# The HW-8 Handbook


A collection of articles on the repair and modifications for the Heathkit HW-7, HW-8 and HW-9 QRP transceivers

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Second Edition First printing 2003

# Table of Contents

# An Introduction

## Welcome to the second edition of the HW-8 Handbook.

I told myself I would not do a second edition of the HW-8 Handbook. There's just not enough interest in these old radios anymore.

I was wrong.

QRP has taken on a life of its own. Dozens of new QRP clubs have been formed. Why even the ARRL has taken notice! Although approaching 25 years old, the Heathkit HW-8 is still demanding big bucks on the used ham market. I guess there really is a lot of interest in the HW-8!

Now having said that, here is the second edition of the *HW-8 Handbook.*

In this edition, I have added more information for the three QRP radios that Heathkit produced. This time there are PC board overlays, adjustments and even the factory repair tips. I've put together a lot of information on the HW-7 in this edition, also

As always, the publication of this handbook is due in large part to the generosity of the authors of the modifications to the HW-7, HW-8 and HW-9 transceivers. They allowed me to reprint their work here, which appeared in the pages of *QST, CQ, 73, Ham Radio, Worldradio,* and *SPRAT.* Additional modifications came from the pages of *The QRP Quarterly,* published by the QRP Amateur Radio Club International.

## A "thank you" to all

**A word of caution: Not all of these modifications have been tried by the editor. The fact they appeared in print elsewhere indicates they work, but there is no guarantee, written or implied, to that affect. Second, there is some duplication in the kinds of circuits (RIT, improved keying, audio amplifier, etc.) offered. Look them over carefully and pick the one which will best suit your needs. Installation of one mod might preclude use of another, so check the circuits and their possible effects carefully before proceeding.**

***Cover photograph of the Heathkit HW-8 provided by Chet Sprinkle, K8YTO***

***A Special thank you goes to Rich Arland, K7SZ, and his box of red pencils***



And just for those people that like to know such things, the entire HW-8 Handbook was produced on a Apple Macintosh computer. The font faces are Old Bookman, Palatino, Helvetica. The main title text is in New Century Schoolbook.

The entire book was assembled in QuarkExpress version 3.3. From the Macintosh a CD rom was burnt. The CD was taken to the printer. From the printer's computer, a Trimetric film generator produced the required plates for the Heilberger web offset press.

# The Heathkit HW-7 QRP Transceiver

This is the one that started it all. The HW-7 was the first QRP transceiver sold by Heathkit

## The HW-7

The HW-7 Heathkit transceiver is a three band QRP CW transceiver with provisions either built in VFO or crystal transmit. Band coverage is the CW portion of forty, twenty, and fifteen meters. The transceiver can be operated from the Heathkit accessory power supply model HWA-7—1, an equivalent low impedance power supply or batteries. The experienced amateur, QRP man, and novice alike will appreciate the dependability and versatility of this transceiver.


*The Heathkit HW-7 three band QRP transceiver*

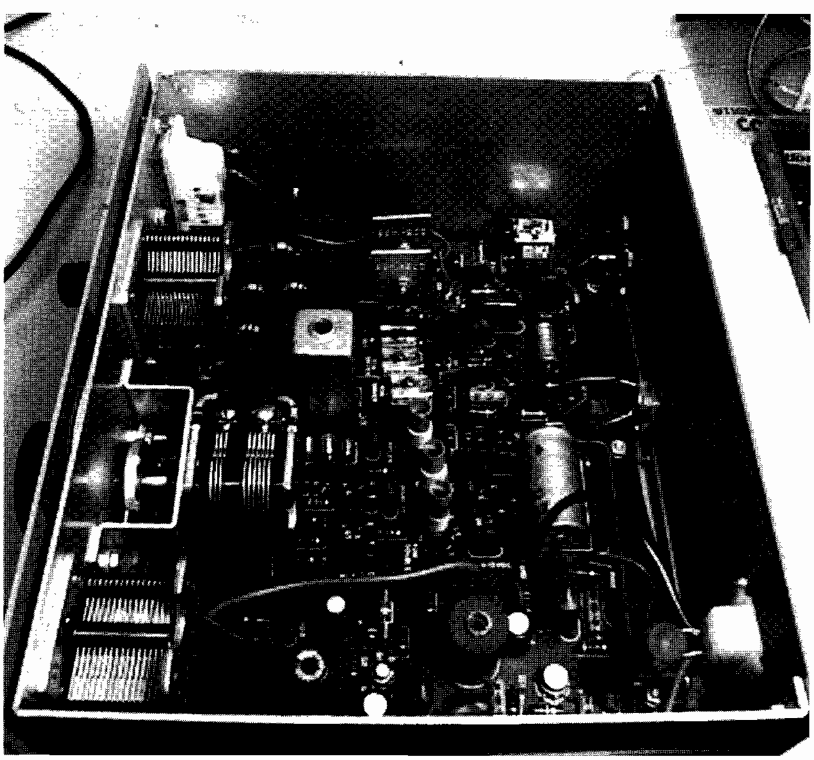
Whether you use it for standby, camping, emergency operation, or your primary rig, the transceiver will prove its worth. Band changing and tune up are easily accomplished with pushbutton band selection and single control tuning. The lightweight and compact transceiver has a pushbutton crystal transmit provision for the novice or QRP roundtables. Main tuning is accomplished through a 6-to-1 vernier that is virtually backlash free. A relative power meter, built in sidetone, and carry along size make the transceiver a pleasure to operate.

The HW-7 started the famous Heathkit QRP series. Of all the QRP transceivers made by Heath, very little is said about the HW-7. The HW-7 was Heath's first entry into the QRP fray.

Although the HW-7 did perform to specifications, the main fault in the rig centered on the receiver. Like its younger brother, the HW-8, the HW-7 uses a direct conversion receiver. There's nothing wrong with a direct conversion receiver, provided it is of good design. Unfortunately, the HW-7's receiver is not that blessed.

## Receiver overview

The receiver in the HW-7 is unbelievably simple. A dual gate MOSFET is both the front end and mixer. Signals from the antenna are dropped directly into the MOSFET via a brute force tuned circuit.



*As you can see, there's not much inside the HW-7. It's a very easy radio to repair. The three coils down the center of the PC board are the doubler and tripler coils used by the VFO. The two final transistors are mounted to small heat sinks. They are shown at the very top center of the photograph.*

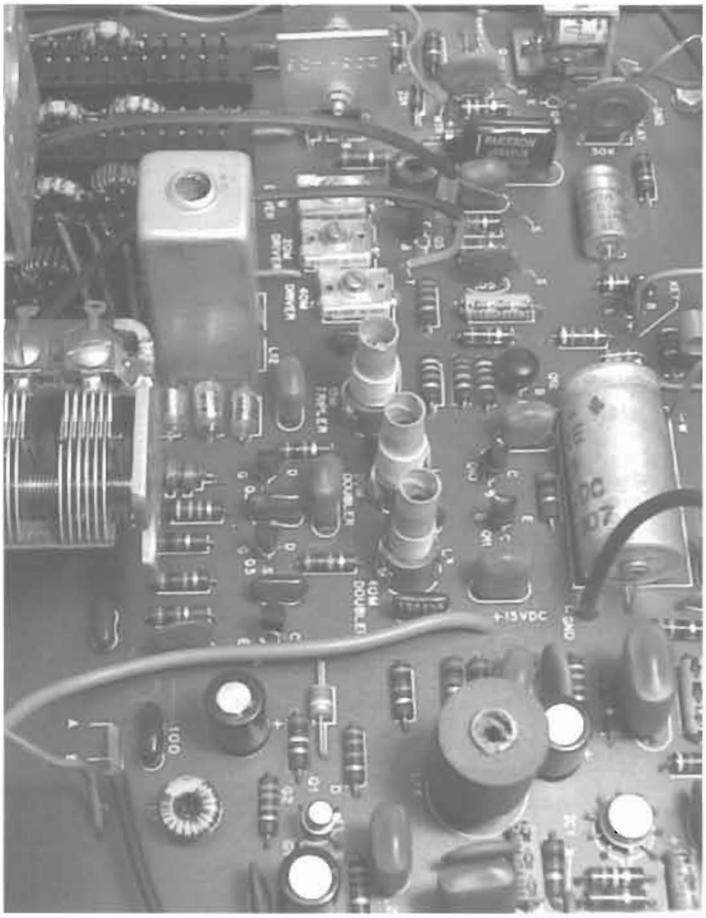
# The Heathkit HW-7 QRP Transceiver

The output of the VFO or crystal oscillator is also routed to the MOSFET. Here the two signals are mixed and the resultant audio is applied to a simple LC tuned circuit consisting of L14 and C5, C7 and C9. It is these components that provide the selectivity of the radio.

After the audio filtering, the audio signal is then routed directly to the audio amplifier. This amplifier boosts the signal up to headphone volume.

## The transmitter

The transmitter is just about as simple as the receiver. The same VFO or crystal oscillator is coupled to a doubler/tripler before the signal is sent to the transmitter driver. From here, the signal is amplified to about two watts by two RF transistors running in parallel. Low pass filters are selected by the proper pushbutton filter at the output of the transmitter.



*Inside the HW-7. The large object in the foreground is the inductor that sets the rig's selectivity*

All in all, the HW-7 is about as simple as you can make a transceiver. It is this simplicity that hurts the HW-7. In fact, Heath could have not chosen a worse device than the 40673 dual gate MOSFET which is used in the receiver mixer.

