLEX jumper (provided) on the board. There is also a board-mounted potentiometer for adjustment of sidetone pitch. The thought occurs that if the use of a keyer is fairly consistent by the builder, he may wish to discontinue installing sidetones in each and every transmitter or transceiver project and opt to use the keyer sidetone only.

Because of the wide voltage range of operating possibilities, two speed ranges are provided: HI and LOW. Selection is made with a shorting plug, and there is no soldering required to change the speed range. The timing clock runs at 64 or 128 times the code rate, so the first DOT or first DASH is the same length as the last. This is a feature not found on most low cost keyers.

A&A points out that the keyed output is an open collector NPN transistor capable of keying most modern rigs that have a +30V or less keying line.

The MOLEX connectors are a treat. Once the soldering of the connector pin unit is made to the board, installation of the connecting wires is very easy, and they can be disconnected (i.e., unplugged) very quickly and simply if needed.

While there is no weight control option (not usually a feature of any keyer in this price range), the quality of the keying is just fine, and should please the most discriminating of CW ops.

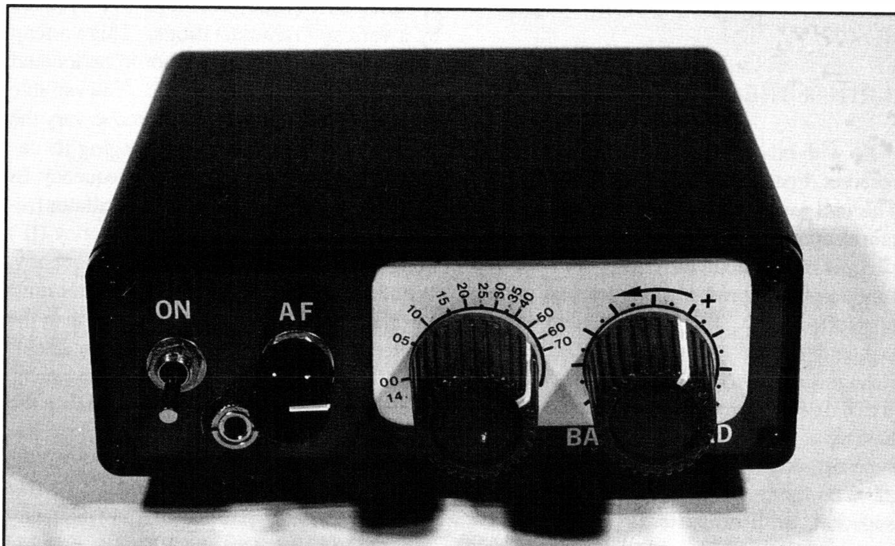
Three options are available to buyers for this kit: A&A can supply a blank circuit board (#151-PCB) for $12.95, a board-level kit with no enclosure included (#151-KIT) for $29.95 or an assembled and tested board, no enclosure included, (#151-ASY) for $39.95. Shipping and insurance is extra.

Catalog also available (S.A.S.E.):

A&A Engineering
2521 W. LaPalma, Unit K
Anaheim, CA 92801
(714) 952-2114

K6LMN 20 Meter Single-Conversion Superhet

Roger A. Wagner,K6LMN
1045 S. Manning Ave.
Los Angeles, CA 90024



This three-IC. superhet receiver for the 20M band is about as simple and inexpensive a receiver that you can find. While it is a no frills receiver, it offers excellent performance. It is a straightforward single-conversion superheterodyne receiver for reception of SSB and CW signals. The circuit was designed by K6LMN and the printed circuit board was designed by KB6NQ.

BACKGROUND

I was looking for a simple "no-brains" receiver to monitor one of my favorite HF bands - 2OM. My friends, heavy into QRP experimenting, suggested the Sudden Receiver by G3RJV. So I built it for 40M but and went on to its cousin the Neophyte. With some minor improvements, the Neophyte was a great performer on 40M CW/SSB, not bad for only a two chip receiver. These two receivers, being direct conversion designs, provided no rejection of the received signal's opposite sideband, most necessary in our crowded HF bands. Also the VFO built in to the NE602 would not be very stable at 14 MHz. Nevertheless, they proved simple to build and were fun little receivers capable of amazing performance despite their simplicity. Just a bit more complicated than a crystal set.

Desiring more performance in a simple receiver, I went on to build a 20M version of the 75M Superhet from an old *QST* article (May, 1989) which featured dual-gate FETs. This is a classic design using the IF at 9 MHz, allowing operation at 75 M or 20 M with just a simple change in the front end antenna filter. It was used as a test bed to check out various crystal filter designs for IFs from 8 to 11 MHz. It worked well but it was still too complex. I had not reached my goal. It used three transistors, an LM386, four hand-wound toroids and a lot of passive components. The dual-gate FETs are becoming more scarce in this age of integrated circuits, so after three months of building and testing these rigs, the obvious dawned on me: Why not a single-conversion superhet receiver based on the ubiquitous NE602?

BIRTH OF THE SIMPLE SUPERHET

So with bits and pieces from the Neophyte receiver, I patched together the first superhet. The end result was a receiver only slightly more complex than the Sudden and Neophyte designs in that another NE602 is added and functions as a product detector and crystal controlled BFO. The basic building blocks can be used on any band from 160M through 10M just by selecting the appropriate IF and VFO. It is a bare-bones three chip design having a minimum of components for a superhet receiver. As determined in the evaluation on the earlier discrete component 20M superhet, an IF amplifier is not essential for most signals on 20M even when using a basic antenna like a dipole. Off-the-shelf components are used throughout, and the only hand-wound coils are in the front-end antenna filter. I stayed with the same scheme of a 5.0 - 5.350 MHz VFO and a 9 MHz IF since I already had some nifty 9 MHz SSB crystal filters on hand.

Most communications receivers have an overall gain of over 100 dB and this basic superhet had an estimated gain of only 75 dB. So every effort was made to maximize gain at each stage.

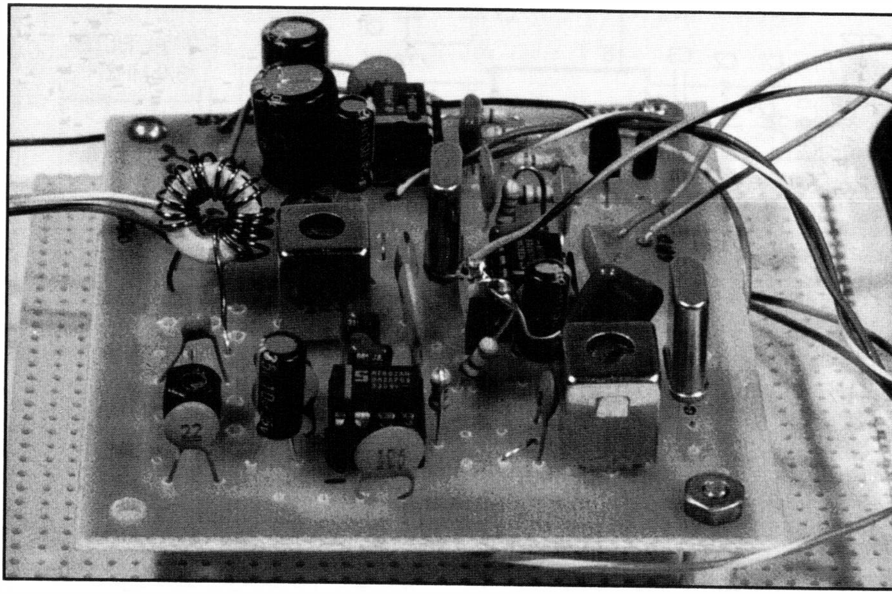
CIRCUIT DESCRIPTION (Refer to Figure 1 for the schematic diagram)

Front-end filter

The circuit of T1, C1 and C2 tuned broadly from 14.0 to 14.35 MHz, matches the antenna input (50 ohms) to the approximately 1.5K input impedance of the NE602 mixer/oscillator chip U1. A bare-bones front-end antenna filter is recommended for beginners because it is simple to construct and align. Since the IF (9 MHz) is high relative to the input frequency (14 MHz) image rejection even with a simple one-stage filter is quite good.

IC U1 is an NE602A which features a built-in variable frequency oscillator (VFO) tuned by a varicap (varactor) diode. This varicap allows the receiver tuning pot to be located remotely from the circuit board. The variable voltage output from this pot is used to vary the voltage across the varicap, changing its capacitance thus changing the VFO frequency. In a superheterodyne receiver, the oscillator frequency and the intermediate frequency (IF) determine the selected receiver frequency. With a 9.000 MHz IF filter the oscillator must be offset 9.000 Mhz lower or higher than the desired 20M signal, i.e., 5.000 MHz or 23.000 MHz for 14.000 MHz antenna input frequency. In the interest of good oscillator stability the lower frequency 5.000 MHz is desirable. Thus to tune the entire 14.0 to 14.35 MHz band the v.f.o must tune from 5.000 to 5.350 MHz respectively. An external digital frequency counter connected to the VFO can provide continuous frequency readout of the received signal. Connect counter to U1-7 via a small capacitor like 10 - 47 pF (to avoid loading the VFO). Simply add 9MHz to the reading or ignore the leading 5.xxxx MHz portion displayed.

I tried a balanced input as recommended by the manufacturer, Signetics, to reduce 2nd order mixer effects. The receiver somehow was quite susceptible to strong, local AM broadcast signals. I did some math and determined the 2nd harmonic of the 5 MHz VFO (10 MHz) was mixing with broadcast signals around 1 MHz. After all, 10 MHz mixed with 1 MHz input gives a mixer output of 9 MHz which is the IF. So the front-end design is unbalanced as in the Neophyte and the problem went away. A balanced input would



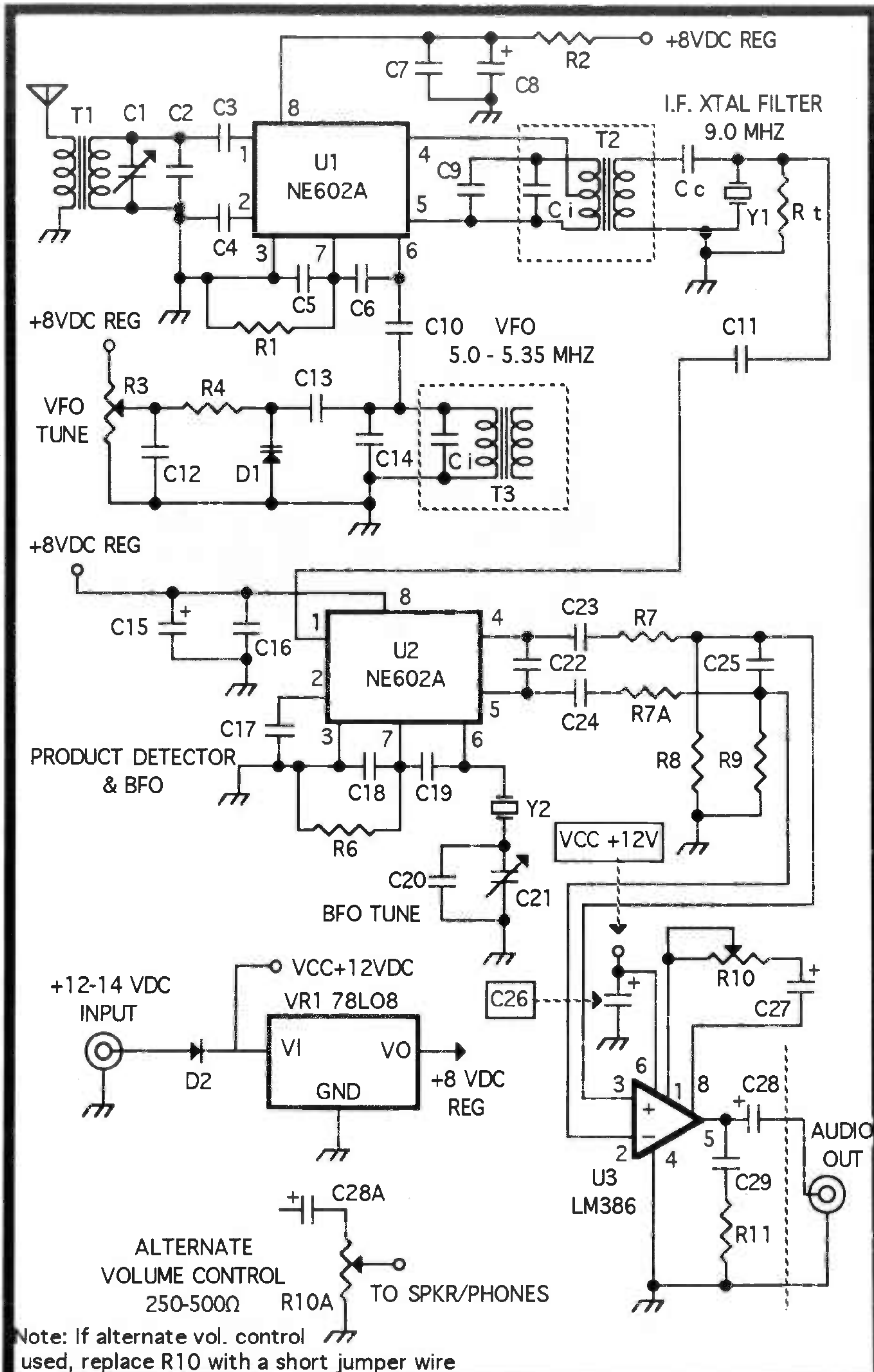
eliminate the need for bypass capacitor C4.

Crystal Filter

Other IFs can be used from 8 to 11 MHz using inexpensive microprocessor clock crystals, but the oscillator L and C values and T2 (IF) tuning caps must be changed accordingly. The balanced output of the first 602 chip is coupled by IF transformer T2 to the crystal filter Y1. Use of the highest possible IF, unlike the commonly used low IF (455KHz). provides superior front end image rejection. The choice of a 9.000 MHz IF allows for a simple change to the 80M band. The antenna input circuit must be changed to cover 3.5 - 4.0 MHz. Many classic and modern ham transceivers also use this 9.000 MHz as well as nearby 8.800 MHz IFs.

This basic receiver features a minimal crystal filter which produces good filtering for SSB despite its simplicity. The crystal operates in the parallel resonance mode, passing USB signals and rejecting LSB signals, which are shunted to ground. Lower sideband rejection is at least 15 dB. You may want to add a store-bought filter (expensive!) or build your own 4 to 8 pole ladder, lattice or Cohn-type filter. If you brew your own filter using inexpensive surplus or microprocessor clock crystals, be sure to select and match them for frequency and the highest Q. External filter loss may drop the signal 6 to 15 dB, so a single-transistor IF amplifier may have to be added externally to make up for the loss. All crystal filters must be terminated by some specified impedance. For broad filtering for SSB no terminating resistor was found necessary for 8 to 11 MHz single crystal filters. Any crystal filter termination resistor is in parallel with the approximate 1.5 K input impedance of the next IC stage U2. You may wish to experiment here to alter the filter bandwidth with a parallel or series resistor, but any resistor will lower the overall receiver gain.

Remember the crystal phasing control located on the front panel of the 1940s and 1950s receivers? It was used to notch out unwanted signals like heterodynes. Well the same concept used back then at 455 kc IFs applies to today's 9 MHz single crystal filters. One can


+8VDC REG
R2
C7
C8
T1
C1
C2
C3
8
U1
NE602A
1
2
4
5
C9
T2
Ci
I.F. XTAL FILTER
9.0 MHZ
Cc
Y1
Rt
C4
3
7
6
C5
C6
+8VDC REG
R1
C10
VFO
5.0 - 5.35 MHZ
C11
R3
R4
C13
VFO
TUNE
C12
D1
C14
Ci
T3
+8VDC REG
8
C15
C16
1
U2
NE602A
2
4
5
C23
R7
C22
C25
C24
R7A
C17
3
7
6
PRODUCT DETECTOR
& BFO
C18
C19
R8
R9
Y2
R6
VCC +12V
C20
C21
BFO TUNE
VCC+12VDC
+12-14 VDC
INPUT
VR1 78LO8
R10
C26
C27
VI
VO
D2
GND
+8 VDC
REG
6
3
1
8
C28
AUDIO
OUT
2
4
5
U3
LM386
C29
R11
C28A
ALTERNATE
VOLUME CONTROL
250-500Ω
R10A
TO SPKR/PHONES
Note: If alternate vol. control
used, replace R10 with a short jumper wire

K6LMN SINGLE CONVERSION SUPERHET

C1, 21	5 - 80 or 10 - 100pF trimmer cap
C2, 11	68pF ceramic capacitor
C3	20pF ceramic capacitor
C4, 7, 16, 17, 23, 24, 29	0.1µF ceramic 50V capacitor
C5, 6	660pF NP0/C0G*
C8, 15, 27	10µF/15V-35V electrolytic
C9	33pF ceramic capacitor
C10	330pF NP0/C0G*
C12	0.33µF ceramic capacitor
C13	56pF NP0/C0G*
C14	Optional cap> 10-47pF NP0/ C0G ceramic capacitor
C18, 20	100pF NP0/C0G*
C19	39pF NP0/C0G*
C22, 25	0.015 - 0.018µF (0.022 for CW only) ceramic or poly. capacitor
C26	220 - 470µF 16V to 25V electrolytic
C28	220 - 330µF " " " "
Cc	10 - 15pF capacitor
R1, 6	27k, 1/4w, 5%
R2	100Ω, 1/4w, 5%
R3	10k - 25k VFO pot, linear taper 10-turn type preferred
R4	100k, 1/4w, 5%
R7, 7A	1.5k 1/4w, 5%
R8, 9	10k 1/4w, 5%
R10	10k volume control, audio taper
R11	4.7Ω, 1/4w, 5%
T1	Toroid transformer, 3T primary, 15Tsecondary, #24 on T44-6 yellow core. Primary wound in same direction as secondary and located near ground side of secondary.
T2	Mouser IFT128 10.7MHzor equivalent
T3	Ditto T2 or for low drift use 29T #26 on T50-6 powdered iron toroid core. Use C14 = 68 - 82pF NP0 + 10 pF trimcap to trim
VFO	
U1, 2	Signetics/Phillips NE602AN Mixer/Osc. DIP
U3	LM386 Audio Amplifier DIP
VR1	78L08 8V voltage regulator
D1	270pF varactor diode
D2	1N4001 rectifier diode
Y1, 2	Crystal, 9.000MHz, 0.005%, parallel type

*ceramic, poly or silver mica

Note: These values are for the 20 Meter version.

move the notch and peak around with various series and parallel capacitors and inductors. Crystal coupling capacitor Cc was determined experimentally and the whole filter is a compromise for SSB and CW reception. The depth of the null or notch on the opposite sideband is over 35 dB.

Product Detector/BFO

The next IC, U2, is the product detector. Again, it features the NE602A mixer/oscillator chip. For detection of SSB and CW signals using a product detector a beat frequency oscillator (BFO) is required. For excellent BFO stability the oscillator frequency is fixed by crystal Y2 at a frequency slightly offset from the crystal filter center frequency. For upper sideband, which is the standard on 20M, the BFO is set about 1.5 KHz lower than the IF. So for a 9.000 MHz crystal filter the b.f.o. is adjusted to 8.9985 MHz. C21 is a trimmer to adjust the BFO frequency. Tune it for the most comfortable sounding voice or CW signal. So to reproduce audio from the incoming SSB/CW signal now translated to the IF, the BFO is mixed inside the product detector chip and out comes audio, either voice or a CW note. The balanced output at pins 4 and 5 is fed thru a simple audio bandpass filter (300 to 3000 Hz) to the audio amplifier. The design for the low pass filter preceding the audio amplifier was lifted from the Neophyte.

Audio Amplifier

The last IC is the audio amplifier U3, an inexpensive and easy-to-find LM386 chip. It is capable of tremendous gain of 46 dB and features a low distortion 250 to 500 MW audio output. Higher power versions like the LM386-3 and -4 will provide a bit more power output. Speaker/headphones can be 4 ohms and up. Eight to 45 ohms is preferred for best results. The audio gain pot provides a change in audio output of some 20 dB (voltage gain change from 20 to 200). Fortunately the chip's designers allowed some gain control by varying the chip's negative feedback at pins 1 and 8. The speaker volume cannot be reduced to zero with this design. I chose this approach because it is difficult with a balanced audio input to provide full audio gain control with constant filter bandwidth. The Neophyte receiver can be likewise modified. Thus the annoying audio hiss in the Neophyte can be reduced somewhat. You may want to unbalance the audio input (but lose 3 dB overall gain) and use a lOk to 50k pot at the LM386 input. In either case keep the volume control leadwires very short and shielded. If more gain reduction is required using the stock design, add a 100 ohm pot in series to the speaker.

There is a considerable impedance mismatch between the NE602 product detector balanced output and the LM386 balanced input. Purists may want to add an audio transformer to match the NE602 3K differential output impedance to the LM386 lOOK differential input impedance. I tried this and found it did add tremendous audio gain but at max. gain there was some audio circuit instability. The audio matching transformer also picked up hum from nearby power supply transformers.

Voltage Regulator

To provide needed voltage reduction, isolation from the DC power bus and voltage regulation for the NE602s, an LM78LO8 8 V voltage regulator is used. A shunt regulator such as a zener diode is simple but wastes a lot of precious battery current.

POWER REQUIREMENTS

Recommended power input voltage is 12 VDC minimum to 14 VDC maximum from a battery or well-filtered DC supply. The receiver can be modified to run off d 9 v battery by changing the LM78L08 voltage regulator to a 5 volt 78L05. Gain will drop slightly and the maximum speaker volume will drop somewhat with 9 v input. If headphones are used this may be OK. Tuning range will drop down a bit also. This receiver, because of its simplicity and minimal parts, requires very little current. With low audio output, current draw is only 16 mA. While at full power output, current consumption rises to over 100 mA on peaks, depending on speaker impedance. Low speaker impedances like 4 ohms draw much more battery current for the same speaker volume. Try to use as big a speaker as possible for best volume output.

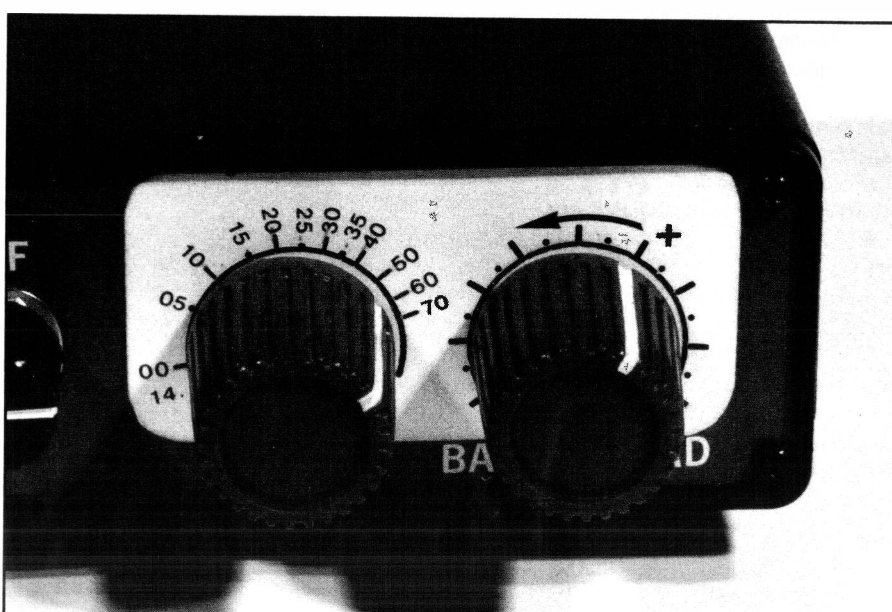
IMPROVEMENTS

No automatic gain control (AGC) is provided in this basic receiver but gain can be controlled manually by the volume control pot. Also a lK antenna gain pot can be added at the receiver antenna port to reduce gain even more. This is particularly helpful to reduce front end overloading on S9+60 super strong signals. You may wish to experiment with a PIN diode attenuator in series with the antenna to provide AGC. AGC voltage can be derived from audio signals from the 2nd NE602 amplified by an op amp and then rectified and filtered. This attenuator can also double as an antenna relay when using the receiver with a companion transmitter. AGC applied to a grounded gate JFET preamp also works very well. With a typical 20M vertical antenna no overloading has been experienced except from my ham neighbor. To reduce the possibility of blowing out the front end from nearby lightning (not a direct hit!) solder some lN914 signal diodes forward and backwards across T1 primary to ground etch.

If images and spurs are a problem from strong stations not on 20M, add a trap or add another stage of antenna filtering (double tuned front end). If you have a problem with cross-modulation or intermodulation distortion (non-image problem) try deleting R1 resistor but overall receiver gain will drop a bit. For CW fans, either add an outboard audio filter or select a narrowband crystal filter. For about lKHz audio bandwidth (for CW) change the onboard audio filter caps from 0.018ufd to 0.022ufd or more. The VFO varactor diode can be replaced by a 270 to 365 pf variable capacitor commonly available at surplus stores or from an old table radio. I recommend a 4 or 10 to 1 gear reduction on the shaft of the tuning pot or tuning (Continued on page 45)
(Continued from page 15)
capacitor to ease tuning in stations. To improve tuning in a station if you only use a one turn VFO pot, try adding a 50 or 100 ohm fine tuning pot in series with the main coarse tune pot. Connect the fine tune pot wiper or center pin to its cold (ground) side. Lift the ground off the VFO existing coarse pot and connect in the other pin of the fine tune pot. The frequency control pot can be wired for frequency increase in a clockwise direction (conventional) or vice versa. To reverse direction, keep the wiper (center) wire the same and reverse the ground and +8V leads to the pot.

For more audio output power add an external audio power amp like an LM380 chip, which is good for some 2 - 3 watts out. If an external audio amp is used, solder in a dummy load resistor like 47 - 100 ohms to ground at the output of your receiver. Then connect your external audio amp input to the receiver's SPKR/PHONES terminal and to circuit ground.

The basic receiver offers a VF0 with a stability of 100 - 200 Hz drift (negative going) after a 10 minute warmup. The main cause of drift is VF0 inductor T3 (a 10.7MHz IF transformer) which has a large positive temperature coefficient of (Continued on page 45)



• New Products •

New Radio Shack Frequency Counter

Fred Bonavita, W5QJM

Radio Shack's newly introduced frequency counter is a sleeper for bargain-hunting hams.

Like its costlier counterparts, it's a hefty handful that measures rf from 1 MHz to 1.3 GHz. The others are heftier in gongs, whistles and bells and in price tags that are from 30 percent to 300 percent more than this one.

For instance, this Radio Shack unit won't store readings to be fed into a computer later or perform other laboratory type functions that have little application for the ham who is building and testing gear at home. This is a pure vanilla counter that sits there and works.

It is ideal for Field Day or some other battery-powered outing to check the frequency of a homebrewed rig without a power-hungry digital display. Back in the shack, it is an asset in tuning rigs under construction.

(Photo: W5QJM)

At this writing (late July), Radio Shack sells these counters (catalogue No. 22-305) for $100. Because it's new, the counter is offered at a 10 percent discount (see coupon in back of the catalogue). It works from four AA alkaline or NiCd batteries or a 9-volt wall transformer (none included).

Bottom line: It's a good buy on a good piece of equipment for the shack or field use.

Have a new product?
Put it in ***Hambrew***!

Neophyte Roundup

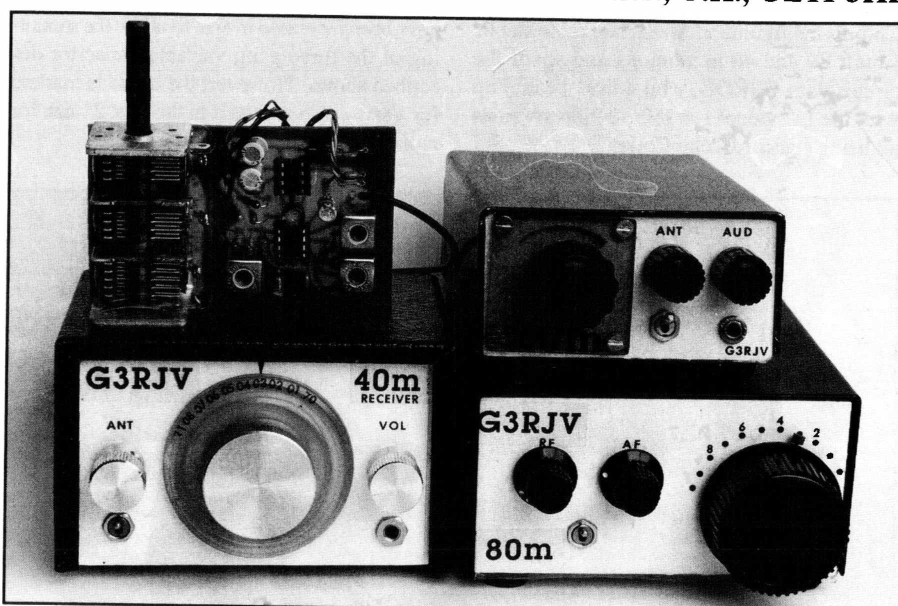
Another Report In An Ongoing Compilation Of Neophyte Information

The following article, reprinted from *SPRAT*, the publication of the renowned G-QRP Club, details construction of the "Sudden", a receiver which could be termed a design cousin of the Neophyte. Interesting how great ideas bounce back and forth across the "pond"!

The "Sudden" Receiver

Rev. George Dobbs, G3RJV

St. Aidan's Vicarage
498 Manchester Rd.
Rochdale,
Lancs., U.K., OL11 3HE



Three versions of the Sudden are shown, along with the PCB/Main Tuning capacitor configuration at top left.

For several years club members have been asking for a G-QRP Club simple receiver project and I had been half -heartedly investigating the possibilities. Then on our visit to Dayton I met John Westphal, W8YNA. John, an avid constructor, introduced me to the NE602 and some of the circuits which had appeared using this IC in the USA; he also provided me with samples. Amongst the circuits was a simple QST design called the Neophyte and this approach seemed to offer a possible solution to the request for a simple club receiver project.

The NE602 is a useful device: being a

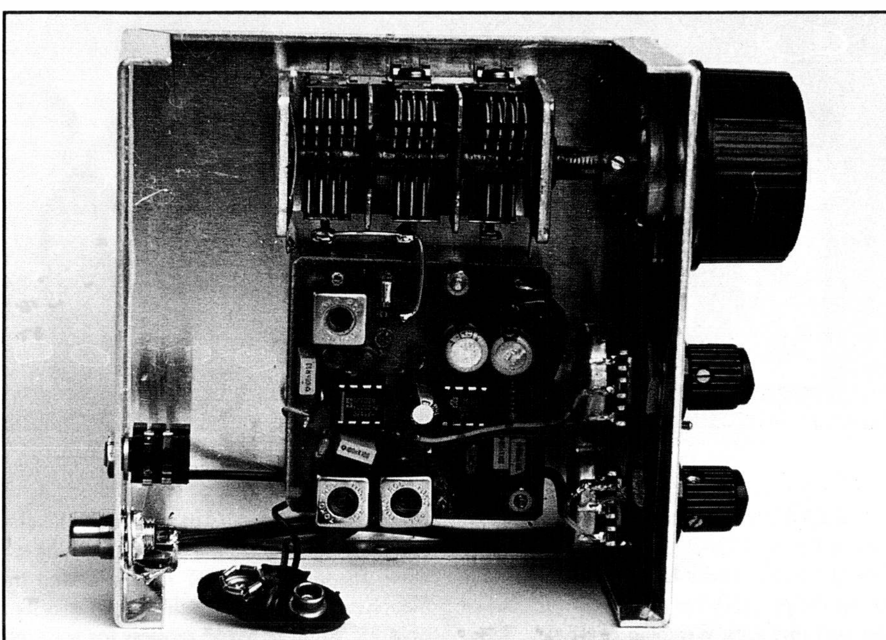
double balanced mixer, a voltage regulator and an HF oscillator all contained in one eight pin DIL (DIP) package. The oscillator is capable of working to about 200 MHz and the access to the IC allows for several VFO configurations. That adds up to about three quarters of a direct conversion receiver in one chip... very handy!

I tried several designs, including the Neophyte and the device seemed to work well. The problem with the Neophyte was its use of balanced input and outputs which made the use of commercial coils more difficult. The circuit described here was originally hooked up on the bench to see the practical disadvantages of using the mixer single ended. The results were very pleasing for such a simple circuit. The mixer worked well and the VFO which might be recognized as the popular Colpitts configuration, was remarkable stable. I built 80 and 40 m versions and shard the circuit with G3ROO, who quickly came up with the LC values for 160/30/20m versions all using standard Toko Coils.