## HW-7 fixes

There is really nothing you can do to improve the receiver in the HW-7, short of tearing out the entire circuit and starting over. You can sometimes get better performance if you use a resonate antenna coupled through an antenna matching circuit. Between the two, the extra tuned circuits will help prevent unwanted signals from getting into that dual gate MOSFET.

To reduce microphonics and hum pickup from the audio circuits, run the HW-7 from a battery supply. This holds true for the HW-8 as well. The direct conversion receivers can suffer AC pickup from a line operated supply.

## Modifications to the HW-7

Even though the receiver is such a poor performer, there's very little in the way of modifications that can fix it. Generally, the only way to improve the receiver in the HW-7 is to tear it out and start all over again.

If you want to try your hand at improving the HW-7's receiver, I would suggest you scrap the MOSFET and try using a doubly balanced mixer such as the SBA-1. You more than likely will need to add some impedance matching transformers between the mixer and the VFO/ antenna input.

An additional stage of low level audio amplification would do wonders as well. By using either a low-noise op-amp such as the LM301 or a pair of transistors, the additional gain would be a great improvement.

The only problem with incorporating any of these ideas? They are not a drop in fix. The majority of the receiver would have to be scrapped, and new circuit boards designed and installed. It's not a task for the weak at heart. So, for the majority of HW-7s out there, the receiver is exactly the way Heathkit designed it.

# The Heathkit HW-7 QRP Transceiver

## Playing with the audio

Because the selectivity of the radio is generated inside the audio chain and since the audio circuits are very simple, you could spend a rainy afternoon experimenting with the circuit.
As designed by Heathkit's engineers, the LC components are very simple. A 200 uH coil and some capacitors do the work. Mouser electronics handles a line of high inductance coils that may be used to tailor the audio response of the radio. They won't fit the PC - board, as their lead spacing is not the same as the original one however a small hunk of perf-board would be ideal to use.

A handful of Mylar capacitors would round out the parts needed. Although you could sit down and calculate the values needed for the components based on frequency, cut and try is a lot more fun.

## Some HW-7 fixes and improvements

With some HW-7 radios, you can improve the sensitivity by placing a small jumper wire across C6 on the foil side of the PC board. Then remove R1, a 100K resistor. If you don't see any improvement or the radio fails to operate, replace the resistor. Some HW-7 will improve, others wont.

If the audio seems low replace R411, 10K with a 1K resistor. Again, this fix will only show up in the first run of kits. Newer HW-7s will more than likely have the values changed.

*This HW-7 has been modified to include several small add on circuits. This radio belongs to Rich Arland, K7SZ*

# The HW-7

## Heathkit produced service updates to ensure the service departments were up to date on any fixes or problems.

## February 16, 1973
## HW-7 QRP Transceiver
## Bulletin No: HW-7-1

Dial Rubbing

To Prevent the dial rubbing against the front panel the following change has been made in production. Replace the [4] 253-27 flat washers with two aluminum spacers, Part No: 255-1.

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## February 16, 1973
## HW-7 QRP Transceiver
## Bulletin No: HW-7-2

Broadcast Interference

In spite of the article in the January issue of QST, page 48, we do not plan to make a modification kit for this problem. However, we plan to track the identity of all purchaser's & mail the information & parts to them individually. To service those we miss [retail sales primarily],
the attached information sheet will suffice. The parts should be furnished at no charge. Only those with serial numbers starting '002' require the change. Others already have them in the kit itself.

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## February 16, 1973
## HW-7 QRP Transceiver
## Bulletin No: HW-7-3

Low Audio Level - Receiver

Replace R411 [10K Ohm] Part # 1-20 with 1000 Ohm, Part #1-9. This is a production change which should be made in all kits with SN's starting with '002'.

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## February 16, 1973
## HW-7 QRP Transceiver
## Bulletin No: HW-7-4

## Service Hints

RECEIVER: The receiver section of the HW-7 is basically a direct conversion type circuit. The incoming signal is mixed with the on-frequency VFO signal to provide audio output.

The audio is filtered by the lowpass audio filter & coupled to the audio IC which has approximately 100db of gain. A certain amount of microphony is normal for this type of circuitry.

Normal sensitivity for this receiver is less than 1uv which will provide a readable signal. This is normal since all protos & field test units showed much better sensitivity.

Typical RF voltage readings at the detector FET Q1 are .6 to 1 volt RMS nominal measured on Boonton 91-C meter. Any injection appreciably less than .4 volt RMS will give a loss of sensitivity. NOTE: This voltage is not a pure sine wave.

When Receiving a signal, the front panel preselector control must be carefully peaked in the designated areas.

## VFO/DOUBLER/TRIPLER

The Colpitts oscillator operates on 3.5 to 3.6 MHZ and doubled to 7.0 to 7.2 MHZ for 40 Meter operation. For 20 & 15 Meter operation, the oscillator runs at 7.0 to 7.1 MHZ & doubled for 20 meter [14.0 to 14.2 MHZ] & tripled for 15 meters [21.0 to 21.3 MHZ]. Following are typical RF readings:

Gate of Q3 = Approx. 1 Volt RMS [Sine wave]
Base of Q4 = Approx. .8 Volt RMS [Approx. Sine wave]
Collector of Q4 = Sine wave with harmonics

# The HW-7

## OSC./DRIVER & RF AMPLIFIER

Base of Q5 [xmit] = 1 to 2.5 Volts RMS [not Sine wave]
Base of Q6, Q7 = 1.5 to 2.5 Volts RMS [not Sine wave]
RF output across 50 Ohm load should be approximately 10 Volts RMS [Sinewave for all bands].

A possible problem area in transmitter may be two extremely mis-matched out transistors [high gain with low gain]. This may cause one transistor to "hog" all the current thereby destroying itself. When this happens, also check zener diode, ZD1, for possible open circuit. If instability is a problem, also check ZD1 for an open circuit.

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## May 3, 1974
## HW-7 QRP Transceiver
## Bulletin No: HW-7-5

Audio ["popcorn"] Noise Reduction

The following modification will reduce the noise level of the CA-3035V1 audio IC considerably:

1] Connect a 220K [PN 1-29] resistor and a .1uf [PN 21-95] disc IN SERIES from pin 4 to pin 5 of the CA-3035V1 on the foil side of the board.

2] Connect a 1 uf Electrolytic [PN 25-197] from pin 6 of the CA-3035V1 to the ground foil between pins 2 & 8.

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## July 12, 1974
## HW-7 QRP Transceiver
## Bulletin No: HW-7-6

Sensitivity Improvement

1] Jumper a small wire across C6 [100pf] on the foil side of the board.

2] Remove R1 [100K Resistor].

NOTE: If the unit fails to operate, or there is no increase in sensitivity with this resistor removed, it should be reinstalled in the circuit.

These circuit changes are to be made only as needed.

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## March 26, 1975
## HW-7 QRP Transceiver
## Bulletin No: HW-7-7

Pulse Oscillation on 40 Meters

If the HW-7 has an oscillator problem, check to see if Q2 is a Teledyne device rather than a Motorola.

To prevent the circuit from pulse oscillating, install a ferrite bead [PN 475-10] on the gate lead if Q2 is a Teledyne type.

HW-7 Modifications

A. Remove & discard capacitors C-5, C-6, C-8, C-9.
B. Replace C-5 & C-9 with .22uf mylar capacitors.

A. Lift coax from point A on circuit board.
B. Install 100pf mica capacitor between center conductor of coax and point A. [Improves BCB rejection].
A. Install heat sinks on transistors using silicone grease for PA protection.

PARTS LIST

| | | |
|---|---|---|
| [2] | .22UF | 27-85 |
| [1] | 100PF | 20-102 |
| [2] | #4-40X1/2" SCREW | 250-52 |
| [2] | #4 LOCKWASHER | 254-9 |
| [2] | #4-40 NUT | 252-15 |
| [1] | SILICONE GREASE | 352-13 |
| [2] | HEAT SINK PLATE | 205-1436 |

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## April 17, 1975
## HW-7 QRP Transceiver
## Bulletin No: HW-7-8

Modifications F/U/W the HD-1410 Keyer

The HW-7 keying circuit was designed to be compatible with the HD-10 keyer. This is the reason that the key jack has the tip contact grounded. Two changes should be made to the HW-7 to allow use with the HD-1410:

A] The two wires going to the HW-7 key jack should be reversed.

B] R39 should be changed from 470 Ohm to 4700 Ohm.