The receiver uses a fixed tune input filter, from an RF attenuator, control feeding the mixer. The oscillator circuit (around pins 6/7) uses another Toko coil and is calculated for the cheap 10/10/20pF three-gang capacitors sold by John Birkett. The band values chart shows the required LC values for each band including the use of this variable capacitor. Naturally other variable capacitors of similar value could be used.

The audio gain is provided by an LM386 eight pin DIL IC. There is plenty of available audio for driving walkman type headphones but hardly enough for good loudspeaker volume. The receiver is supplied by a 9 volt battery: a 12 volt supply must not be used.

The receiver fits easily onto a 2"x2" printed circuit board. The copper layout and component layout are shown. Our prepared boards have been increased in size to allow the mounting of the three gang variable capacitor described above. However, the board is marked for a saw cut to reduce it to the 2" x 2" size for mounting a capacitor off board.



Interior of the Sudden cabinet, showing placement of main tuning capacitor

Parts List

Resistors

R1	1k potentiometer
R2	27k
R3	1.8k
R4	4.7k potentiometer
R5	15 ohm
R6	22 ohm

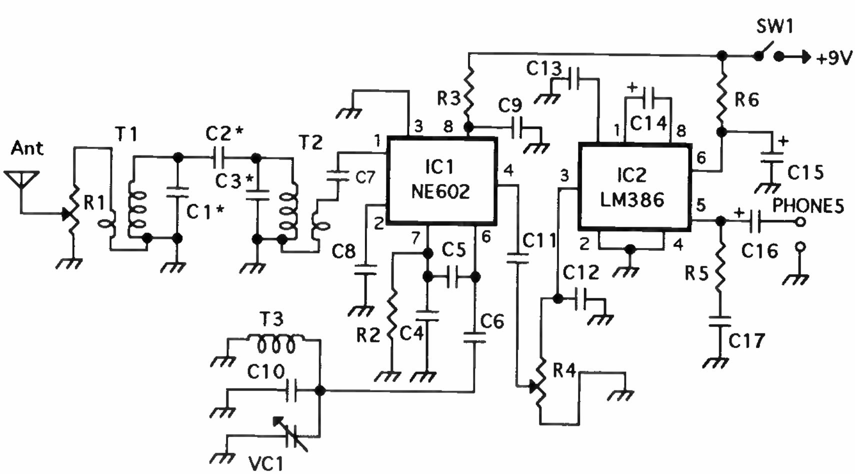
Capacitors

C1-6	See Table 1, pg. 21
C7	100pF
C8	0.01 μF
C9, 12, 13, 16, 17	0.1μF
C10	See Table 1, pg. 21
C11	1.0 μF/35V tantalum
C14	10μF/16V tantalum
C15	100μF/25V elecrolyt

Coils, ICs and Misc.

T1, T2, T3	See Table 1, pg. 21
IC1	NE602
IC2	LM386
SW1	SPST switch
VC1	Variable capacitor; three gang: 10pF, 10pF and 20pF

G3RJV's Sudden Receiver



Choice of components is non critical except for the capacitors C4/5/6 and capacitor across VC1, which should be polystyrene. I used miniature ceramic plate types for C1/2/3 and the rest are miniature discs and electrolytics. All resistors are quarter watt. The 1K attenuator control is a carbon track linear potentiometer of any value from around 50 ohms to 2.2k. The audio gain control is a log. pot. of 4.7k or 10k. During construction, it is helpful to build the audio section first (audio gain control to output) and test this section before completing the rest of the circuitry.

The only adjustments required are getting the oscillator onto frequency, using the core in T3 and peaking the input filter using the cores in T1/2. A counter can be connected to the unused winding on T3 but I found that this gave unreliable readings on my counter. The best, and simplest, way to adjust the oscillator is to tune a receiver to the required band and use a few feet of wire as an antenna, draped across the body of the NE602. the core on T3 is adjusted (slowly!) until the signal is heard in the receiver. The bottom end of the band may be set with VC1 fully meshed. Secure the core with "goo": I like beeswax.

Connect an antenna or a signal generator and peak T1/2 for maximum signal strength. I suggest several "peak-ups" in the order: centre of band, high end, low end, and back again to centre for final peaking.

The receiver is simple but it works surprisingly well. The RF attenuator may be essential in the evenings to reduce BC breakthrough. A recommended way to use the two gain controls is to have the audio control set high and to use the RF control as the effective gain control.

Build it... I think you will enjoy this little receiver... Why "SUDDEN"? Well, that's G3ROO's idea. When I am not building up QRP equipment for that matter when I am!) I am the Vicar of Sudden, once a village until it was swallowed by the town of Rochdale.• • •

The SUDDEN Receiver kit is available for $30 (+ $4 S&H) from
Kanga US: Bill Kelsey, N8ET
3521 Spring Lake Drive, Findlay, OH 45840
It includes everything necessary to build the receiver except
the enclosure, variable capacitor (also available from Kanga US), knobs, battery, connectors and earphones. A catalog is available.

TABLE 1
(all capacitance values in picofarads unless otherwise noted)

Band	C1	C2	C3	VC1+C10	C4	C5	C6
160	220	10	220	All Sections+100pF	.001μF	.001μF	560
80	47	3	47	All Sections +100pF	.001μF	.001μF	560
40	100	8.2	100	1 Section + 47pF	560	560	270
30	47	3	47	1 Section + 68pF	680	680	220
20	100	3	100	1 Section + 68pF	220	220	68

Band	T1	T2	T3
160	BKXN-K3333R	BKXN-K3333R	BKXN-K3333R
80	BKXN-K3333R	BKXN-K3333R	BKXN-K3334R
40	BKXN-K3334R	BKXN-K3334R	BKXN-K4173AO
30	BKXN-K3334R	BKXN-K3334R	BKXN-K3335R
20	BKXN-K3335R	BKXN-K3335R	BKXN-K3335R

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add $5.50 S & H

Curtis 8044ABM Keyer Kit

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

8044ABM Keyer Kit $31.00

8044ABM Chip and Data Sheet $17.50

W7EL QRP Wattmeter

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

Wattmeter Kit $36.00
With Minibox $45.00
With Minibox and meter $53.00

Mini Circuits Labs Mixers

SBL-1	$6.00
SBL-3	$6.50
TUF-1	$6.50

Toroid Cores

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

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

Specials

NE602AN 10 for $14.50 Postpaid

10 FT37-43 cores $2.25

10 T50-2 cores $2.25

10 T37-2 cores $2.25

IC's

NE602AN	1.65
LM386N	1.00
LF353N	1.00
LM358N	.75
LM324N	1.00
NE555N	.75
MC3362P	3.50
LM6321N	5.00

Experimenter's Kit

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

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

Experimenter's Kit $13.00

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Start With An Old Relay...

Roy Gregson, W6EMT
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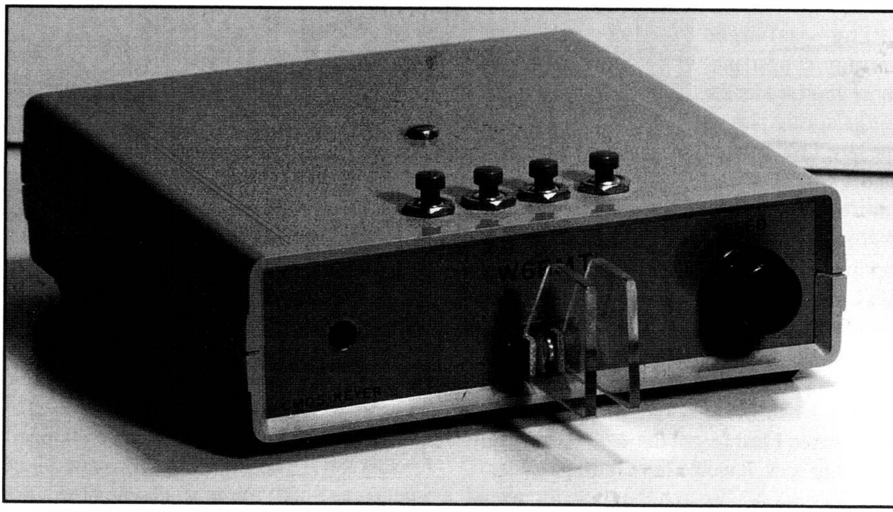


They say necessity is the mother of invention. I don't think of myself as an inventor, but, I really did come up with what for me was a better mouse trap.

For the last forty years or so, I have used a "BUG" for CW, a "SPEEDEX model 500" to be exact. A few years ago while on field day, Bob, WU7F gave me the opportunity to try the "CMOS SUPER KEYER II". It's a kit with a preprogrammed chip on a pc board, with all of the bells and whistles you could want, and was assembled in a small box with four push button switches on top. I was amazed with the ease the keyer made of CW, and I decided that I had to have one. To my complete surprise, my wife and a good friend presented one to me for my birthday.

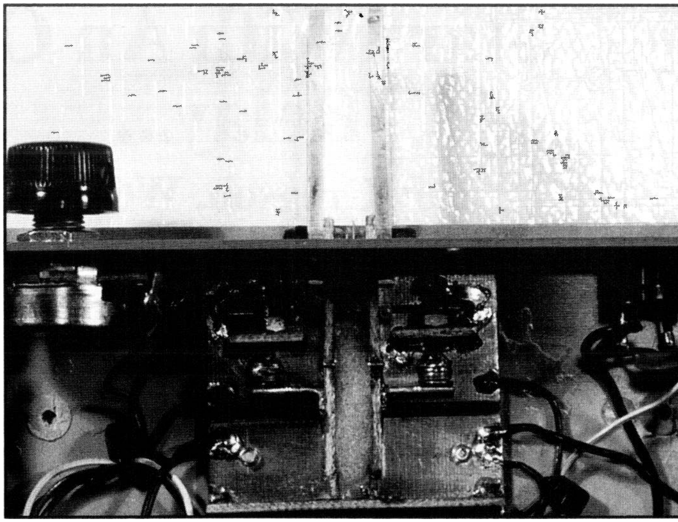
Now all I needed was a key!. At field day, Bob used a Bencher Iambic key. No problem I figured, so down to the local ham store I go with checkbook in hand to purchase a Iambic key. Whoa!, I guess I haven't been in the real world lately. My budget just couldn't stand the cash outlay without some preplanning (saving).

I took a long hard look at my bug, trying to picture a way to modify it for use as an Iambic key (it is possible). But no way, it is, after all, a collectors item, and old, like me. I thought it would be nice to keep it as a standby.

Anyway, to make a long story short, I decided I could make a key (as a temporary measure, of course) 'till the budget could afford a "REAL" Iambic key.

The junk box produced several 24V 3PDT relays with good clean contacts, and some copper springy material.

I disassembled a relay, and broke the molded stuff to get to the fixed contacts which I used for the adjustable contacts on the key. The moveable relay contacts with the spring were used for the moveable key contacts by cutting and bending as shown in fig 1. Or you could use one of the fixed relay contacts for a more firm contact. Your relay may be somewhat different, but the basic idea should work for you too!



The salvaged springy copper material was used for the hinge/spring part of the key. I had thought that I'd have to experiment with how many layer pieces of spring to use for that "just right feel". But one was perfect for me.

The most difficult part was soldering the adjustable contacts to the ends of the 4-40 screws, and keeping them straight. And of course I had the first one all together and discovered I had forgot the 4-40 locking nut! Looking back, it would have been far better to use brass screws because the soldering would be easier. I should mention that the 4-40 locknut also ensures a good electrical contact to the PCB material.

Note that there are no critical dimensions for the keys. You can pick a size that fits your needs. But for reference, the key base plate is about 2.0" x 2.0". I used double-sided PCB material for the base plate, arms, adjustable contact mounts, and the hinge/spring mounting plate. Tack solder the assemblies in place "till final adjustments, then solder to stay!

I wanted the key and keyer to be a self contained unit. I recycled a 5" x 1.5" plastic cabinet, and made new front and rear panels. A miniature piezo-electric "buzzer" was found that made an excellent speaker. I made a cord from the keyer to radio that has a 1/8" phone plug on one end and a 1/4" phone plug on the other end. With 1/8 and 1/4 inch phone jacks wired in parallel on the back of the keyer, just switch cord ends to accommodate any size key jack on the radio. I used some scrap sheet lead bolted to the cabinet inside top to give the whole thing some "stay put".

This was not intended to be a construction article, but more of an idea generator. I believe the basic key can be improved upon, and probably with much better craftsmanship. The Curtiss keyer IC would also be a good project for this key. The key could be made much smaller, and built inside of a home brew QRP rig. That's one less thing to carry on that backpacking trip you have always wanted to take!

The key doesn't have precision ball bearings, infinite adjustments, chrome plating, big price tag, etc. But it does have silver plated adjustable contacts, recycled material, and the pride of home brewed creative accomplishment, with a low price tag. I've used the key for about 3 years now,.... so much for temporary.

The photos show what I did. So check out your junk box, use your imagination, some common sense, that HAM ingenuity, a whole bunch of good luck and see what you can come up with.

I am pleased with the end result. I have a "REAL" Iambic key and keyer now. It really works great, and best of all, it "feels just right". Now if I can retrain my sending hand that there no longer a "BUG" there.........

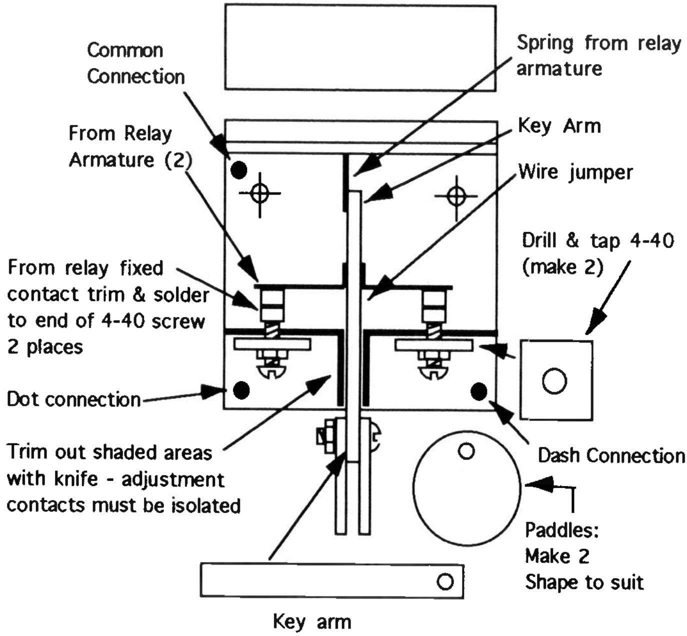


Figure 1

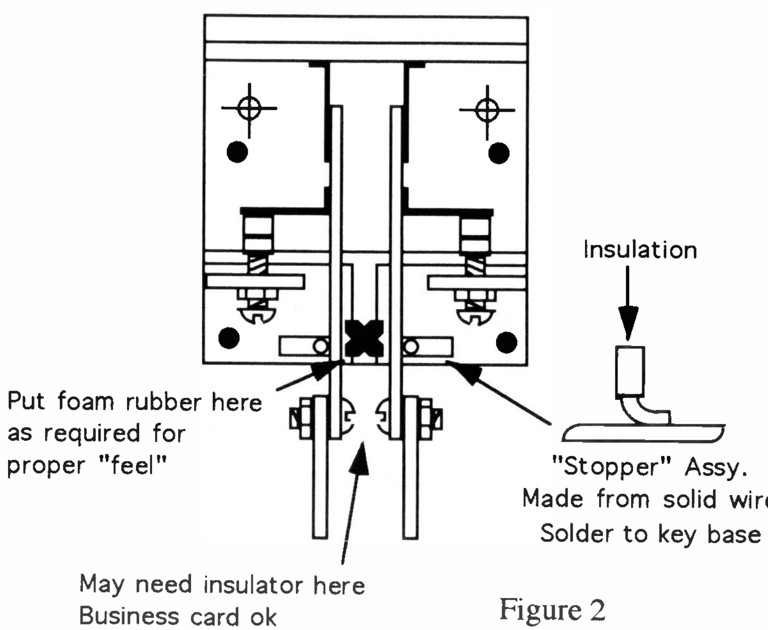


Figure 2
Key 2A

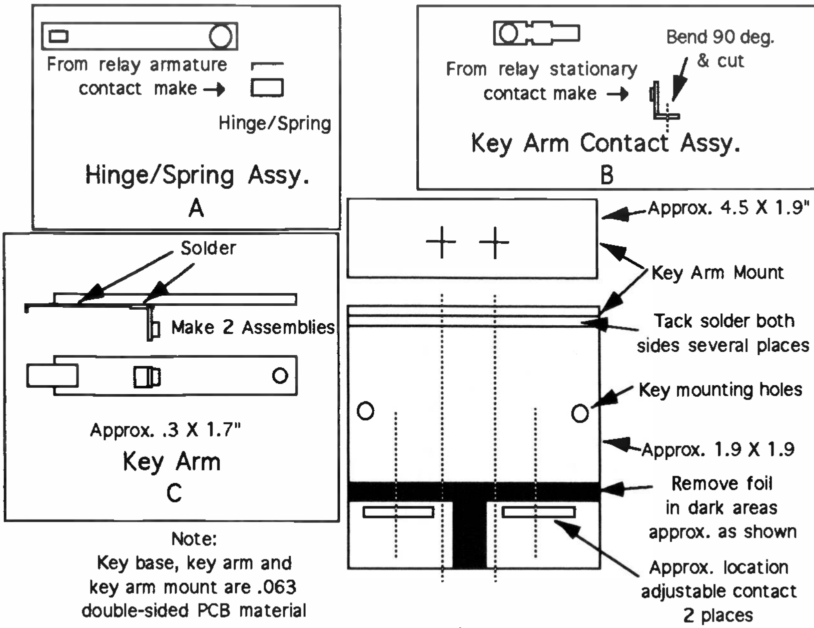


Figure 3

All dimensions are for reference only

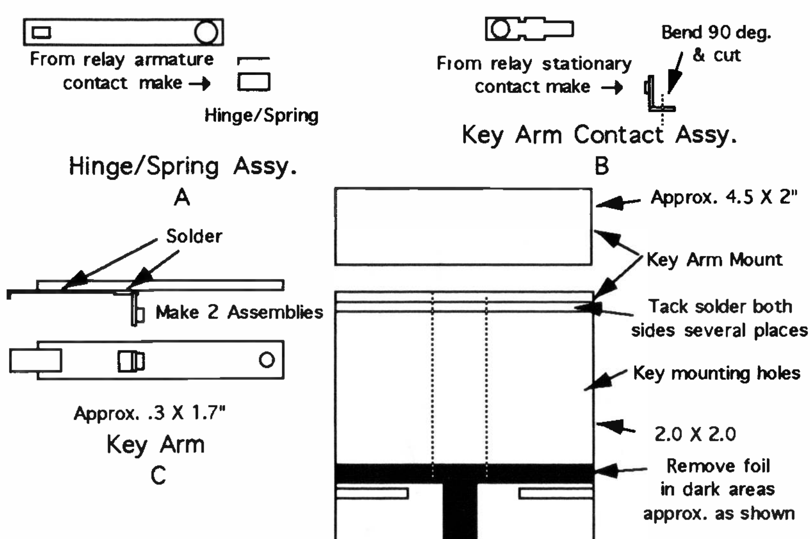
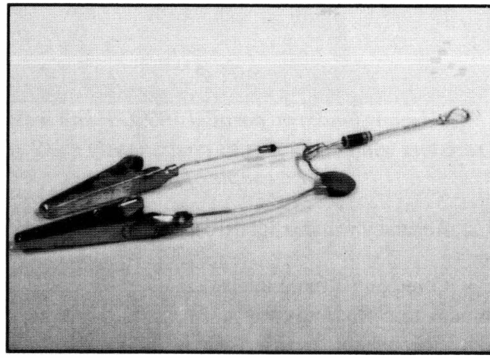


Figure 4

A Versatile 50 Cent RF Probe

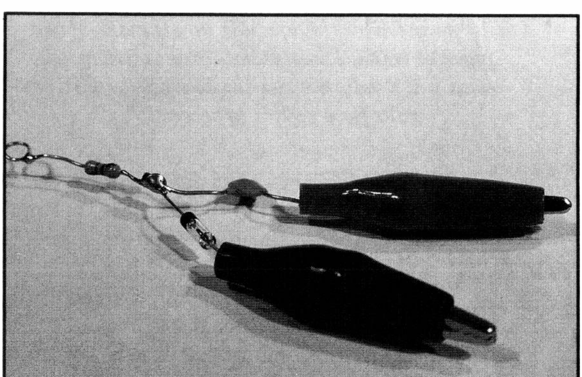
Lew Smith, N7KSB
4176 N. Soldier Trail
Tucson, AZ 85749


RF probe using 1N34A.

An RF probe consisting of a diode, a capacitor, and a resistor will allow you to use your volt-ohmmeter to accurately measure RF voltages and QRP power. The addition of a few more resistors allows SWR and also higher power measurements. The RF probe makes a handy field strength meter and it can even be used to check harmonic output.

RF Voltage Measurements

Figure 1 shows the capacitor input configuration that is normally used to measure RF voltage. The DC blocking action of the capacitor makes this version especially useful for troubleshooting RF circuits that have DC bias on the signal to be measured. A field strength meter can be made by connecting a small whip antenna to the capacitor input and by using the VOM leads as a ground.


RF probe using the 1N4148

RMS Calibration

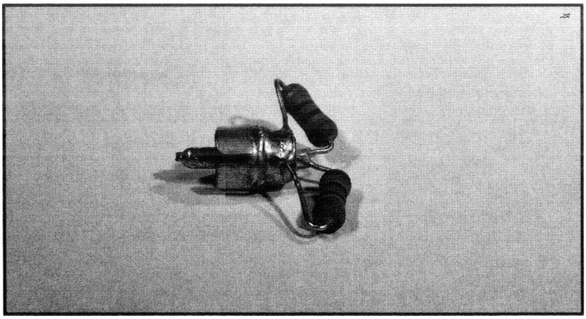
The RF probe is a peak detector that responds to the crest of the RF sinewave. Traditionally, meters have been calibrated in RMS (square Root of the Mean of the Square of the signal) regardless of whether the basic detector is peak, average, or true RMS.

If RMS calibration is desired, the RF probe resistor should be 0.414 times the input resistance of the VOM. Host digital and JFET input meters have a 10 megohm input resistance. A 4.14 megohm (3.9M will work) resistor is needed for these type of meters. Non-electronic analog VOMs have a resistance that is usually 20K ohms times the number of full scale volts on the particular range that you are using. Thus a "20k/volt" meter on it's 50 volt range will have a 1,000K ohm input resistance and a 414K ohm (390K will work) RF probe resistor will be required.

Peak Calibration

There are several reasons to forgo RMS calibration and let the RF probe remain in peak volts:

1. The probe will work on any DC voltage range of any VOM.



50Ω dummy load: two parallel 100Ω, 1 watt metal-oxide resistors will handle 2 watts continuously or 12 1/2 watts for a couple of seconds.

RF source one is likely to be measuring.

Power Measurements

Figure 2 shows the diode input connection often used to measure power. The capacitor input connection will also work, but swapping the input leads allows less RF to get into the VOM. (Although non-electronic analog meters are not RFI sensitive, this may not be true for JFET input and digital meters. A 0.01 mf ceramic capacitor right at the input terminals of a VOM should cure any stubborn RFI problem).

Note that the diode input version must be used with an RF source that is free of DC and that has a DC return path for the VOM. A dummy load will provide a suitable return path.

The diode will be subjected to twice the peak voltage of the signal. Thus a lN34A diode rated at 75 volts can be safely used up to 37.5 volts peak (or 26.5 volts RMS). Assuming a 50 ohm load, this limits the maximum power that can be safely measured to 14 watts.

2. Accuracy will be slightly better.
3. Often one is more interested in peak than RMS anyway.
4. The equation for power into a standard 50 ohm load is a little friendlier when peak volts are used:

RMS: $$P = \frac{E^2_{rms}}{R}$$

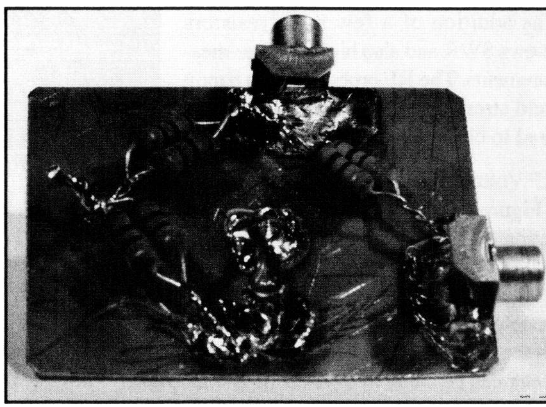
or

$$P_{50\Omega} = \frac{E^2_{rms}}{50}$$

Peak: $$P = \frac{E^2_{peak}}{2R}$$

or

$$\boxed{P_{50\Omega} = \frac{E^2_{peak}}{100}}$$



4 to 1 Power Divider: Each 50Ω arm is made of two parallel 100Ω, 1 watt metal-oxide resistors. This will handle 8 watts continuously or 50 watts for a couple of seconds.

5) In many cases a ratio of voltages is needed (for example: SWR measurements) and it does not matter whether the readings are peak or RMS. In the rare case where RMS is required, it can be calculated:

$$E_{rms} = 0.707\, E_{peak}$$

The RF probe will be calibrated in peak volts if a 4.7K ohm probe resistor is used as shown in figure1. This resistor is very small compared to the input resistance of most VOMs but much larger than the 50 ohm impedance of the

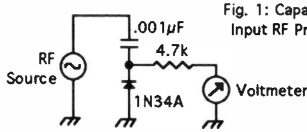


Fig. 1: Capacitor Input RF Probe

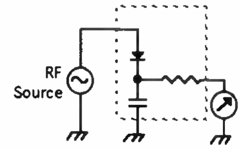


Fig. 2: Power Measurement

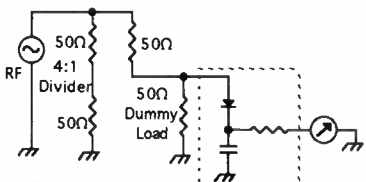


Fig. 3: Higher Power Measurement Using A 4:1 Power Divider

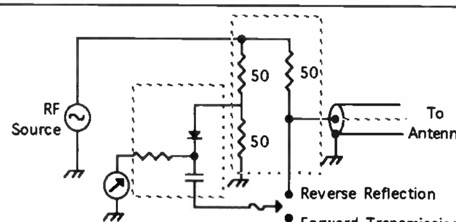


Fig. 4: SWR Measurement Using 4:1 Divider As An SWR Bridge

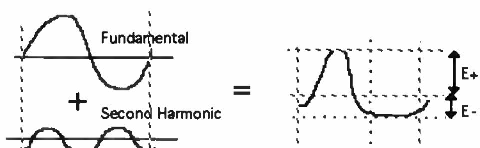


Fig. 5 Even-Order Harmonics Cause Unequal Positive and Negative Peaks

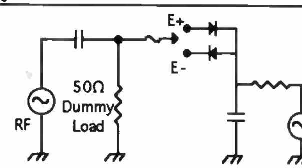


Fig. 6: Even-Order Harmonic Measurement

Up to 56 watts can be handled by using the 4 to 1 power divider shown in figure 3. The basic technique can be extended to even higher powers by cascading power dividers. Each arm of the divider will dissipate 1/4 of the total power. Use carbon composition, carbon film, or metal oxide resistors. Do not use wire-wound resistors. Resistors can be wired in series-parallel for higher power. Many metal oxide resistors are rated for a 6.25 times overload for a duration of a few seconds.

SWR Measurements

Standing wave ratio (SWR) measurements can be made by using the power divider and the RF probe as shown in figure 4. If the probe is made with small alligator clips on the diode and capacitor leads, it will be easy to move the clips between the forward transmission and reverse reflection positions. If the SWR measurement is being used to adjust an antenna tuner, the forward transmission reading is not needed—just tune for minimum reverse reflection. Since this SWR meter will attenuate the transmitter power by 6 db, it should be disconnected for normal operation.

$$SWR = \frac{E_{forward} + E_{reverse}}{E_{forward} - E_{reverse}}$$

Harmonic Measurements

If even order harmonics (2nd, 4th, 6th, etc.) are present, the positive and negative signal peaks will differ as shown in figure 5. The diode input connection measures the positive peak. The negative peak can be measured by swapping the alligator clips to get the capacitor input connection. Better results will be obtained if another diode is used to measure the negative peak as shown in figure 6. If the peaks of the fundamental and harmonic line up as shown in figure 5, the ratio of harmonic to fundamental is:

$$\frac{\text{even harmonic}}{\text{fundamental}} = \frac{E_+ - E_-}{E_+ + E_-}$$

If the zero crossings of the harmonic line up with the peaks of the fundamental, or if the phase alignment is unknown, this technique must be modified. Figure 6 shows a simple method for shifting the phase alignment of the fundamental and harmonic. Two pairs of E+ and E- readings are taken: one pair with the 220 pF mica capacitor in the circuit, and one pair with the capacitor shorted. The capacitor shifts the relative phases so that if one pair has an unfavorable alignment, the other will be better.

The worst case of the two pairs of readings will be within 2 db of the correct answer for the second harmonic. Scale the mica capacitor for fundamental frequencies other than 14 MHz. If a suspected fourth harmonic is being measured, a 390 pF capacitor will make a better phase shifter.

RF Probe Errors

Readings will typically be low by 0.1 volt when using a 10 megohm digital or JFET input meter. Expect errors of roughly -0.2 volt when using a "20K/volt" analog style VOM. This error is primarily due to the voltage drop across the 1N34A diode. Silicon diodes such as the 1N4148 can be used but the error will become about -0.6 volt.

Frequency response is very flat below 30 MHz. The probe I built exhibited a barely detectable 1% droop at 30 MHz. Even better frequency response can be obtained with an NTE583 Schottky diode.

Construction

Construction of the RF probe requires about 2 minutes of work and 50 cents worth of parts. I built it by soldering one end of a diode, a resistor, and a capacitor together. Alligator clips were fastened to the free ends of the diode and the capacitor. The free end of the resistor was fashioned into a small loop so that it could be easily grabbed by the VOM cliplead. • • •

Note: Lew adds "I can't really recommend the 1N4148 (the 1N34A is better below 10 volts and better at 10 meters), but for 160 through 15 meters and voltages above 10V, there is very little difference between the diodes and the 1N4148 is easier to obtain".

A HAMBREWERS' CONVENTION?

We think that readers might enjoy having a yearly convention/ colloquium devoted to building, kits, theory, sightseeing, recreation, good food and a chance to meet old friends and make new acquaintances. What do you think of this idea? Please take a moment and let us know if you would support and participate in such an event!

20/20 Hindsight

Looking Back Into Past Issues • Updates & Elaborations

KEØNH's Decoupling Loops: (Autumn, '93)
A Commentary

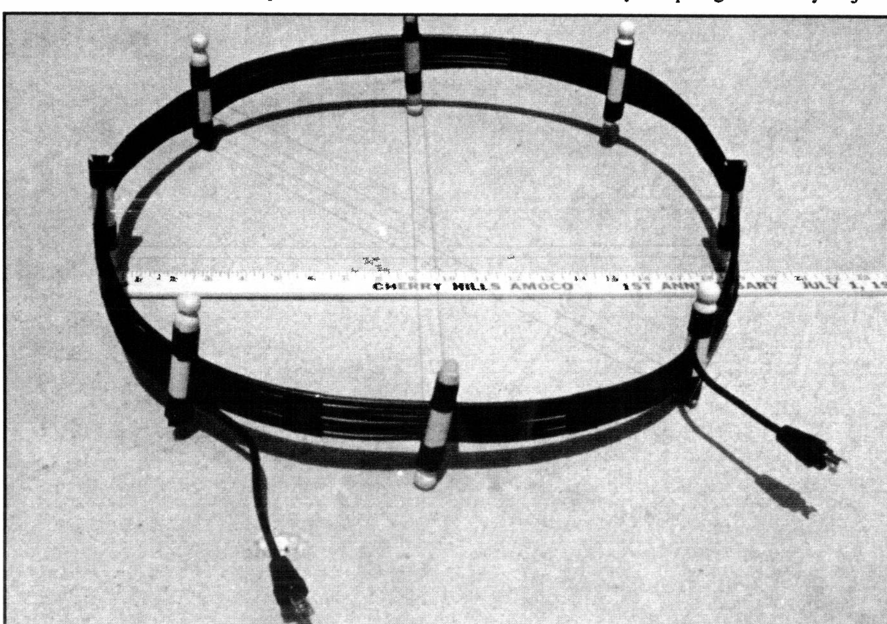
Bill Shanney, KJ6GR

Few amateurs have given much thought to imbalances to antenna currents produced by asymmetry. Les Moxon, G6XN mentions the effect of imbalanced resonant radials in his book *HF Antennas For All Locations* (RSGB). Due to my small 75' X 75' lot, I'm forced to use a vertical on 160 meters, which motivated me to study elevated verticals seriously.