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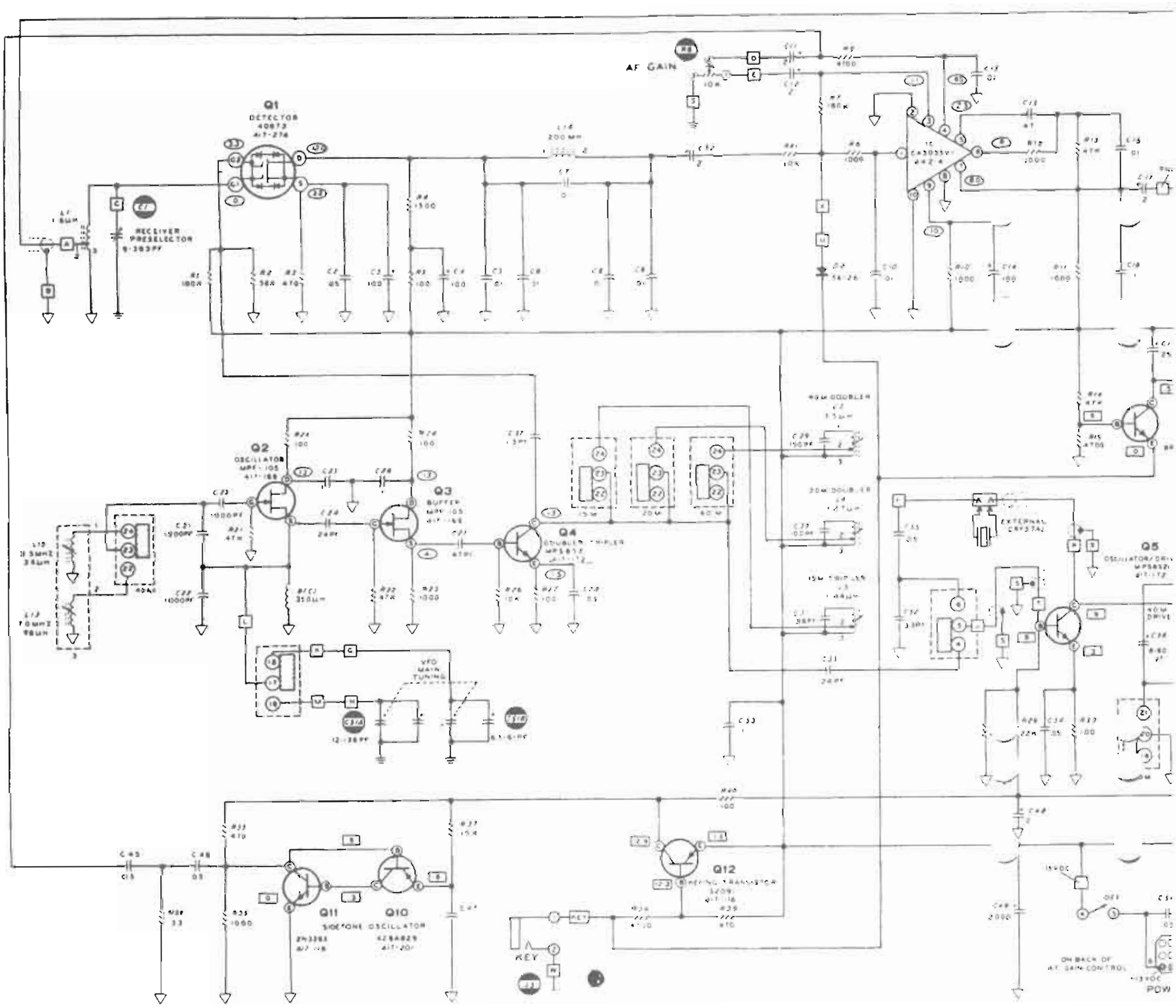
# The HW-7




*The front end of the HW-7 QRP transceiver*

Because the receiver in the HW-7 is noted to be lacking, here's a snippet of the front end. The problem is the use of a dual gate mosfet. Heath could not have selected a worse device to simultaneouslyserve as the front end and the mixer.

# The HW-7

NOTE: Transceiver alignment requires the use of a calibrated receiver, such as a Heathkit Model SB-303 or equivalent, capable of receiving 7.0 MHz, 7.2 MHz, 14.0 MHz.and14.2MHz.

## VFO ALIGNMENT

( ) Turn on the calibrated receiver and allow it to warm up.

( ) Be sure the 50-ohm dummy load, headphones, key, and power supply are connected to the Transceiver.

( ) Press in the 40M pushbutton.

( ) The CRYSTAL TRANSMIT pushbutton should be in its out position.

( ) Rotate the TUNING knob fully counterclockwise.

( ) Rotate the RECEIVER PRESELECTOR knob fully counterclockwise.

( ) Rotate the AF GAIN - OFF control to the twelve o'clock position.

( ) Set the Transceiver VFO to 7.1 MHz.
NOTE: In the following steps, you will zero beat the receiver to its crystal calibrator. Then you will zero beat the calibrated receiver against the Transceiver. Zero beat is a point where the two frequencies being combined (beat against each other) are exactly the same frequency. As zero beat is approached, the tone caused by the two combined frequencies will gradually decrease in pitch and volume until it just stops.

The two frequencies to be zero beat first are the crystal calibrator and receiver frequencies. Then the receiver frequency will be used to zero beat the Transceiver frequency. The end result will be a calibrated Transceiver that has a true frequency nearly identical to the dial frequency.
( ) Tune the calibrated receiver to 7.0 MHz. Then turn on the crystal calibrator and gradually adjust the receiver frequency until the tone decreases in pitch and volume. It may be necessary to increase the RF and AF gain controls. When the tone just stops, zero beat has been reached.

( ) Turn off the crystal calibrator,

( ) Tune the Transceiver VFO to 7.0 MHz.

( ) Refer to Figure 1-1 (fold-out from Page 24) and tighten both trimmers on the VFO capacitor until they are just snug. Then rotate each trimmer 1/2-turn counterclockwise.

( ) Again refer to Figure 1-1 and rotate the top slug in the VFO coil until a zero beat is heard from the calibrated receiver. It may be necessary to turn down the calibrated receiver AF gain control. Use the supplied alignment tool to make the adjustment. Do not rotate the coil slug more than one turn in either direction.

( ) Tune the calibrated receiver to 7.2 MHz.

( ) Tune the Transceiver to 7.2 MHz.

( ) If a zero beat is not heard, rotate the rear trimmer on the VFO capacitor slightly in either direction until a zero beat is reached.

( ) Again tune the calibrated receiver and the Transceiver to 7.0 MHz and check the zero beat. Then recheck the 7.2 MHz position for a zero beat. When no further improvement can be made in the zero beats, proceed to the next step.

( ) Tune and zero beat the calibrated receiver to 14.0 MHz.

( ) Press in the 20M pushbutton on the Transceiver.

( ) Tune the Transceiver main tuning to 14.0 MHz.

Again refer to Figure 1-1 and use the alignment tool to adjust the bottom slug of the VFO coil until a zero beat is heard from the calibrated receiver. This adjustment is rather difficult to accomplish since the zero beat point can be passed over very easily.

Carefully rotate the coil slug back-and-forth until the zero beat is reached.

Tune the calibrated receiver to 14.2 MHz.

Tune the Transceiver to 14.2 MHz.

If a zero beat is not heard, rotate the front trimmer on the VFO capacitor slightly in either direction until a zero beat is reached.

Again tune the calibrated receiver and the Transceiver to 14.0 MHz and check the zero beat. Then recheck the 14.2 MHz position for a zero beat. When no further improvements can be made in the zero beats, proceed to the next step.

The calibrated receiver is no needed: it can be set aside.

# The HW-7

## TRANSMITTER ALIGNMENT

( ) Press in the 40M pushbutton on the Transceiver.

( ) Tune the main tuning to 7.1 MHz.

( ) Key the Transceiver. Rotate the TUNING knob for a peak indication on the relative power meter and release the key.

( ) Key the Transceiver and adjust the 40M DRIVER capacitor for a peak meter indication. Release the key.

( ) Key the Transceiver and adjust the 40M DOUBLER coil for a peak meter indication. Release the key.

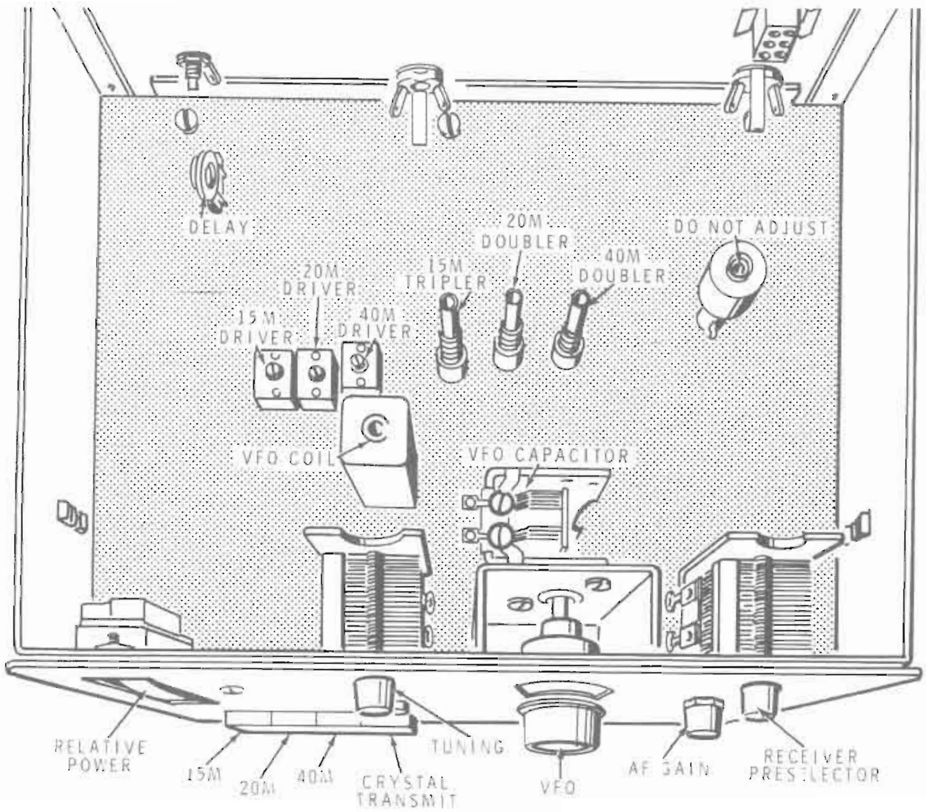



Figure 1-1

( ) Press in the 20M pushbutton.

( ) Set the main tuning to 14.1 MHz.

( ) Key the Transceiver and rotate the TUNING knob for a peak meter indication between 1 and 2 on the tuning dial. Release the key.

( ) Key the Transceiver and adjust the 20M DRIVER capacitor for a peak meter indication. Release the key.

( ) Key the Transceiver and adjust the 20M DOUBLER coil for a peak meter indication. Release the key.

( ) Press in the 15M pushbutton.

( ) Set the main tuning to 21.15 MHz.

( ) Key the Transceiver and rotate the TUNING knob for a peak meter indication between 2 and 3 on the tuning dial. Release the key.

( ) Key the Transceiver and adjust the 15M DRIVER capacitor for a peak meter indication. Release the key.

( ) Key the Transceiver and adjust the 15M TRIPLER coil for a peak meter indication. Release the key.

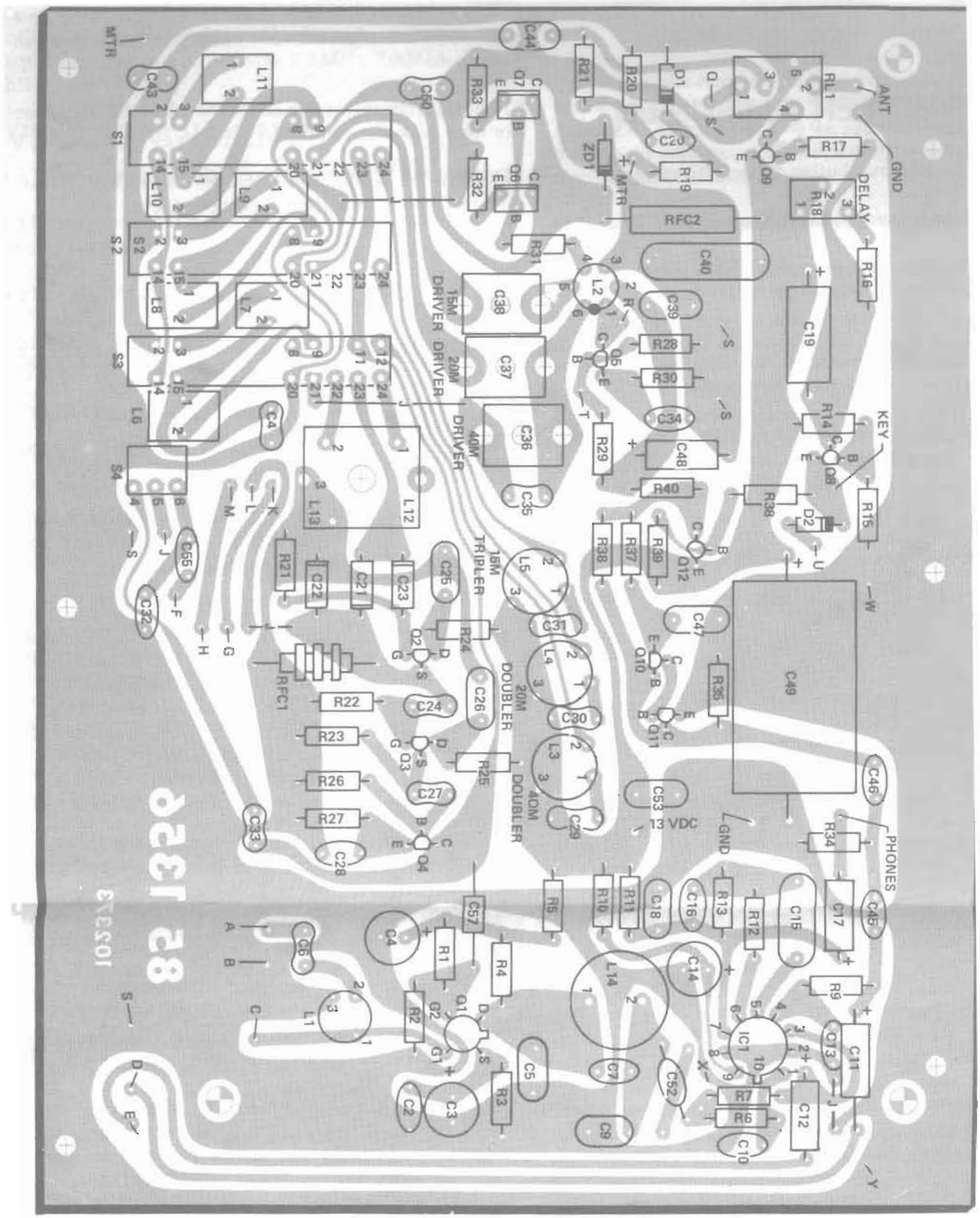
NOTE: This completes the alignment of the Transceiver for VFO operation. If the Transceiver will be used for crystal operation, install your particular crystal and press in the CRYSTAL TRANSMIT pushbutton. Then adjust the DRIVER capacitor for a peak meter indication on the band you have the Transceiver tuned to.

( ) Key the Transceiver and adjust the DELAY control for the desired amount of "delay" that the transmitter "holds in" after the last transmitted character.

( ) Do not attempt to adjust the audio filter coil as it was adjusted at the factory.

This completes the "Alignment" of the Transceiver.

# The HW-7



*The HW-7 PC board as viewed from the component side*

# The Heathkit HW-8 QRP Transceiver

Without question, the HW-8 is by far the most popular QRP transceiver every produced in kit form.

## A little bit of history

The Heathkit HW-8 QRP CW transceiver was by far the most popular of the Heathkit "QRP trio."

Introduced in 1976, it was in production until 1983. Not a bad run for such a simple little rig. The original price was $139.95 minus the power supply. The HW-8 sports the traditional "Heathkit green" color scheme.

Based on the HW-7, the HW-8 was not a fix to the HW-7 but rather a completely new design. The HW-8 was a major overhaul of the problem plagued HW-7.

Although the HW-8 continued to use the direct conversion receiver scheme, many of the problems associated with the receiver built into the HW-7 had been fixed. Heath added a JFET RF amplifier ahead of the receiver. They also added an RC active audio filter and a doubly balanced IC product detector into the same foot print as the HW-7.

Although there are some that scoff at the idea of a direct conversion receiver, the HW-8's receiver is quite good. You can easily hear signals all the way down to .5 uV.

If you've never operated a direct conversion receiver, you'll find that signals seem to "pop" of out a noise less background. There's no phase noise, no sysnthesizer noise and no DSP components on the signals.

## More fire in the wire

With the HW-8, Heath boosted the transmit power up to about 2 watts across the four bands. In actual use, you'll find the 20 and 15 meters bands produce a tad less than 2 watts.

The HW-8 is not a QSK machine. The T/R function is taken care of a small relay. The T/R delay time is adjustable by a small PC mounted trimmer.

*The Heathkit HW-8 QRP transceiver*

## What's inside

The majority of the HW-8 is built on one large single sided PC board. A smaller PC board is mounted on the right rear side panel. This smaller board contains a small audio amplifier.

Extensive use of diode switching is used though out the HW-8.

## What's outside

The HW-8 weighs 7 pounds. It measures 9.25 inches by 4.25 inches high. It is 8.5 inches deep.

The transmitter draws about 450 ma on key down while the receiver consumes around 75 ma.

# The Heathkit HW-8 QRP Transceiver

## 4 Band QRP CW Transceiver

The HW-8 is a surprisingly nice radio to work QRP with and even though it only produced two watts, you can easily work the world with a HW-8 transceiver. The HW-8 is built on one major PC board with a small audio amplifier PC board mounted on the side panel.

## What makes it work

Because the HW-8 is a direct conversion receiver, the VFO plays an important part of the operation of the rig. No VFO, nothing works! The VFO operates from 8.645 MHz to 8.895 MHz. The active devices in the VFO are Q2 and Q3.

The output of the VFO is applied to the balanced mixer along with the HFO oscillators The HFO oscillator operates at 12.395 MHz for 80 meters, 15.895 MHz for 40 meters, 22.895 MHz for 20 meters and 29.895 MHz for 15 meters. Transistors Q4 and Q5 form a mixer amplifier with its output going the transmitter driver, Q8 and to the receiver product detector IC1. So, as you can see, if the VFO, HFO and mixer are not working, the HW-8 will be quite dead.

To check for proper operation of the HFO it to couple a frequency counter to TP1. This is R94, located near the row of diodes in the center of the board. As you monitor this test point, you should see the HFO frequencies:
12.895 MHz=80 meters
15.895 MHz=40 meters
22.895 MHz=20 meters
29.895 MHz=15 meters

If one or more frequencies are not present, remove the counter from TP1 and connect your RF probe. If you have a scope, use it in place of the RF probe. The scope will allow you to see what the waveform looks like, too. Depending on what band is not working try adjusting the HFO coil for the band.

80 meter is the bottom of coil L17
40 meters is the top of L18
20 meters is the bottom of L19
15 meters is the top of L19

*The HW-8 awaiting a tune up and testing on my bench*

When the HFO is operating, you'll see a voltage appear at TP1. Adjust the coils for maximum voltage. Check for proper operation by selecting and deselecting the bands making sure the HFO oscillator starts all the time. If you find one band that is slow, adjust the proper coil until the oscillator starts reliably.

The HW-8 uses diode switching for changing bands. Along with the push button switches to route the high power (two watts!) RF to the output filters. If you have a HW-8 that is dead on one or more bands, start checking the switching diodes. For example, 80 meters requires D22 to be on.

# The HW-8

## A case history

I picked up a broken HW-8 at a hamfest. The seller told me it only worked on 20 meters. There was no transmit at all on any of the other bands. The receiver was also quite dead on 80, 40, and 15 meters. All I could hear was the audio hiss in the earphones.