Imbalance in the radials can cause pattern distortion as shown in the figures. The fact that an elevated vertical is not a balanced antenna provides a greater opportunity for unequal currents to be present at the feed point. This may result in unwanted currents on the outer surface of the coax feedline shield that can further distort the radiation pattern.

Wes Farnsworth's decoupling loops act as chokes to prevent this outer shield current from flowing, forcing equal currents into each half of the antenna system. A current balun does the same thing. Most verticals not mounted on ground have another opportunity to be imbalanced. If the feedline does not go vertically to ground it will/may pick up RF on its outer shield from the near fields of the antenna (and radials). Most roof-mounted verticals I have seen fall into this category since the feedline also runs across the roof, close to at least some of the radials, which imbalances them also!

As far as the dipole is concerned, it too can be imbalanced by coupling to nearby objects



or one side being closer to ground than the other. A decoupling loop or balun at its feedpoint will force equal currents to both halves of a dipole. If the coax feedline (or open wire feed) does not run away from the antenna at right angles, then RF from the two halves of the antenna does not cancel, and a common mode current may exist on the shield or on both wires of an open wire pair. Twisting of the open wire provides some protection from this coupling phenomenon.

The bottom line is that some form of choke decoupling to prevent common mode and shield current flow is a good idea for most antenna installations. Careful design and layout of antenna systems will minimize problems, but unless your antennas are many wavelengths away from outside influences such as other antennas, buildings, structures, power lines, etc., it is possible to have feedline radiation and/or antenna imbalance-induced performance problems.

The effect of the difference in potential between earth ground and the negative side (shield side) of the feedpoint is also important since this also sets up RF current on the outer

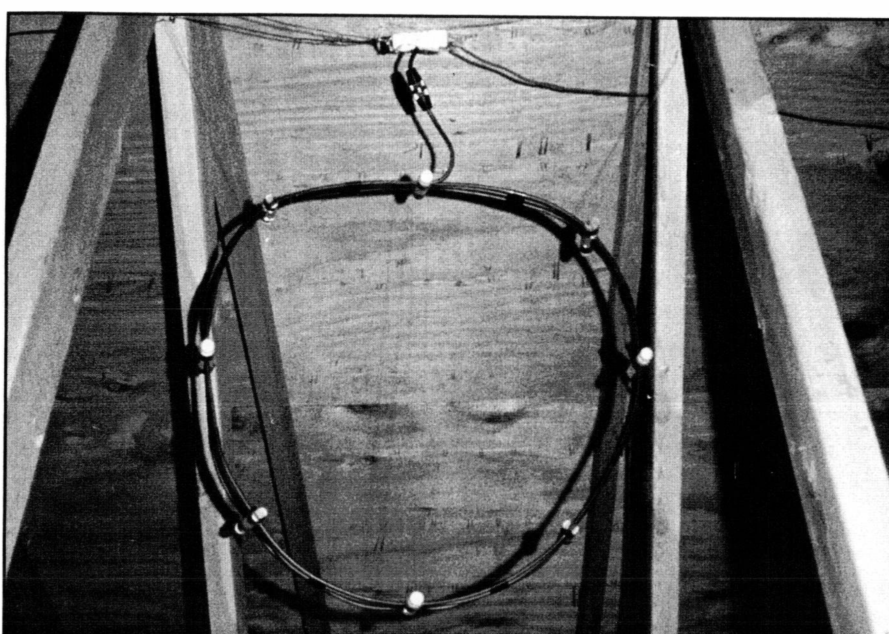
shield (Wes knew this too).

The Jerry Sevick Baluns and transformers published recently in *CQ* and *Communications Quarterly* work great and are nearly lossless.

One other thing I do to prevent feedline radiation is to put a Chosorb bead every 20 feet or so on my vertical coax feedline. Each bead has about 8 dB of RF loss at 10 MHz, and they are inductive, which makes a distributed, lossy choke on the outer coax shield to prevent current flow. These beads are available in two sizes: RG-59 and RG-213 from RadioKit.

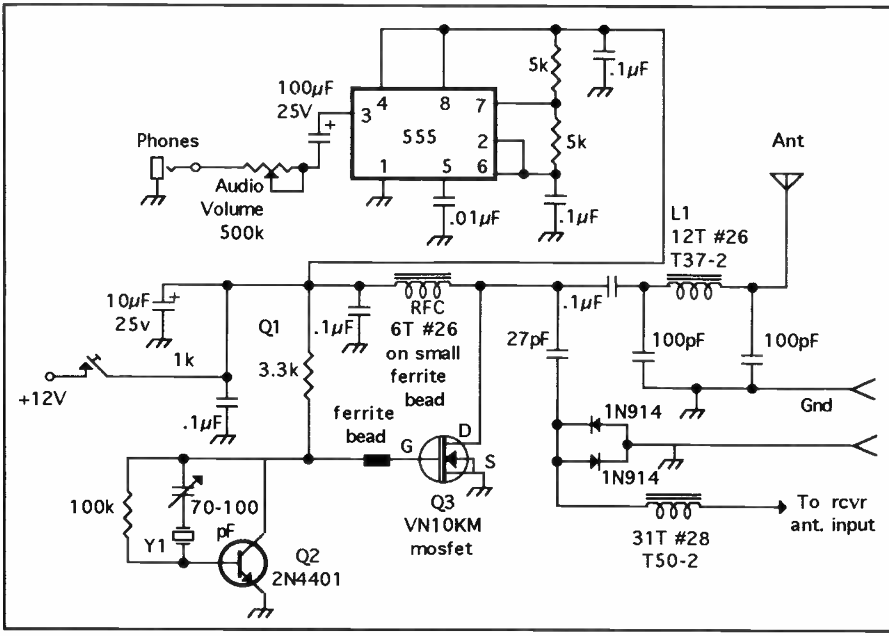
Considering how much we invest in our rigs, a few extra bucks spent on baluns and decoupling beads are a bargain compared to their potential for improving our signals. • • •

More on above-ground mounted verticals in the Hambrew '95 Winter Issue



NG7D OneDer Mods

(Summer, '94)



Depending on how the 70-100pF variable capacitor (in series with Y1) is tuned, the OneDer can indeed be found to chirp (at least on the *Hambrew*-built version). If this is found to be a problem, above are two mods which need to be implemented to the original schematic.

The mod to the power input of the sidetone oscillator should be made in any case: note that the 12V input to pins 4 and 8 of the 555 chip should be fed as above. This should prevent RF from entering the audio.

Eliminating the 2N3906 keying transistor and the 1k resistor from the original schematic, and feeding 12VDC directly to key the oscillator and PA did eradicate chirp in our 20 meter version. • • •

W6EMT 80M VXO Transmitter

(Summer, '94)

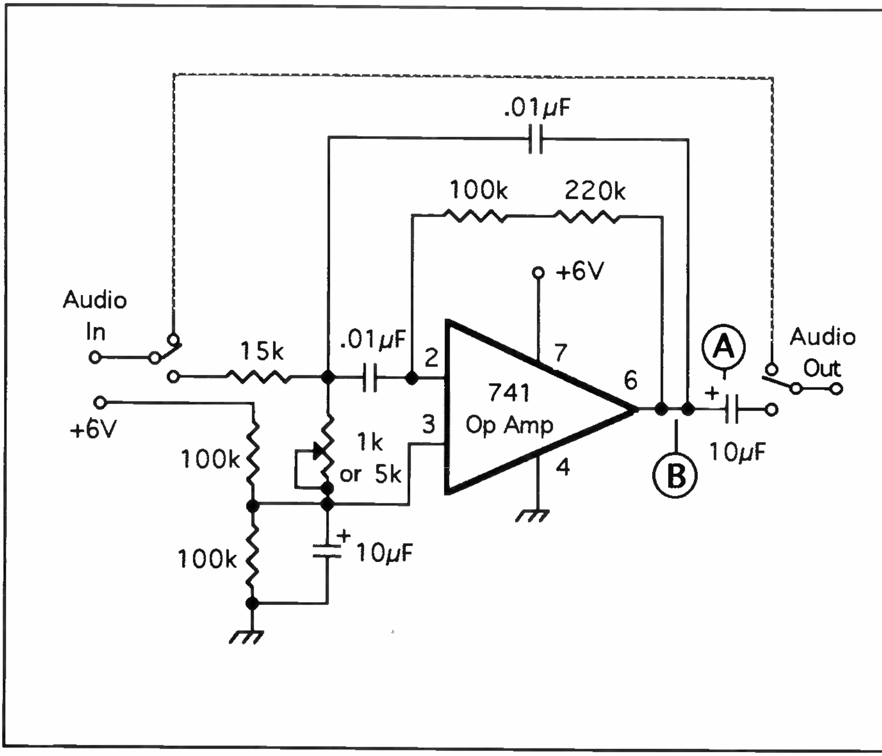
1.) C19, a 10µF electrolytic capacitor is in the parts list and assembly drawings, but not on the schematic. It should go from +12V input to ground.

2.) CX, a capacitor used in place of the variable cap during testing, should be disregarded.

3.) RFC1 is L10 on the schematic, and is a molded choke.

4.) L9 is also a molded choke

5.) Disregard reference in text to a 200pF capacitor. "...although I show a 200pF...", etc.)



This version of the filter will play much better. Note polarity of coupling capacitor (A) and tie in of feedback capacitor and resistors (B) from pin 2 to pin 6.

VE7GC Preamp and AGC For The Neophyte (Summer, '94)

Regarding C1, Dick writes: " You are correct in your supposition that C1 is shown as "50" in the schematic, whereas in th parts list it is noted as 100pF for 7 MHz and 400pF for 3.7 MHz. It is shown correctly in the parts placement diagram as being connected to C2 and T1. Its true value would depend on the inductance value of T1's secondary. This value is adjustable by means of the screw-type core of T1. I assumed that the builder would adjust this core to the frequency of interest. Sometimes I have used variable capacitance for C1, but although this takes up more room, it offers a quicker method of covering a wider frequency range, i.e., when using the preamp to tune from 7 to 14 MHz.
The Tak Lee brand of I.F. transfomers were obtained from a parts supplier in Victoria. They resemble the type used in the Neophyte receiver and cost around 70 cents."

Amateur Radio QRP Design and Construction, Part III

Burning Solder And Fingers

Bruce O. Williams, WA6IVC

MXM Industries, Smithville, TX 78957

Since this installment provides some real hands-on suggestions, I'll try to cover much more material than in past installments. If you've paid attention to my suggestions, you should have the parts and supplies you need. We have not covered the selection of a work station, however, nor the final selection of tools and test equipment.

Work Station

The location of the work station is controlled by a lot of factors other than just preference Most of us have to cater to a helpmeet, sometimes one that is a bit hard to persuade that Amateur Radio and its requirements are the most important considerations in our lives, and *hers*! If you are blessed with this type of XYL, I commiserate! My wife will allow anything I want *as long as it is not in the house and doesn't make noise*. My work area is therefore in a building separate from the house. It's been in garages, thrown-together shacks, and custom-built "offices" situated away from the house. The point I'm trying to make is *whatever you choose, make sure the wife goes along with it!*

You will need a workbench dedicated to your messing around It can be just a card table, or some other type, but it should be dedicated to your efforts—you don't want to dismantle your work station every time you leave the shack Be sure there is a door on the shack—this keeps some of the rug-rats under control.

I've known some hams that use just a closet in the house. Awfully small and dark, but they are happy there, and after all, it takes only about two square feet of table space for the actual work area.

Tools And Test Equipment

You'll need a good soldering station—I don't say soldering iron because I think you deserve the best soldering system possible. I use an Unger system that I've had for about ten years. Just this year I've replaced the tip and done some repair work on the tip holder. This system comes dear at about $120, but there are comparable systems available for less. Swap meets usually have several soldering stations available at from $25 to $50. Do not buy a $4 soldering iron at the local supplier and expect to be satisfied. The tip will be copper, and will erode so fast that if you get a couple of hours' use, you'll be lucky. Buy a tip that is iron-plated—it will last years instead of hours. In my case, I've replaced my iron tip twice in ten years, and my station is generally on about 6 hours a day! Use a small, chisel-shaped tip about 1/8-inch wide. The pointed tips generally do not get enough heat to the joint. You want about a 25-watt rating on the iron, or even less—any higher rating will destroy pads on the boards, and will not give you a good joint.

You need a good supply of solder—I use SN-63 (63% tin-37% lead). This is the type of solder required for military work. It has a low melting point and is eutectic (no plastic stage, it is either molten or solid). This reduces the potential for cold joints. A $10 investment will buy you about a pound of good solder, and it will last for years. There is little need for the "solder tools" sold in some

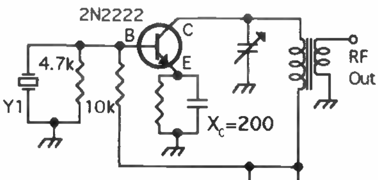


Figure 1: Common bipolar crystal oscillator

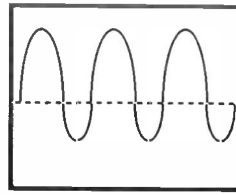


Figure 2: Output waveform of a bipolar oscillator

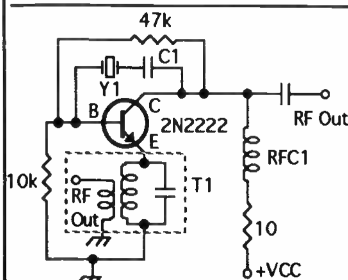


Figure 3: Bipolar crystal oscillator with tuned emitter

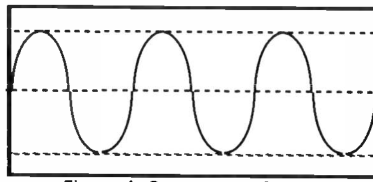


Figure 4: Output waveform of tuned-emitter oscillator

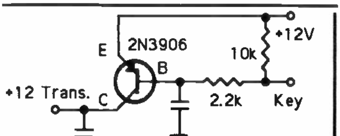


Figure 5: Simple Transmitter keying circuit

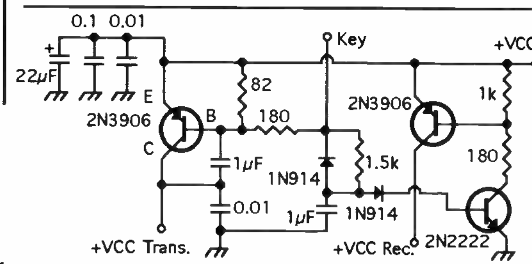


Figure 6: Transmitter keying circuit with receiver control

outlets You do need a supply of good solder wicking, however.

It is important to have good hand tools for electronic assembly. The prices for tools range from a couple of bucks each to around $10. If you can afford the top of the line, by all means buy those. Sears has a good line of rather expensive tools, but you can buy Chinese-made tools at swap meets and discount stores for a fraction of the price. Remember that we are interested in cutting copper, lead and soft wire. Cheapie tools are okay for our purposes. You absolutely need diagonal cutters, long-nose pliers, insulation-strippers, and a pin vise with a couple of No. 64 drill bits. In addition, it would be nice to have a tapered reamer, a 1/4-inch electric drill and a selection of drill bits from 1/8-inch to about 3/8-inch for working chassis and cabinets The tapered reamer allows you to fit control shafts through panels without having a lot of slop.

A general-coverage receiver is a must to monitor oscillators, etc. , and a frequency counter rates high up in the list of gottahaves. An oscilloscope is one of the most useful pieces of test equipment there is, but be sure it will cover the frequency range you want. A new 20-MHz scope will cost you around $400, but sometimes you can find a good used one at ham flea markets. I couldn't operate without my scope and counter. A digital voltmeter is a must, but remember we are really not interested in what the voltage is to 1/100th of a volt, but whether there is *any* voltage! There are many good, small DVMs available for about $20.

Well, these are the tools we absolutely need, but there are others that are nice to have. For years I went to the tool store every payday and bought one hand tool. As a result, I have a nice selection of goodies, some of which I have not yet used, but which will be there if I need them. You can plan on spending anywhere from a minimum of about $100 to a maximum of whatever you wish. If you decided on any other hobby, you probably would have to spend several hundred bucks to get started!