As I looked around at the PC board, I found that out of twelve of the compression trimmers, only three had their adjustment screws. The rest were missing. Now, why on earth would anyone want to remove the adjusting screws from the trimmers? I've still not been able to figure that one out.

Also missing, or rather destroyed, is the slug in the L19/L18 coil. This is one of the heterodyne oscillator coils. If this coil is out of adjustment, the circuit it controls will not function. In this case, L19 controls the operation of the 20-meter oscillator. The other half of this coil controls the 40-meter oscillator. Since the slug for the 40-meter band was in crumbs, it told me that someone had attempted to work on the heterodyne oscillator. It also told me that they could not find the problem by simply adjusting the slug in L18/L19.

## Checking the heterodyne oscillator

Heath wants you to use a RF probe to check for the proper operation of the heterodyne oscillator. The test point is TP1 and is located on the diode side (as looking down onto the PC board) of R94. I have found in the past it is best to couple an oscilloscope to this test point and forgo the RF probe. The scope will not only show you the output level of the oscillator but also what the waveform looks like. Sometime more is not better!
So, couple your scope probe to R94. As you select the different bands via the front push buttons, you should see a nice waveform on the scope. There should be at least 50-mV pp on the scope. On this radio, none of the crystals would fire except on 20 meters. Since Q7 and Q6 are the only active devices and they both work on 20 meters, there had to be another problem.

*The heterdodyne crystals inside the HW-8*

The HW-8 is full of switching diodes. They control the various tuned circuits. We've talked about these diodes in the past, and I won't go into great detail here again. Its enough to say that if one or more of the switching diodes are kaput, then the section that is controlled by those diodes will not function.

On this radio, the switching diodes controlling the heterodyne oscillator were all working. This test is simple. Use your VOM and check to see if plus 12 volts is routed via the diode to the crystal.

The front panel push buttons do much more than direct the 12-volt switching voltage to the various diodes. They route the antenna to the front-end amplifier, and also route the output of the PA to the various output filters. These push buttons have wires on the top and connections via the PC board on the bottom. I mentioned this because I found while checking the switching diodes I had 12 volts on the green wire leading from the 20-meter switch even though the 80-meter button was in! The color codes are from the Heathkit manual and allow you to trace the various switched circuits.

The color code is:

Black for 80 meters
Red for 40 meters
Green for 20 meters

The white is for 15 meters. This color-coding is the same no matter if the wire goes to the front end or to the PA stage.

While we're at it, looking at the front of the radio, the push buttons are (left to right):

| | |
|---|---|
| 80 meters | SW1 |
| 40 meters | SW2 |
| 20 meters | SW3 |
| 15 meters | SW4 |

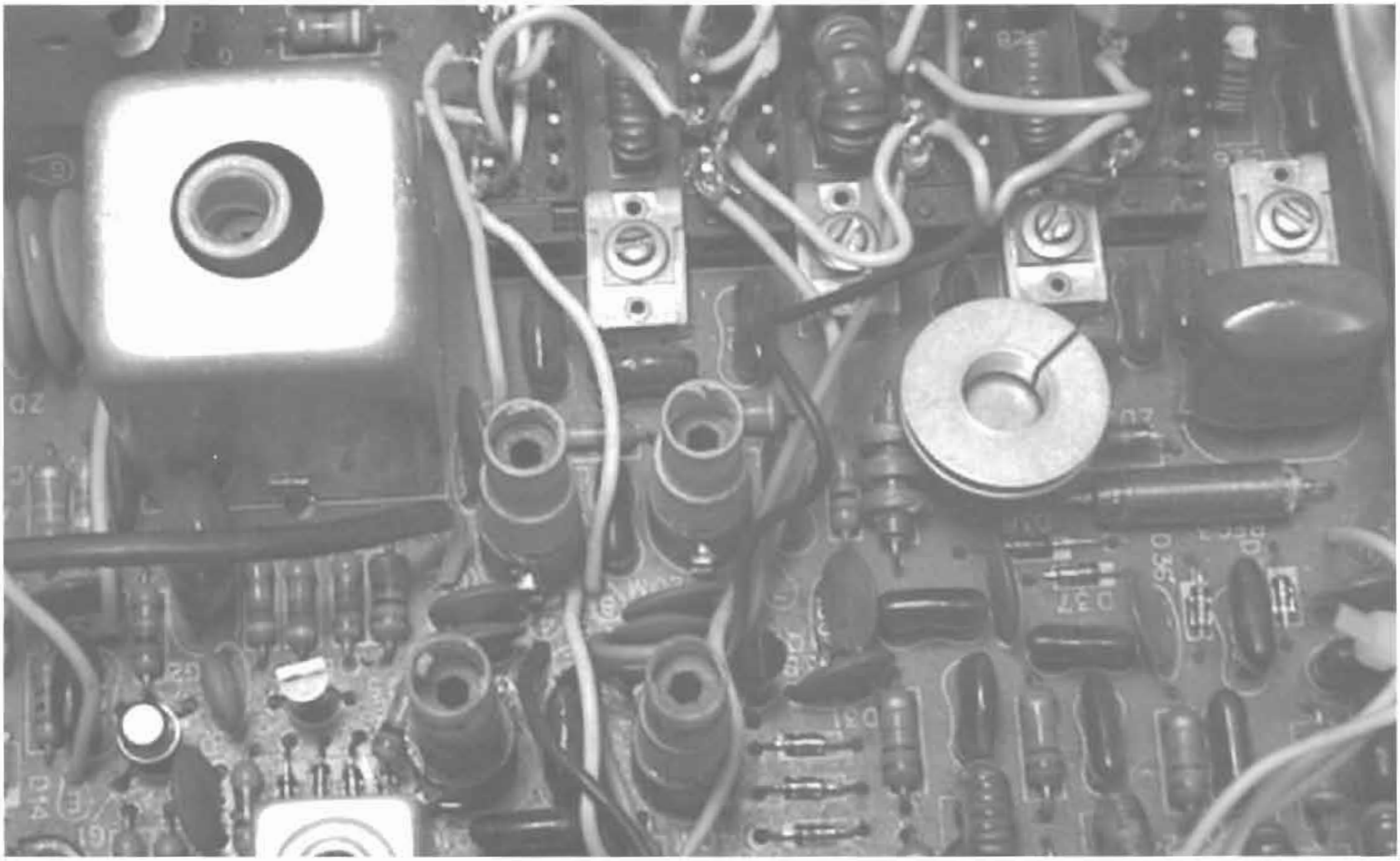
On each pushbutton SECTION the PINS are numbered like as followed:

The section closest to the front panel left most side pins
10, 11, 13 right side 1, 2, 3,

Middle section pins
13,14,15 right side 4,5,6

End section pins
16,17,18 right side 7,8, 9

# The HW-8



*Looking inside the HW-8. The heterdodyne oscillator coils are shown here. The large heatsink is on the PA.*

The sections are lettered. Again, front panel, RIGHT most switch (the 15-meter button.) The section closest to the front panel is section A. Middle section is B, and the last section is C.

This sequence is repeated on all the switched. So, 80 meters can have section D, E and F with pins 1,2,3 and 10, 11, 12

Now having said all of this, a quick touch of the soldering iron detached the green wire from the 20 meter switch. With this wire no longer connected to the heterodyne oscillator, the other crystals fired right up.

No matter what switch was pressed; the wire going to the 20-meter band was always hot with 12 volts. The problem was finally traced to a shorted switching diode in the front end. As it turned out, diode D7 was at fault. Here's what happened. When any other band switch was press in, the switching voltage was applied to all stages. In this case, we'll select the 80-meter band.

With the 80-meter button in, 12 volts is applied to select L5 via D5. , C2 and L1 in the front-end circuit are now active thanks to diode D1. At the same time, D22 is turned on and places Y1, 12.395 MHz, in the heterodyne oscillator. And last by not least, diodes D31 and D35 are forward biased and select the L27/C77-C78 combination for the final transistor.

What happened is kinda of simple once you look at it. With D7 shorted, no matter what band you selected you always had several other stages turned on as well. That's why the heterodyne oscillator did not work. When 80 meters was selected, the 20-meter crystal was also selected.

# The HW-8

That's why the heterodyne oscillator did not run. Two crystals were in parallel!

The fix is simple. Replace D7. After the new diode was in place, the 12 volt switching voltage was only present when 20 meters was selected by the push button.

The only other fixes were to the L18/L19 coil and the trimmer capacitors.

The trimmers were an easy to fix. The screw size is 5-56 by 1/4 inch long. Radio Shack sells a pack for about two bucks. However, the heads of these screws are too small to hold the top half of the trimmer together. The fix? I used nylon shoulder washers. These are the same kind you would find in a TO-220 mounting kit. The shoulder part of the nylon goes into the trimmer first. Then the screw is dropped down into the trimmer. The trimmer has the same thread size, so all you need to do is tighten the screw! Don't over do it as you can easily run the screw head through the nylon washer.