Getting Started

One of the most important circuits we use in electronic equipment is the oscillator. There are several good texts on oscillator theory, but not much on the actual use or selection of an oscillator. Crystal oscillators serve many purposes, but we should decide what the purpose is *before* we decide on the design. If you want a crystal oscillator as a band marker, or for tuning up a receiver, a common bi-polar type will serve (figure 1). This type has some drawbacks, however. The output waveform seldom is a perfect sine wave, and usually looks like figure 2 on the scope. Fine for band marking, but not suitable for a transmitter. Figure 3 shows a circuit I have used in my commercial designs. The tuned circuit in the emitter of Q1 serves to reduce any harmonics, and to maximize the power output. The output waveform will approximate a perfect sine wave (fig. 4), and can be taken at the junction of the collector and RFC1 or from the secondary of T1. Although a modified Pierce oscillator configuration is shown, the oscillator works well in a standard Colpitts configuration. All of the parts required can be bought at Danny's, or several other sources (see notes).

I have seen several QRP designs lately that either key the +VCC or the -VCC to the oscillator. I do not like this approach because there is really no shaping to the keying, and the problems with turning the oscillator ON and OFF are considerable. If the oscillator is kept running and the following stages are keyed, you have the problem of always having the oscillator signal in the receiver. I prefer to key the oscillator and buffer stages, and let the final amplifier loaf along in class C operation. If there is no signal to the final amplifier, there is no output. If you wish to key the oscillator and buffer, figure 5 shows a simple circuit that I've used for years It does not, however, provide for turning off the power to the receiver during transmitting. Figure 6 shows a circuit that provides a keying voltage to the transmitter during TRANSMIT while it interrupts power to the receiver, then turns the receiver ON when the keying stops. This will allow the use of a sidetone oscillator, if desired. Key the sidetone with the TRANSMIT voltage. In both of these simple designs, the keying is instantaneous (well, almost so). If we add a regulator to the design of figure 5, the time delay of the regulator will provide a "timed sequence" keying characteristic. The buffer stage is turned on before the oscillator starts, and thus is capable of accepting the oscillator signal without distortion. It is not just coincidence that I use this circuit in all of my Simple series of designs. It works well and has a nice keying characteristic without key clicks or other distortions.

You can use several different construction techniques to check out these simple circuits. If you think you're up to it, try etching a small circuit board. If you'd rather, use perf-board or look in your local Radio Shack for a small "project board" that has copper traces for a variety of different uses. As a last resort, use "dead bug" construction (or "ground plane construction" as it is now called). This method will tax your ingenuity, but I know lots of hams who use "dead bug" for their initial prototypes. It ain't pretty, but it works!

Well, this should give you some food for thought, and get a couple of your fingers to hurtin'. Soldering irons are dangerous weapons—they can hurt you, so be careful, you hear? In the next installment, we'll build a Simple transmitter, and in subsequent ones, an excellent Simple, receiver. • • •

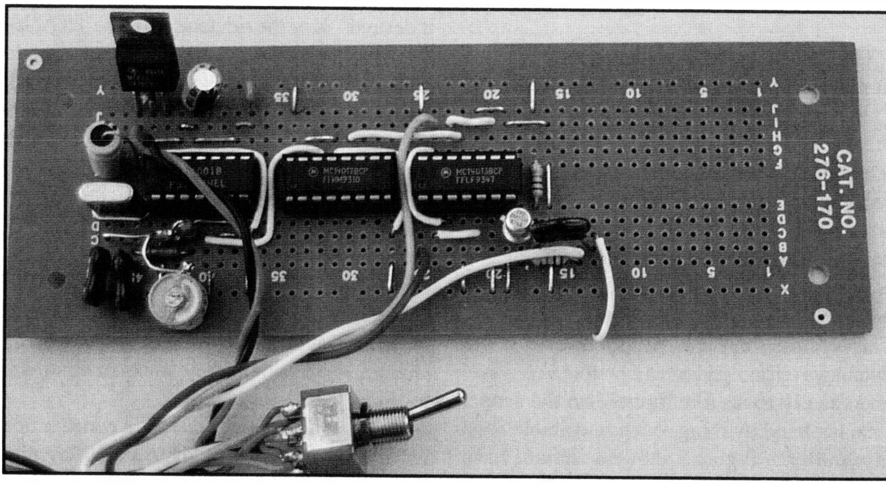
Notes: Danny's Small Parts and Kits
1935 So 3rd West #1
Missoula, MT 59801

Mouser Electronics
Four locations, call for catalog
1-800-346-6873

A Marker Generator For HF Receivers

Steven O'Kelley, WA7SXB

11437 5th. Ave. S, Seattle, WA 98168



One of the biggest advantages of modern ham gear over the older gear is frequency accuracy. When you tune that new rig to 7.050 MHz, you can be reasonably assured that you are on 7.050 MHz. With homebrewed or even older commercial equipment, that is not necessarily true. It is easy to find yourself in the wrong part of the band or even out of the amateur band altogether.

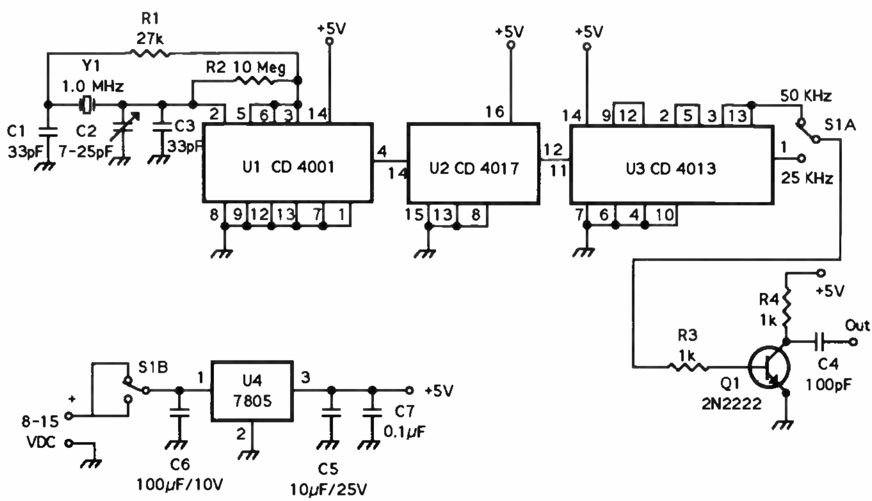
A handy item for the shack that will help out is a crystal calibrator or marker generator. The circuit described here will generate a reference signal every 25 or 50 KHz on all HF bands. Using digital logic ICs available from Radio Shack and a 1 MHz crystal, it can be put together by most builders in an evening or two. You can build it into a receiver or as a stand-alone device in its own housing.

HOW IT WORKS

Referring to Fig. 1, the circuit centers around U1, a CMOS quad NOR gate. Capacitors Cl, C2 and C3, Resistors R1 and R2 along with Y1 and one NOR gate form an oscillator running at 1 MHz. A second NOR gate serves as a buffer. The output signal from U1 pin 4 is routed to U2 pin 14. U2 is a divider configured to divide by ten. The output at pin 12 is at 100 KHz. U3 contains two D type flip flops. One divides the 100 KHz signal by two to give a 50 KHz signal which is again divided to 25 KHz by the other.

Switch S1 is a 2 pole 3 position (on-off-on) toggle switch. One half of S1 is used to select either the 25 or the 50 KHz output from U3 and route it to Q1 via R3. The amplified signal from Q1 is coupled through C4 to the output. This signal is a square wave full of harmonics that can be heard every 25 or 50 KHz on all the HF amateur bands.

Power to the circuit is fixed at 5 Volts by regulator IC U4. This assures that variations in the input supply voltage do not affect the oscillator. The input voltage should be at least 8 volts. The other half of S1 is used to switch



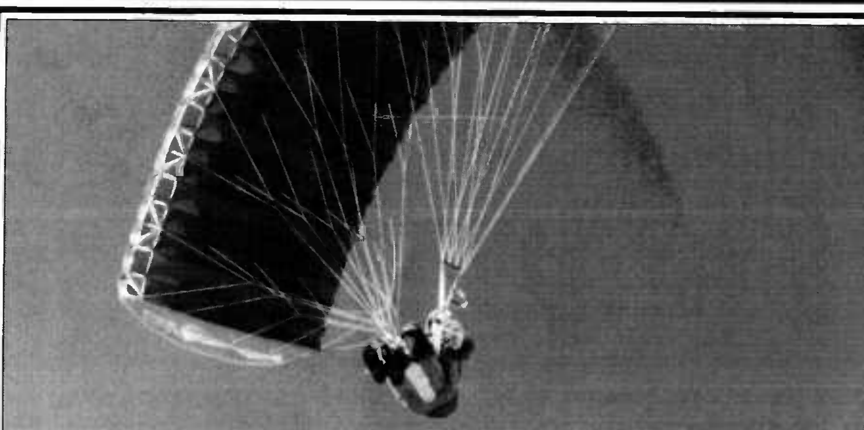
WA7SXB MARKER GENERATOR

C1, C3	33pF ceramic or silver mica
C2	7 - 25pF ceramic trimmer
C4	100pF ceramic or mica
C5	10μF electrolytic 25V
C6	100μF electrolytic 10V
C7	0.1μF mono. ceramic
Q1	2N2222 NPN
R1	27k 1/4 watt
R2	10Meg 1/4 watt
R3, 4	1k 1/4 watt
S1	DPDT 3-position toggle RS# 275-664*
U1	CD4001 Quad NOR Gate RS# 276-2401
U2	CD4017 Decade Counter RS#276-2417
U3	CD4013 Dual D Flip Flop RS# 276-2413
U4	LM7805 5 Volt Pos. Regulator RS#276-1770
Y1	1 MHz crystal

Miscellaneous Parts

Circuit board, wire, housing, IC sockets

* Radio Shack part numbers



power to the regulator on and off.

CONSTRUCTION

The prototype was built on a Radio Shack 276-170 circuit board. Parts layout is not critical although you should try to keep the crystal, capacitors and resistors in the oscillator circuit as close to U1 as possible and keep the lead lengths short. Trimmer capacitor C2 should be a ceramic type.

I recommend using sockets for U1, U2 and U3. They are inexpensive and will help prevent damage during soldering. They will also save time if you ever need to replace an IC. Mount the sockets but do not plug in the ICs yet.

Mount the remaining components. My favorite method is to make a copy of the schematic and draw a red line along side of each connection as I make it. This will help you keep track of where you are and help prevent wiring errors.

With the circuit assembled apply power to the board (at least volts). Measure the voltage from ground to the output of U4 to make sure that it is 5 Volts. Check your wiring if it isn't. If all is OK, remove power and install the ICs.

ADJUSTMENT

Once construction is complete, you will likely need to adjust the oscillator. There are a couple ways to do this. If you have a frequency counter, connect it to pin 14 of Ul and adjust C2 for a reading of 1 MHz. If the oscillator is high or low and cannot be set on frequency, you may have to change the value of C3. If it is too low, try lowering the value to 27 or 22 pF. If it is too high, raise the value of C3.

Another way to set the frequency is to use a receiver. Connect a piece of wire to the output of the marker generator and place it near a receiver. Tune in WWV on 5 or 10 MHz (AM). With the marker on, adjust C2 for a zero beat. Again, if it will not quite zero, alter the value of C3. Make sure to check the frequency adjustment again after mounting it in a housing as this can affect the tuning also.

You now have a new tool for the shack to help you when calibrating receivers. You may even find it convenient for use as a signal generator for general receiver testing and alignment. • • •

RIG-O-RAMA WINNER!

Lew Smith, N7KSB

is flying high after winning the Hambrew Rig-O-Rama contest(see photo, page 40 opposite)! Lew paraglides with 2 meter equipment both for fun and an occasional mountain rescue. Congratulations to Lew for a fine design of a 5/15 watt CW transmitter, and congratulations and thanks to all who took part- the decision was close! Judges were **Bruce O. Williams, WA6AIV**, **Jim Lee, W6VAT** and **Bruce Muscolino, W6TOY/3.** The judges were impressed with all of the entries, and encourage all to *keep designing*!

From The
CONTEST GURU

Bruce Muscolino W6TOY/3
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A contest. You have all run across them. Stations from one end of the band to the other, apparently deliriously happy with the idea of QRMing the non-participant while trying to do DXCC, or WAS, or something else, in a weekend. Is that kind of activity really necessary? I am not going to even attempt an answer because once upon a time I used to revel in that kind of contest, and I may yet. But, there are other types of contests, often with markedly different goals that I want to talk about this time.

Contests ought to be fun when you are operating and after they are over. I can remember years ago, sitting in front of my venerable TS-520, knocking them off at the rate of 15 or 20 per hour, wishing I was someplace else working on my tan, or working on a tall cold one. Yet I stuck it out. Then, after it was over, putting together my entry: counting countries, or zones, or states, or postcodes, for God's sake, and eliminating duplicate contacts, and typing up a clean log to send with a copy of my original log, so they could see where my numbers all came from. This was a lot like work; thank heaven my job was not too demanding at the time. Why did I do this? I thought it was fun. I still think it is fun taken in moderation. But I found way to have the same fun in a more relaxed format - QRP contests. I do not mean operating a QRP station in a major contest, I mean QRP to QRP contesting.

Most of the QRP contests I have been in are not the frantic, frenetic events we have found crowding out the honest band users on Saturdays and Sundays. They are slow paced events, often with lots of time between contacts. And the contacts seem to have more meaning, probably because there is sweat involved in working the other station. These contests can return a tremendous amount of satisfaction regardless of your level of participation. That was the principle in my *Hambrew* Fall Festival Contest Plan.

I wanted to create a contest format that would emphasize operating fun. Thus the apparently weird point structure. We are, after all, a magazine devoted to building equipment. But I recognize that building from scratch may elude some of you at the moment, and that some of you will never reach that point. That's OK. If you get on with a piece of commercial equipment or a rig you built from a kit, it is no reason to penalize you. I think I have created an award structure that will accommodate everyone. And if I have not, then I will fix it by our next contest, at a minimum.

Also, I did not want you to burn yourself out on this contest, nor did I want you to burn out your family's patience. Thus the limit on operating hours. There *is* more to life than contesting, I'm sure about that. Back when I was really "the contester", the contest of the moment would take on a life of its own. Nothing else would matter but the contest, and the certificate *I was going to WIN!* An awful lot of work for a piece of paper and a one line listing in a magazine read mostly by other people nearly as warped as myself

Contests actually have valid uses beyond collecting wallpaper. If we look back at the history of most technical specialties we find contests used to improve whatever technology was involved. These are the roots of this little niche in the ham radio activity spectrum. My first contest in recent memory was in October 1978, four months after I had been assigned to work in The Netherlands for three years. I had a simple station, a TS-520 and a ground mounted tri-band vertical, and I wanted to know how well I was getting out. One Saturday afternoon I turned on the rig and lo and behold, there was *CQ*'s World Wide DX Contest, CW. By Sunday afternoon I knew the dimensions of my station's performance and my neighbor's TV. Oh well, with the good comes the bad!

So I hope you entered my contest. Please write me a note telling me what you did and did not like about the format. I will try hard to fix the big problems. Thanks, and have fun! • • •

DESIGN BASICS SERIES

Thoughts On Theory

James G. Lee, W6VAT

LOGARITHMS AND DECIBELS

I know, I know. I said I'd try not to use any more mathematics than necessary in this column, but logarithms and decibels appear often in electronics and you need a good understanding of them. Decibels - or dB as they are called - are related to logarithms since logarithms are used to calculate them. Both logarithms and dB are dimensionless numbers and the decibel simply represents the ratio of two numbers. By dimensionless I mean they have no "units" attached to them such as feet, inches, ounces, pounds, liters, or gallons. They are simply numbers, so lets start with logarithms.

LOGARITHMS

Logarithms were discovered back in 16th century England by John Napier, Baron of Merchiston. He had been studying theology and mathematics, but his mind turned more and more toward mathematics. Many of his writings still exist, and on one of the pages the following table appears:

-	I	II	III	IV	V
...					
1	2	4	8	16	32
...					

Napier noticed that the top row is called an arithmetic progression. That is, each number is one larger than the one to the left. He also noticed that the bottom row is called a geometric progression. Here each number is larger by a greater amount then the one to the left.

The bottom row is also a "binary series" - that is, each number is a "power" of 2. The power of a number is the number of times it is used as a factor in multiplying itself. For example, II= 2 X 2 = 4, III= 2 X 2 X 2 = 8 and so on. Not a difficult concept to understand. The hyphen (-) in the top row over 1 is 2 not raised to any power, and by convention, this is taken to be 1. It is simply a mathematical convenience.

Napier noted that both progressions grow together. For every number in the top row, there is one in the bottom row, and vice versa. Napier called the number in the top row the logarithm of the number below it in the bottom row. The number in the bottom row is then the antilogarithm of the number above it in the top row. Knowing either number allows you to determine the other one.

While the binary system of numbers is very important to the computer world, most of us use the decimal system which is based on the numbers 0 to 9. Unfortunately, logarithms in a decimal system are much more complicated than in a binary system. That's why computers use the binary system; it greatly simplifies the computations and circuitry of a computer. It took Napier about 25 years to calculate logarithms for the decimal system. But once calculated and listed in tables, it need never be done again for most of our everyday uses.

As an example, the logarithm of 2 in the binary system is 1. But in the decimal system the logarithm of 2 is 0.30103, or quite a different number. But not to worry, any system of logarithms brings a simplification that is very useful for mathematical calculation. Logarithms allow us to substitute simple "addition" for the more complicated "multiplication" when solving certain problems. We all know that 4 X 4 =16, but since 4 = 2 X 2, then from the top row II + II = IV, and 2 to the IV (or 4th) power equals 16. We simply add logarithms to perform the multiplication function. Yes, we have to look up the resulting logarithm in a table to find the final number, but addition is easier than multiplication. And as you might suspect, "subtracting" logarithms is the same as our more difficult "division" operation in arithmetic.

THE DECIBEL

All human senses have what is called a detection threshold. Below this threshold we detect nothing. For example, if you look at the stars through a telescope on a clear night, stars are visible that you cannot see without the telescope. There is a distinct cutoff in our visual acuity below a certain level of brightness.

Our ability to hear is similarly affected. If you listen to a sustained note on a musical instrument while you move away from it, the level of sound does not decrease in a linear fashion. That is, it doesn't get weaker and weaker as you move away, yet remain audible no matter how far away you go. It diminishes for a while, then drops below our hearing threshold, and nothing more is heard.

Scientists who first measured sound levels and took this effect into account, named a ten-fold difference in the sound level the "**bel**" after Alexander Graham Bell, the inventor of the telephone. Unfortunately, this difference in levels turned out to be too great to be very useful. So they settled on 1/10th of that amount - the **decibel**. Since our hearing is not linear, but responds to low levels as well as high levels, here is an ideal application of logarithms.

In the table below, the detection threshold level for sound is taken as 0 dB, and the remaining "progressions" are shown in both dB and sound levels:

1 unit of sound	0 dB
1.2 units of sound	1 dB
1.6 units of sound	2 dB
2 " "	3 dB
4 " "	6 dB
8 " "	9 dB
10 " "	10 dB
100 " "	20 dB
1000 " "	30 dB, etc.

You'll notice a couple of things in the table. If you increase or decrease the sound level by a factor of 2, then the change in dB is equal to 3 dB. A change of 10 results in a change of 10 dB. A change of 100 = 10 X 10, and since we add the logarithms of numbers we want to multiply, the answer is 10 dB plus 10 dB or 20 dB.

The decibel can be used to compare other quantities since it is a dimensionless number. The basic formula for doing this is:

$$dB = 10 Log(P1/P2),$$

where P1 is the first quantity, and P2 is the second quantity. If P1 is twice as large as P2 then - in the decimal system - the equation becomes:

$$dB = 10 Log(2)$$
$$= 10(0.30103)$$
$$dB = 3.0103$$

If it is small enough, the decimal portion to the right is often ignored so that the dB change for a ratio of 2 is 3 dB as you saw in the table. Finally, you can't compare "apples and oranges" - both P1 and P2 must have the same units.

See, that wasn't hard was it? Manipulation of dB values is quite useful in analyzing radio paths and links. For example, moonbounce calculations are very straightforward in dB for defining required transmitter power, antenna gain, and receiver sensitivity. Somewhere down the road in this column the use of the decibel will be seen again and, hopefully, by that time you will be comfortable with it. • • •

(Continued from page 15) inductance. To combat drift you may wish to experiment using a negative temperature coefficient capacitor for C10 or C14. For a rock solid VF0 try replacing T3 coil with a T6 or T7 powdered iron core toroid and capacitors as specified in the parts list. My 40M version of this simple superhet also uses the same VF0 circuit (5.0 - 5.3 MHz). Here I use a T50-6 core in the VF0 and find long term drift after a few minutes warmup is less than 100 Hz without resorting to any temperature compensation schemes.

A companion SSB transmitter has been designed and checked out. Here the transmitter scheme is the reverse of the receiver. The transmitter output frequency is generated by summing the USB (after IF filter) at IF with the receiver's VFO frequency. A linear power amplifier is needed to build up the 20M USB signal from present 50 milliwatts to several watts or more.

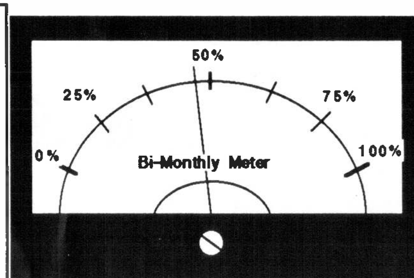
TUNE-UP PROCEDURE

After you check over the completed receiver and verify parts installation, coil installation, VFO pot wiring, parts are soldered in with no solder bridges, etc., hook up an antenna, ground, power supply, and speaker. If you have a receiver or frequency counter for 5.0 to 5.35 MHz, fine, then you can use it to tune up the VFO.

Set the volume control for maximum output or hiss. Rotate the VFO pot through its range and you should hear some signals. Peak up the IF transformer T2 by adjusting the powdered iron slug with a small screwdriver, preferably plastic. Adjust the VFO oscillator coil T3 so that CW signals are heard with the VFO pot nearly full counterclockwise and SSB voice signals are heard with the VFO pot nearly full clockwise. Then peak up the antenna trimmer C1 for maximum on a 20M signal. The BFO trimmer C21 should be adjusted for best reception and voice quality. AM signals are tuned in by exactly zero-beating the station's carrier frequency. If the receiver does not quite cover the full 14.000 to 14.350 MHz, add a 1 - 5 pF capacitor across the 56 pf VFO-range capacitor C13. Conversely, if only the CW portion or SSB is desired, reduce the 56 pF cap down to like 30 pF (use NPO/COG zero drift type cap). Re-tune VFO oscillator coil T3 to the desired portion of the band.

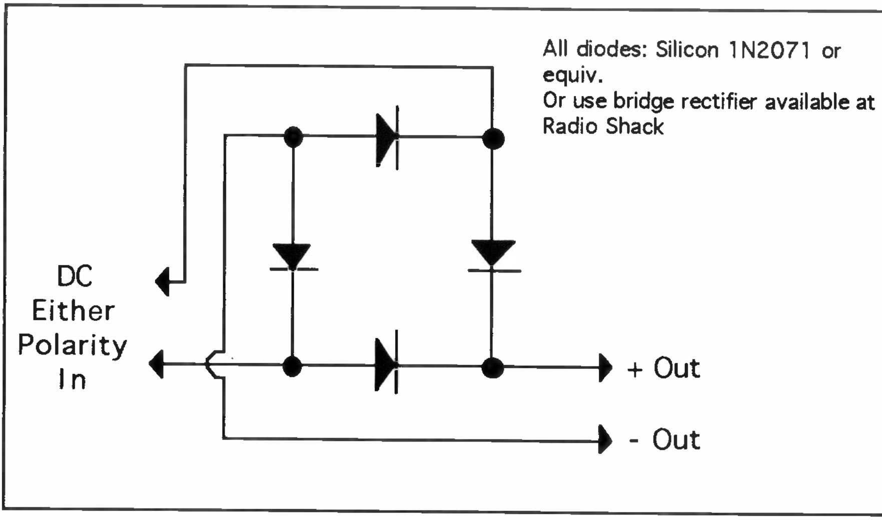
Troubleshooting hints - Verify +8VDC on pin 8 of U1 and U2. If not, see if the voltage regulator is hot (output shorted). Check the audio amp U3 by touching pin 2 or 3 thru a 1 - lOK resistor. 60 Hz hum pickup from your body should be heard in the speaker. Repeat at U2 pin 1 and you should hear pickup from local AM broadcast stations.

Good luck and have fun! • • •



WIRES AND PLIERS

Don McCoy, WAØHKC

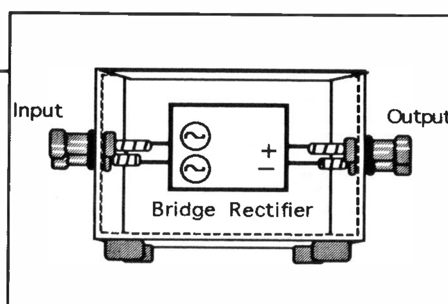


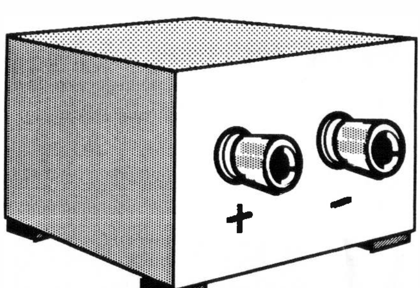
If you like to work on DC stuff, here is a little device that might save a power supply for you.

It can be easy to get the positive and negative leads mixed up while working on a radio on your crowded work bench.

The bridge rectifier will always deliver the correct polarity to its positive and negative output no matter what the input DC polarity is. This, or course, is due to the configuration of the diodes in the bridge.

It is a quick and easy project! • • •

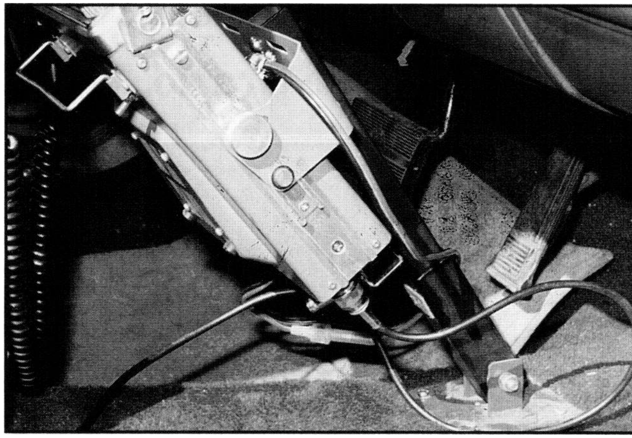




Output panel on small "Bud" box with banana jacks or jacks of your choosing (back side has jacks or plugs of your choice).

A Quick, Detachable Mobile Rig Mount

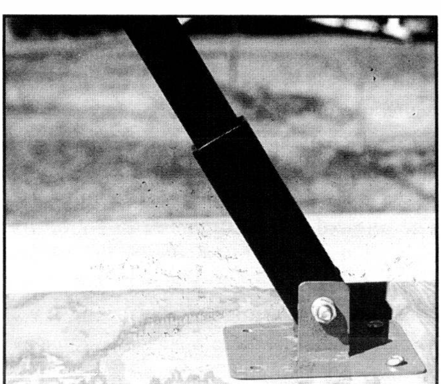
Dave Holesovsky, KØIPH
521 West 33rd. St.
Loveland, CO 80538



After someone tried to steal my Uniden 2510 for the second time, a quick detachable mobile mount was in order. With my experience in working with metal, I knew that different pieces of square tubing could be sized to telescope together. I went to the local machine and welding shop and purchased two lengths of square tubing, 1 1/4" and 1" respectively.

Having a car with the shift on the steering column, I came up with an idea: in the home workshop I made a 4" square metal plate with 1/8" X 1" X 1 1/2" steel ears welded to it, spaced to accept the 1 1/4" square tubing, and allowing for two star washers between the tubing and ears.

A 1/4" X 1 3/4" bolt holds these together and allows adjustment for the angle desired. My transceiver already had an adjustable bracket so one did not need to be fabricated.



(Photos, this page, KØIPH)

List of Materials:

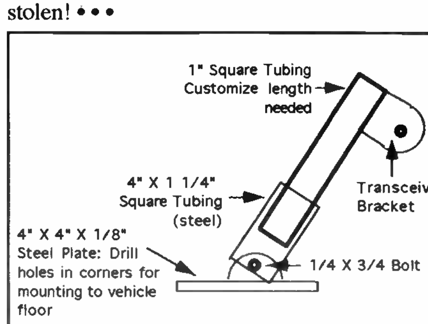
4" length of 1 1/4" Square Tubing
12" or more length of 1" square tubing
4" X 4" X 1/8" steel plate
1 1/2" X 1" X 1/8" strap or angle iron
1 3/4" X 1/4" bolt

Screws to hold the plate to floor and transceiver bracket to the square (your choice of size).

Reminder: If you are using an HF transceiver, don't forget to connect a grounding strap from the plate to the rig's ground lug.

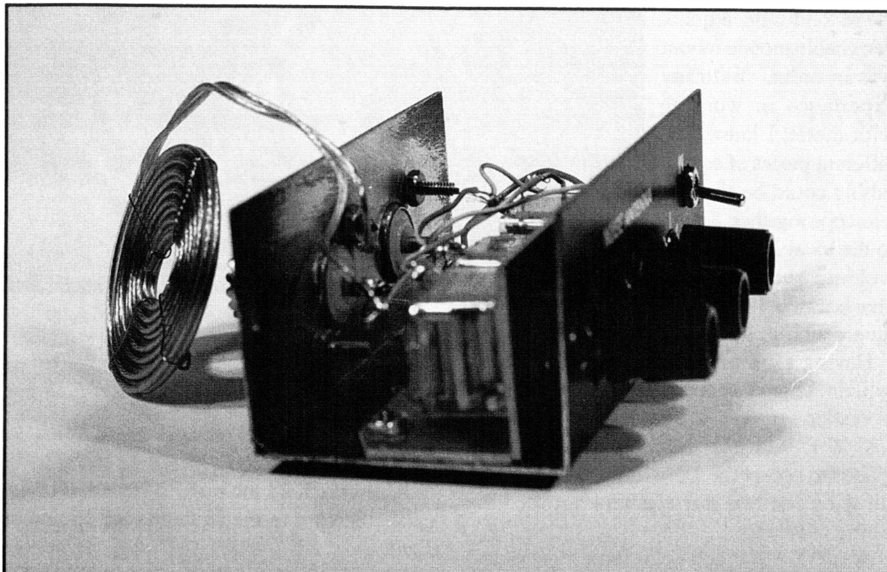
With a quick disconnect power cord, the rig slides out faster than the time it takes to tell about it.

If you want greater security for your rig, try this solution; it could save your rig from being stolen! • • •



An Inexpensive Noise Antenna

G. De Grazio, WFØK

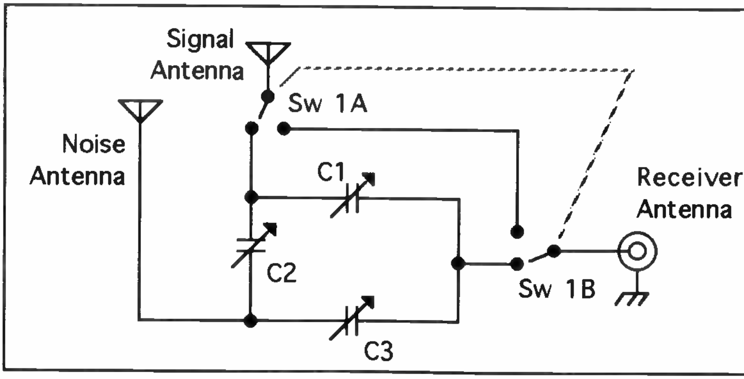


In 1993, Wes Farnsworth, KEØNH (SK) casually mentioned a device which he called a "Noise Antenna". He added that the idea was not new, and had been described in the ARRL Handbooks printed during the 1940s. He had built one, and stated that it could eliminate certain electrical noises such as generated by electric motors, fluorescent lighting, engines, etcetera. When questioned further, he explained that when the reception of noise by a short, inefficient antenna, placed on the floor and put in series with a variable capacitor, was mixed with a true (i.e., resonant) antenna aloft (which received the same noise along with the desired radio signal), also placed in series with a variable capacitor, the electrical noise could be phased out by adjusting the two capacitors.