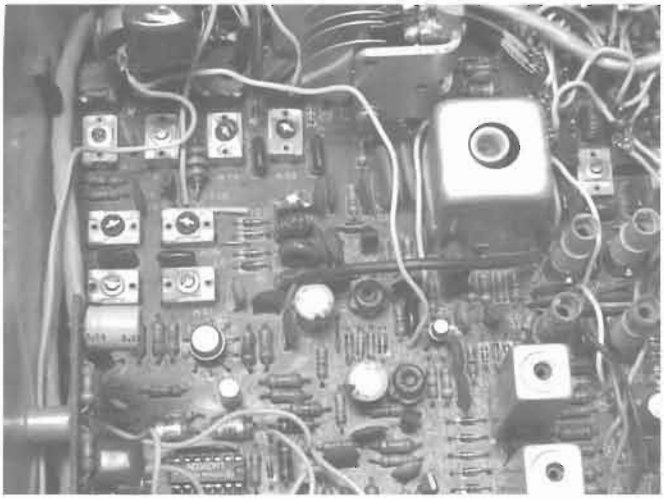
The L18/L19 slug was a bit trickier. Before recycling became fashionable, Heathkit was already into it. Many of the same components are used in a variety of Heath products. Case in point, the heterodyne crystals used in the HW-8, are the same as those used in the Heathkit HW-101! So, to replace the broken slug in the L18/L19 coil, a slug was removed from the heterodyne oscillator coil from a dead HW-101. It worked like a champ!

## Transmitter fixes

I've come upon some information about the final output transistor that you may find interesting. Heathkit used a house numbered part. But from the printing on the device, it looks like Motorola made the transistor. I can't find a cross-reference for the Heath number anyplace. However, the instruction manual for the HW-8 references the part to a 2N4427. Mouser electronics stocks this transistor. It's about $3 a pop.

In my original "HW-8 Handbook" a high power modification for the HW-8 is as simple as subbing in an ECG 488 for the final. I can't for the life of me find anyone that stocks the ECG line. But, NTE replacement parts cross the ECG488 to an NTE488. I have not yet tried this in my HW-8s. I did notice that NTE crosses the 2N4427 to a 15 watt RF device in a TO-5 case. The NTE488 comes in at a 5 watt RF device in a TO-5 case. I don't know why the difference between the two. I guess I will have to experiment with one of my radios. I have had luck with the 2N3553 and the 2SC799. Both will produce a good watt and a half on 80 and 40 meters. On 20 and 15, the max power seems to be about one watt.

In some of the HW-8s I have come across, I have put in MSPA20 in Q8 and Q5 locations. They seem to have bit



*The receiver front end trimmers. The large shield coil is the VFO oscillator coil*

more bite that the original Heathkit devices. Although I have not tried them, a METAL case 2N2222A might work also as Q5 and Q8.

There are two other locations you should look at if you ar having trouble with the HW-8's output. Check the Zener diode at location ZD2. If this diode has become leaky, it maybe the cause of low output. This diode is there to protect the final, Q9, from excessive high collector RF voltages, which can happens if you key the transmitter into an open antenna. Any RF voltage over 36 volts will be clamped to ground via the Zener diode.

If your HW-8 has been repaired in the past, especially with final PA troubles, look to see if a ferrite bead is on the base lead of Q9. This bead is there to keep Q9 stable. If your transmitter seems to take on a life of its own, check for this bead on Q9's base.

The manual calls for 3.5 watts of RF into a 50-ohm load, I've found these values to be much closer to real life.

| Transmit power @ 13.8 volts into 50-ohm load | |
|---|---|
| 80 meters | 2.1 watts |
| 40 meters | 1.75 watts |
| 20 meters | 1.5 watts |
| 15 meters | 1.2 watts |

### *Heathtip*

NTE bought out ECG several years ago. Most, but not all matching ECG/NTE numbers are simular and will work. Be sure before you sub-out with NTE parts

DE RichK7SZ

# The HW-8

Of course I've seen more power in some HW-8s on 80 meters than 1.5 watts, but the values shown are very typical.

On receive:

| | |
|---|---|
| 80 meters | .5uV |
| 40 meters | .6uV |
| 20 meters | .7uV |
| 15 meters | .7uV |

On 20 and 15 meters, you'll often find the trimmer capacitors in the tank circuit requires tightening all the way down. There's not enough capacitance from the trimmer to get the stage to resonate. Take a 20-pF capacitor and tack solder it across the trimmer that is giving you trouble. Then try the adjustment one more time. With the extra capacitance across the trimmer, you should now find the circuit peaks without twisting the screw out of the trimmer threads. By the way, this fix works for the front-end trimmers as well.

## Setting the VFO

There's one scheme that Heathkit used in almost all of their analog VFO designs; you had to balance the ends of the VFO to calibrate it. Here's how Heath wanted you do to it.

You used a receiver to listen to the output of the VFO. You then turned the receiver to the low end of the VFO. You adjusted the VFO trimmer so you can hear its signal. Then you reset the receiver to the high end of the VFO's output and adjusted the VFO's coil so you can hear the signal. You did this over and over again until the two ends were balanced. What you ended up with is a VFO that tracked from the high end to the low end.

Now if you have ever tried this using the method described above, you'll go batty!

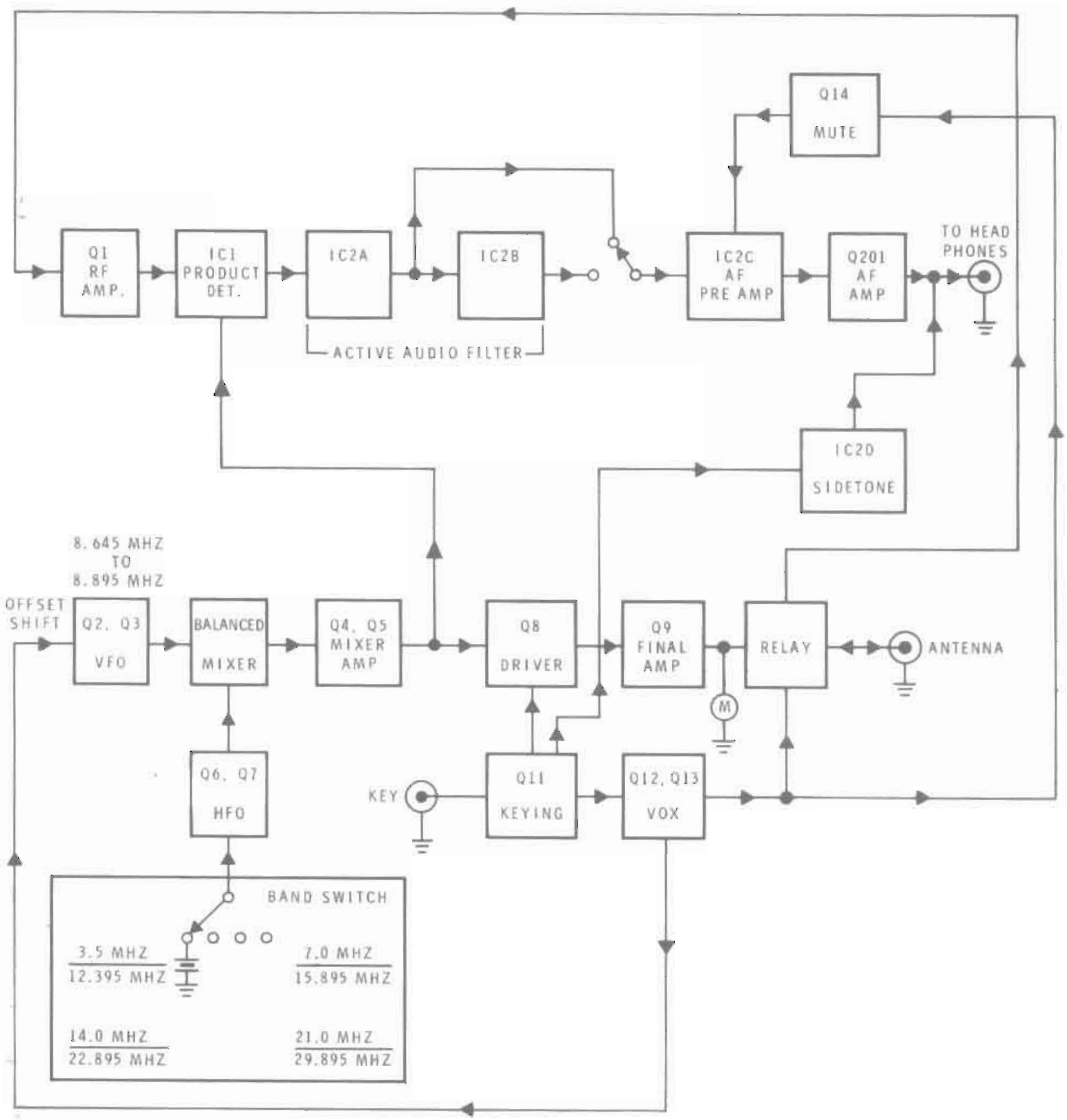
Here's an easier and quicker method. You'll need a good frequency counter. Allow both the HW-8 and your counter to warm up for at least 30 minutes.

Couple your counter to test point two(TP2). This is resistor R49. Go to the end of the resistor that is closest to L9, the large VFO coil. The VFO in the HW-8 runs from 8.895 MHz to 8.645 MHz. The idea is to set the VFO so it will track from one end to the other between the two frequencies of 8.895 and 8.645 MHz. Adjust the trimmer located on the VFO tuning capacitor (C302B) and the slug in L9. Again, the idea is to set the trimmer and slug so the VFO will run from 8.895 to 8.645 MHz. It's not easy to set, so do the best you can. I find the trimmer on the VFO tuning capacitor is very touchy!

## Hint:

Remove the screw from the trimmer on the side of the VFO capacitor and replace it with a 0-20 pF piston trimmer. This will make it much easier to adjust the VFO.