Intrigued, I resolved to breadboard the circuit and find out whether the thing would work, since the idea seemed at first blush to be...well, a little fantastic. Coincidentally, some three weeks later, I read an article by Hank Scharf, W6SKC in *Electric Radio* , in which was shown a circuit for a "Jones Noise-Balancing Circuit"(September, 1993, pg. 18).

It may be seen from the schematic that the circuit involves a shunt variable capacitor (C2). The original called for values to 150pF for each of the variables, however my breadboarded version used three 360pF caps. After considerable fiddling and adjustment, it became evident that there was clearly some attenuation of the unwanted noise, seemingly dependent on the band of operation. Swamp cooler noise on 30 meters just evaporated (no pun) when the null was found. It does take a bit

The schematic is simple, but tuning takes practice!



The noise antenna can be configured in a different fashion than that shown. I have been pleased with the results of the "cinnamon roll" coil shown here. The variable capacitors were set back in the project box so that the shafts would not extend out too far.

of practice to achieve this, in spite of the simplicity of the circuit, and two important points should be noted:

1. This circuit is *not* designed to be transmitted through! It is used in receive mode only, and must be manually or electronically switched out during transmit.

2. If the desired signal is nulled out along with the undesired noise, the inefficient noise antenna is probably doing too good a job, and needs to be shortened orotherwise made more inefficient as a receiving antenna.

I found that a 9 foot piece of speaker wire made a very good noise antenna section. In the final version, I rolled roughly a 7 foot length into a flat, "cinnamon roll" type coil, and tucked it inside the project case. Since the circuit is not transmitted through, there would seem to be no sense in using the more expensive air variables; I chose a garden-variety of poly-sandwich type variables (roughly 140pF) which only cost about a buck each.

The manually-switched version which I built is easy to forget to cut out during transmit. An RF-sensing circuit which switches the noise antenna in and out would be more functional and less "forgetful".

An unexpected dividend is possible with this circuit. If the noise antenna portion is cut to a length which, though short and inefficient, will still receive International Broadcast transmissions, they can be nulled along with the offending noise signals! This was noted when the circuit was used with some DC-type receivers.

If this sounds too good to be true, it doesn't take much to test it for yourself: some wire, alligator clip leads and three inexpensive caps will do. The total cost of the finished project for me, including case and knobs, was under ten dollars. I use it during most QSOs for noise and BCI suppression. • • •

9Y4AT's 20M Station

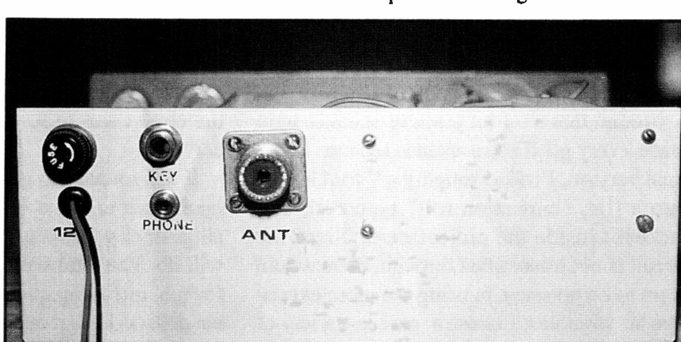
Jeffery C. Gibson
Etobicoke, Ont., Canada

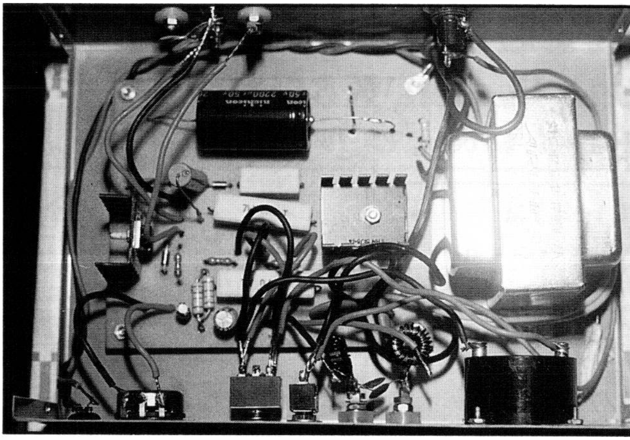
Jeffery's station is compact and efficient. See text for description (all photos: 9Y4AT)

The power supply is below the Rig and runs from 0 volts - 34 volts DC approximately 2.5 Amps with an indicator for volts and amps readings. This was the first project I ever built and it worked from the first time I flicked on the switch, without any problems up to this day. It is very simple and very few parts.

To the right, you will see my Antenna Tuner and the Electronic Keyer. Some of the features of the Rig are S/Pwr meter: on air or Dummy Load Tune Switch, Tx, Rx indicators. The Rig has A VCO & a VFO so I can work stations that operate split frequency, and it has auto and manual AGC control for strong stations, AF and IF gain controls and a RIT for the VFO. The VFO is from Howes out of England and operates from 9.980 -10.350 MHz. Its very very stable, exhibiting almost zero drift. I will recommend Howes VFOs to anyone looking for a Zero Drift System. I can work 10 -15 Stations within an 1 1/2 hours and not turn the dial or the RIT control. The VCO is very limited and only operates on the CW portion of the band. The photo showing the inside of the

The "antenna side" of the transceiver



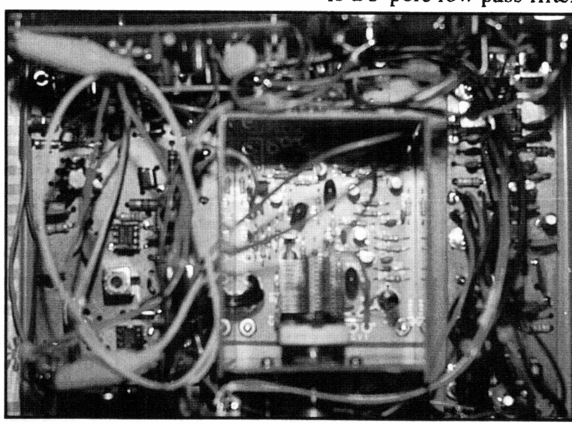


Interior of the power supply

rig has the receiver strip to the right of the VFO. The transmitter is to the left; the board on the rear wall is the QSK and Switching Unit and the little board on the bottom behind the VFO is the S/Pwr meter switching board.

The Rx board has the VCO which is a simple coil and varactor diode that runs into an NE602 to mix with the incoming 14 MHz signal to give a 4 MHz IF, also I can switch in the VFO to do the mixing instead. Next is a two (2) pole crystal filter into the IF amp, followed by a BFO which mixes with the IF to give audio which is amplified and fed to the phone jack; some is sent to the AGC.

The Tx takes its signal from the VFO and mixes in an NE602 with a fixed 4 MHz Oscillator to give the 14 MHz; filters eliminate the unwanted signals so only 14 MHz signals are fed to the LM6321 Driver which are then sent to the 2N3866 Pre-amplifier and on to the power transformer next to the amplifier. There is a 3-pole low pass filter



prior to the Antenna, and some of the output is fed to both of the switch boards.

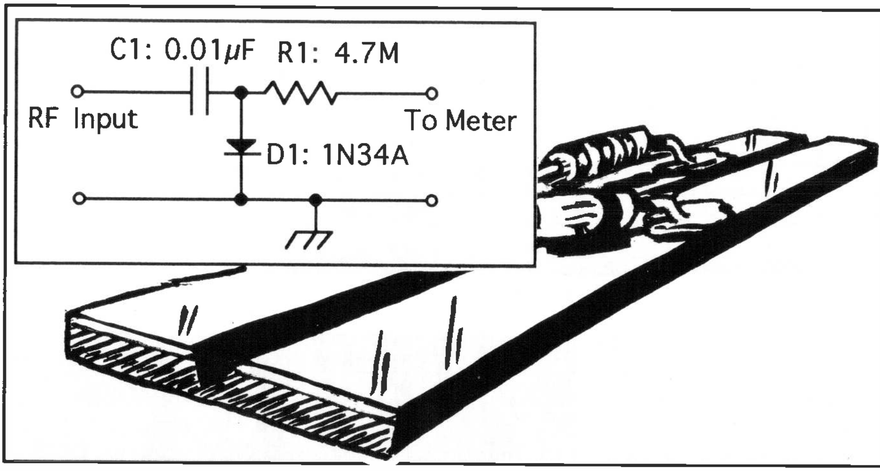
The Rig runs approximately 8 -12 watts. I have biased the 2N3866 to give 1 watt of drive to the amp which is 2SC1969. Both transistors have heat sinks.

The unit measures 8" x 6" x 3" in a regular Radio Shack can. So far I have worked three-fourths of the United States, all of South America, most of the Caribbean islands and some European Countries.

"Circuit" Circuit

Kenneth Payton, KB5RQV

Box 400, Groom, TX 79039



Whereas I have not seen this *exact* system in any literature, it is revised from several articles on the subject. A "knife-cut-circuit" might better describe the system. I have found that there are several advantages over other systems:

1. Simplicity: There is no complicated art work or graphics required, and there is no need for caustic chemicals or transferring the circuit to the copper-clad board.
2. Revisions and changes in layout are easy to perform.
3. The complete circuit is on the same side of the board. No need to turn the circuit over for soldering, no "component fall-out", no having to think backwards and upside down, and very few additional wires to add except to make jumpers and to connect boards.
4. Readily available ground for the whole circuit. No need to run ground wires everywhere as in vector board construction.
5. This construction works well from AF through UHF. On UHF circuits it is advisable to use only single-sided board. Double-sided board forms a capacitor that could adversely affect the signals.

All of the components are mounted to the top of the board as mentioned above. The construction system is a modified "surface mount", as the ends of the leads are all bent in an "L" shape, and then soldered to the circuit. This makes it easy to use salvaged components that have short leads. I have also used IF coils, and have experienced no difficulty in mounting them or any other salvaged components.

Consider this simple circuit from the *ARRL Handbook*: you will recognize the circuit for an RF probe for use with electronic voltmeters taken from page 25-9 of the 1993 Edition, fig 1. There are only three components and this will easily mount on a piece of single-sided copper clad board measuring 1/4" X 2".

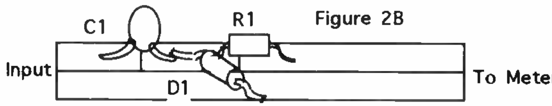
It helps to do the initial layout on paper. Mark an outline that is 1/4" X 2" to correspond to the board. Mark lines on the paper to indicate where the cuts will be located: first, divide the narrow axis in half, making each 1/8" X 2" (see fig. 2 and 2A, page 55).

Next, make two more marks that divide one side into three sections (fig. 2B). C1, R1 and D1 can be drawn in, comparing location and polarity to the schematic. See how the circuit is the same? If not, (Continued next page)

Figure 2: Single-sided copper-clad board

Figure 2A:

Figure 2B



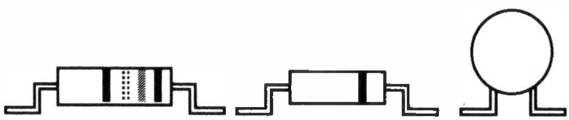


Fig. 3

go over the above steps again and find where the error is.

Now the cuts will be made to remove some of the copper so that the board looks like Figure 2B without the components. When making the long cut, a straightedge will help get the line straight. The smaller cuts can be made free-hand. It is necessary to remove some of the copper and not just to make a cut in the surface, otherwise small bridges will remain which will defeat the circuit. I use a hobby knife that has a retractable blade in the plastic handle. You may prefer a different cutting tool, but just *be careful.*

After making the first straight cut, hold the knife at an angle of about 45 degrees and make a second cut about 1/32 to 1/16 inch from the first so that you are making a "V"-shaped groove in the board which will allow removal of a strip of copper. Check the cuts to be sure that all of the copper has been removed from the groove, and that there are no bridges remaining.

Each of the components should be checked and made ready to mount to the circuit by bending a small "L" shape at the ends of the leads (Fig. 3). Make the leads as short as possible, and melt a bit of solder at the points on the circuit where the component leads will be located. Hold the component with pliers and solder the component to the circuit. Use caution with D1, as too much heat will destroy it. With diodes or transistors, it is a good idea to use a heat sink or tweezers to hold the lead that is being soldered. Try to mount each component as close to the surface as possible.

Finishing the RF Probe

Once the components are mounted to your satisfaction, solder a probe of stiff copper wire (12 or 14 gauge) or a small brass nail to the input side (C1), an 8 or 10 inch piece of stranded wire to the ground, and wire or cable to the end that goes to the meter. You may wish to wrap the board with electrical tape after you have soldered a short piece of hookup wire to each end of the ground side. You can use some braid from a piece of coax to be compressed and placed on the outside of the wrapped board (covering the full length of the board), and solder it to the ground wires. Next cover the braid with tape, put a clip on the 8 inch wire and ends on which to fit your meter on the other wires.

Presto! You are now the proud owner of an RF Probe that will work from about 50KHz to 250MHz.

In a future issue, we will investigate building a VFO using the same techniques. • • •

CLASSIFIED ADS

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The History of QRP in the U.S. 1924-60 by Ade Weiss K8EFG/WØRSP. 208 pages, 56 photos/16 illustrations-W1FB: "I recommend this book for your Amateur Radio library, even if you never become a member of the fast-growing QRP fraternity..." WB8UUJ:"something to warm the cold winter nights with good memories.." $12/lst Class ($10 Sen. Cits.) AdeWeiss, 526 N. Dakota St., Vermillion, SD 57069

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• LETTERS •

(Continued from page 5)

I just received the Summer 1994 issue of *Hambrew* , and I really enjoyed its contents. Lots of really interesting stuff.

One article caught my attention. John Christopher's article "20 Meter One-Der" had a couple of comments about the RSGB that probably need clarification.

The ONER original design as well as the 624 Kits modification of the ONER doesn't have a so called "error". John assumed that the free running crystal oscillator in the ONER was because the original designer put a 3.3 K resistor in the wrong place. He should have asked someone why.

The ONER and many other simple QRP transmitters allow the crystal oscillator to "free-run" and key the driver stage. This is done to prevent "chirp". The crystal oscillator can be keyed at lower frequencies, but as the crystal frequency rises, the crystal doesn't start-up cleanly and the transmitter will "chirp like a bird". The quality of the crystal is also a factor. Lower cost crystals , and FT 243s are notorious "chirpers".

The RSGB, as well as 624 Kits and others offer a control board similar to the one described in my article in "CQ" several years ago. These boards have built-in antenna switching and switched +12 volts to turn the oscillator on during keying. The ONER was designed to operate with one of these boards or with a simple DPDT switch to switch the antenna and the transmitter voltage. With either of these methods , the ONER works great and doesn't chirp. The ONER is a very low cost, novelty transmitter priced at $9.00. A future article in QST will show though, that it can be a powerful and inexpensive DX device.

By the way, the original ONER by the RSGB does not include an on board low pass filter or the ferrite bead on the gate of Q3. I added these components when I designed the 624 KITS version of the ONER.

Best 73,

Pat Bunn, N4LTA, 624 Kits

Pat, your comments are well-said. If any member of the RSGB has taken offense at John's article or comments therein, we apologise sincerely and with contrition. Our opinion of the contributions of the ham-builders in the U.K. is very high indeed, and we feel that anyone who has built a project designed in England would agree. Knowing John, I feel it safe to say that the last thing he would wish is to give offense to any member of our fraternity, yourself certainly included. An excerpted publication of John's response follows:

Thanks Pat for your input and info on the Oner Transmitter. I now have a better understanding of its operation, and why it was designed the way it was. My expertise in designing is better suited for Lincoln Logs, and the old Gilbert Erector Sets of long ago, hi. I freely admit, I'm no expert circuit designer, nor am I an electronic engineer. I am what my FCC Amateur Radio Licenses say: An Amateur, a non professional in the field of radio design, construction, and technique.

I believe the spirit of *Hambrew* Magazine was meant to be used as an open forum (correct me if I'm wrong, George), to share ideas and experiences, experiment, and teach the craft of transmitter and receiver design in addition to other areas of interest to the Amateur reader. Basically what I have tried to accomplish with the One-Der design was to have it be as flexible as possible using the Oner design as a building block.

Adding the sidetone oscillator and QSK allows the operator to just about use any SSB/CW mode communications receiver with the One-Der as well as work split-frequency operation. I have redesigned the circuit layout a bit to correct the chirp (*see 20/20 Hindsight section in this issue - Ed.*). It seems to be working fine for me.

73 de NG7D