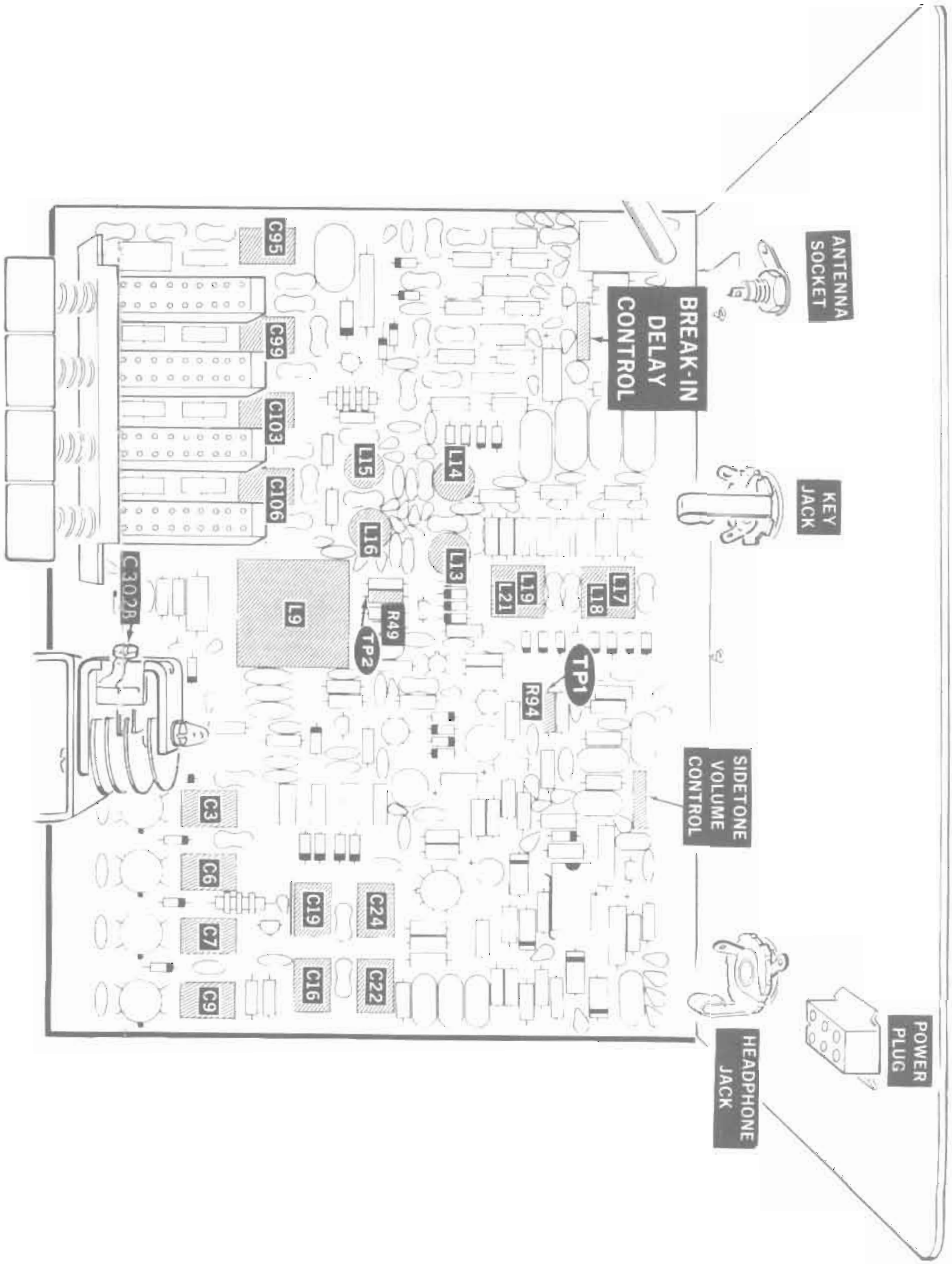
# The HW-8



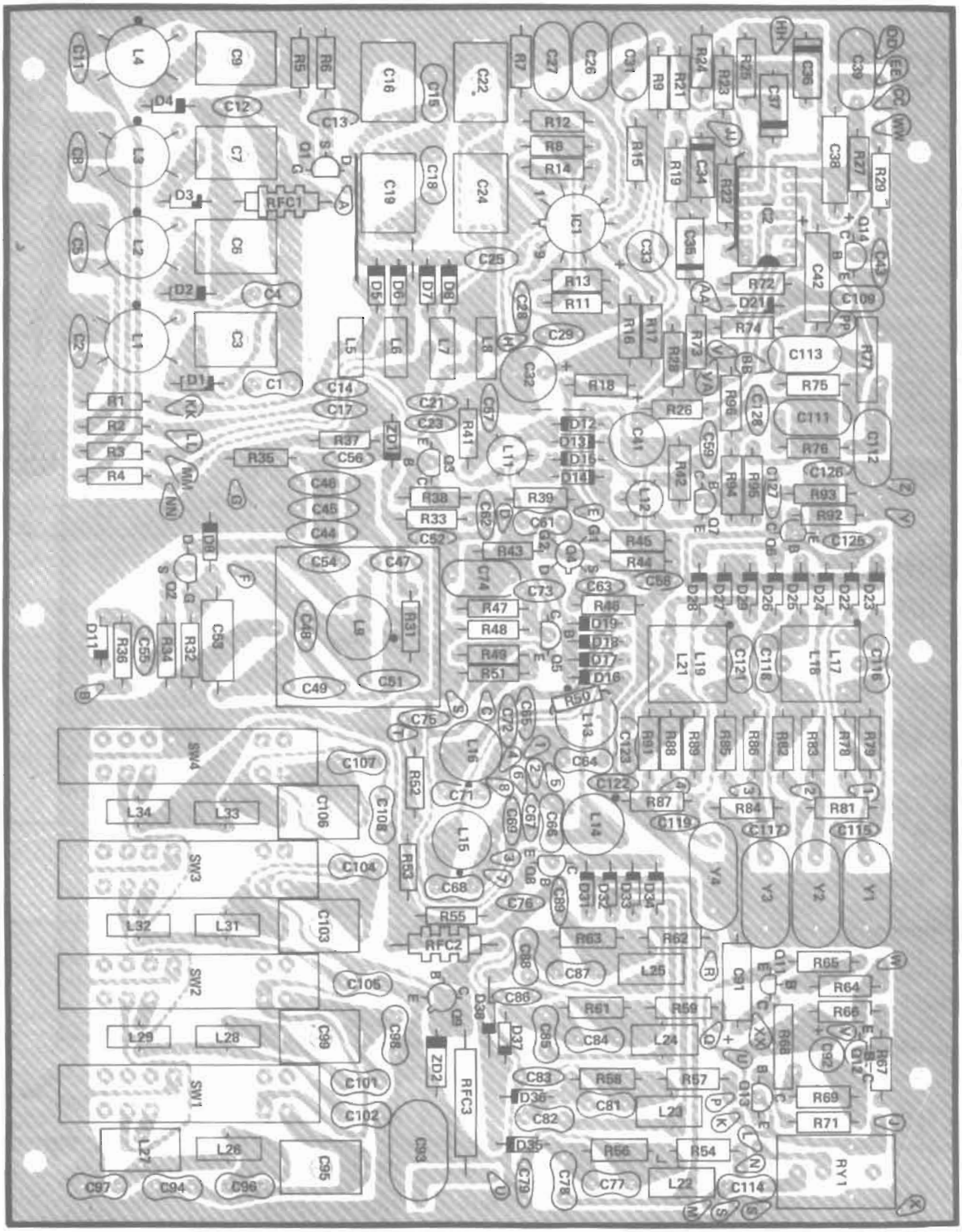

This is the block diagram for the Heathkit HW-8 QRP transceiver. A counter or scope attached to the output of either Q6 or Q7 will show you if the HFO oscillator is running.

The HW-8 is rather simple, but sometimes they can really cause you to do some head scratching!

# The HW-8




## Locations of the various test points and adjustments



**The HW-8 main PC board as shown from the foil side**

# The HW-8

More than likely, you'll want to align your HW-8. That's fine. Just remember that a alignment won't fix a broken radio.

## ALIGNMENT

The following alignment procedure requires the use of a calibrated receiver capable of receiving 7.0 to 7.25 MHz, an RF signal generator, and a VTVM with a RF Probe. If a signal generator is not available, use an on-the-air signal. Figure 1-3 is a schematic of a simple RF probe which you can make if one is not available. CAUTION: A cabinet shell must be installed on the bottom of the transceiver before you start the following procedure.

Refer to Figure 1-2 in the Illustration Booklet for the following procedures.

## HFO (Heterodyne Frequency Oscillator)

Connect the RF probe of the VTVM to test point TP1. This is the lead at the indicated end of resistor R94, a 68k ohm (blue-gray-orange)
resistor.

Turn the transceiver on and press the 3.5 MHz pushbutton.

NOTE: You can reach the bottom slug in coils L17/L18 and L19/L21 by inserting the longer end of the alignment tool through the top slug; then on down to the bottom slug. Be careful when you do this so that you do not damage or turn the top slug.

Use the smaller alignment tool and adjust the bottom slug in coil L17/L18 B to obtain a peak reading on the VTVM. Then turn the slug an additional 1/4 turn clock wise. The VTVM should read approximately.03 volts.

Press the 7.0 MHz pushbutton.

Adjust the top slug in coil L17/L18 to obtain a peak reading on the VTVM. Then turn the slug an additional 1/4 turn counterclockwise. The meter should read approximately 0.3 volts.

Press the 14.0 MHz pushbutton.

Adjust the bottom slug in coil L19/L21 to obtain a peak reading on the VTVM. Then turn the slug an additional 1/4 turn clockwise. The VTVM should read approximately 0.2 volts.

Press the 21.0 MHz pushbutton.

Adjust the top slug in coil L19/L21 to obtain a peak reading on the VTVM. The VTVM should read approximately 0.2 volts. Then turn the slug 1/4 turn counterclockwise.

Disconnect the VTVM from the Transceiver.

## VFO (Variable Frequency Oscillator

Turn the calibrated receiver on and allow it to warm up. Tune the receiver to approximately 7.0 MHz.
Press the 7.0 MHz pushbutton on the Transceiver.

Connect one end of a suitable length of wire to the antenna terminal on the calibrated receiver. Loop the other end of this wire around coil L19/L21 as shown in inset drawing #2 on Figure 1-2.

Turn the Transceiver on and allow it to warm up for at least 30 minutes before you proceed with the following adjustments.

NOTE: In the following steps, you will zero beat the calibrated receiver; first against its own crystal calibrator, and then against the Transceiver. A zero beat is a point where the two frequencies being combined (or beat against each other) are exactly the same. As you approach zero beats, the tone caused by the two combined frequency will gradually decrease in pitch and volume until it stops. This point is very sharp so you must tune very carefully.

Set the calibrated receiver's Function switch to the SSB or CW position Tune the calibrated receiver to 7.0 MHz. Then turn on its crystal calibrator and zero beat the receiver frequency against the crystal calibrator frequency.

# The HW-8

Turn off the crystal calibrator. NOTE: Be careful that you do not change the setting of the receiver frequency.

Refer to inset drawing #1 of Figure 1-2 and insert the metal blade (#205-778) into the small end of the plastic nut starter. NOTE: Use the alignment tool that you made from the nut starter and blade for all trimmer adjustments. DO NOT use a screwdriver.

Turn the Transceiver tuning dial to 0.

Adjust trimmer capacitor C3028 until you hear a zero beat from the calibrated receiver.

Turn the Transceiver dial to 250.

Turn the calibrated receiver dial to 7.250 MHz.

Use the larger alignment tool to turn the slug in coil L9 until you hear a zero beat from the calibrated receiver. It may be necessary to turn down the calibrated receiver's AF gain control.

Repeat the VFO alignment steps several times until the calibrated receiver's dial coincides with the 0 and 250 marks on the Transceiver's dial

Turn off the calibrated receiver and remove the wire from around coil L19/L21 in the Transceiver. The calibrated receiver will no longer be used.

## MIXER AMPLIFIER

Turn the Transceiver tuning dial to 100.

Connect the RF Probe of the VTVM to test point TP2. This is the lead at the indicated end of R49, a 270-ohm (red-violet-brown) resistor.

Press the 3.5 MHz pushbutton and adjust coil L13 for a peak reading on the VTVM.

Press the 7.0 MHz pushbutton and adjust coil L14 for a peak reading on the VTVM.

Press the 14.0 MHz pushbutton and adjust coil L15 for a peak reading on the VTVM.

Turn the Transceiver tuning dial to 150.

NOTE: When you perform the next step, you may have to turn the coil slug several turns counterclockwise before you obtain a peak reading on the VTVM. Press the 21.0 MHz pushbutton and adjust coil L16 for a peak reading on the VTVM.

Disconnect the RF Probe from Test point TP2.

## TRANSMITTER

Plug the previously prepared 50 ohm dummy load into the ANTENNA socket on the back of the Transceiver. (This may already be connected to the Transceiver.)

Connect the key to the KEY jack on the back of the Transceiver. (This also may already be connected to the Transceiver.)

NOTE: Use the alignment tool that you made from the nut starter and blade for all trimmer adjustments. DO NOT use a screwdriver.

Turn the screws in trimmers C95, C99, C103, and C106 clockwise until they stop turning. Do not force the screws.

Turn the screw in trimmer C95 1/2 turn counterclockwise.

Turn the screw in trimmer C99 1/8 turn counterclockwise.

Turn the screw in trimmer C103 1 turn counterclockwise.

Turn the screw in trimmer C106 1/4 turn counterclockwise.

Make sure the TUNING dial is set to 100.

Press the 3.5 MHz pushbutton.

Set the LOADING control on the front panel to the 12 o'clock position.

NOTE: In the following steps, the adjustments will be quite broad.

Key the Transceiver and adjust trimmer C95 for a maximum reading on the RELATIVE POWER meter.

# The HW-8

Key the Transceiver and adjust the LOADING control on the front panel to obtain a maximum reading on the RELATIVE POWER meter.

Repeat the previous two steps.

Press the 7.0 MHz pushbutton.

Set the LOADING control to the 12 o'clock position.

Key the Transceiver and adjust trimmer C99 to obtain a maximum reading on the RELATIVE POWER meter.
Key the Transceiver and adjust the LOADING control on the front panel to obtain a maximum reading on the RELATIVE POWER meter.

Repeat the previous two steps.

Press the 14.0 MHz pushbutton.

Set the LOADING control to the 12 o'clock position.

Key the Transceiver and adjust trimmer C103 to obtain a maximum reading on the RELATIVE POWER meter.

Key the Transceiver and adjust the LOADING control on the front panel to obtain a maximum reading on the RELATIVE POWER meter.

Repeat the previous two steps.

Press the 21.0 MHz pushbutton.

Set the LOADING control to the 12:00 o'clock position.

Key the Transceiver and adjust trimmer C106 to obtain a maximum reading on the RELATIVE POWER meter.

Key the Transceiver and adjust the LOADING control to obtain a maximum reading on the RELATIVE POWER meter.

Repeat the previous two steps.

Turn the Transceiver off.

Disconnect the key and dummy load from the Transceiver.

## RECEIVER

Connect a pair of headphones to the HEADPHONES jack on the back of the Transceiver.

NOTE: You may use a nearby accurately calibrated transmitter for the following adjustments. If you do use one, connect a small piece of wire to the Transceiver's antenna socket. The small wire will act as a simple antenna. (You may also use an appropriate antenna.)

Connect a signal generator to the ANTENNA socket on the back of the Transceiver.

Turn the signal generator on and allow it to warm up.

Set the Transceiver tuning dial to 250.

Set the RECEIVER PRESELECTOR to 14.

Set the RF GAIN control to MAX.

Turn the Transceiver on and adjust the AF GAIN control for a comfortable listening level.

NOTE: In the following steps, as you approach the point of resonance of a trimmer capacitor or coil, the sound from the headphones will increase. As this occurs, decrease the output of the signal generator to the lowest level that you can still hear. This will prevent overloading the receiver.

Press the 3.5 MHz pushbutton.

Adjust the signal generator frequency to approximately 3.750 MHz or until you hear the signal in the headphones. The output of the generator may have to be quite high.

Alternately adjust trimmers C3 and C16 for maximum sound in the headphones.

Press the 7.0 MHz pushbutton.

Adjust the signal generator frequency to approximately 7.25 MHz or until you hear it in the headphones. The output of the generator may have to be quite high.

Alternately adjust trimmers C6 and C19 for maximum sound in the headphones.

Set the Transceiver tuning dial to 100.

# The HW-8

Adjust the signal generator frequency to approximately 7.100 MHz or until you hear it in the headphones.

Adjust the RECEIVER PRESELECTOR for maximum sound in the headphones.

Readjust trimmer C6 for maximum sound in the headphones. NOTE: Do not adjust trimmer C19.

Press the 14.0 MHz pushbutton.

Set the Transceiver tuning dial to 250.

Set the RECEIVER PRESELECTOR to 14.

Adjust the signal generator frequency to approximately 14.25 MHz or until you hear it in the headphones.

Alternately adjust trimmers C7 and C22 for maximum sound in the headphones.
Press the 21.0 MHz pushbutton.

Adjust the signal generator frequency to approximately 21.25 MHz or until you hear it in the headphones.

Alternately adjust trimmers C9 and C24 for maximum sound in the headphones.

Turn the Transceiver off.

Disconnect the signal generator from the Transceiver.

This completes the "Transceiver Alignment,"

## Heathtip

*I don't remember if I mentioned this method here before, but something that has worked well for me on really dirty gear has been the neighborhood car wash. I remove or protect (eg. with saran wrap and a rubber band) anything that might get damaged by water, and have at it with the hot soapy water at high pressure. This cleans places that you can't get to by hand. Be sure to rinse well to avoid water spots, blow out what water you can with an air compressor, and let sit for a few hours in the oven at the lowest possible temperature to bake the remaining moisture out of controls and anywhere else it could accumulate. While spraying with the wand, use a toothbrush or paintbrush on any stubborn areas.*

*This method may sound radical, and I can't guarantee that it will work on everything, but it's worked wonderfully for me on dozens of pieces of test and ham gear. Just be sure to 'bake' long enough to ensure that no water remains in anything you couldn't remove or cover, like transformer end bells. Before reassembly, lubricate any mechanical parts.*

*This method only got me into trouble twice - once in a chart recorder with a gearbox that got water in it, and once on a Tek scope where some water got into the power transformer through unused terminal holes in the end bell.*
*That one arced over on the outer (primary) layer, and fortunately was easily repaired. I'm sure it wouldn't have happened if I'd let it dry out longer.*

*Terry Perdue*

## HeathTip

*Hi Heath Lovers.... A great way to get rid of any annoying smell from a radio is to do the following....*

*Clean the rig up as usual then place the rig in a box with a couple of those "Bounce" clothes fabric softener sheets (the ones you use in the dryer) Place the sheets over the so called problem area or cover the inside of the rig completely in them.... Leave the box sitting closed for a couple of days. The smell will be gone.....*

*Another idea is to spray the unit lightly with Lysol spray !*

*Hope this works for you!*

*73 Michael Kassay - VE3MKX - QRP*

# The HW-8

## Heathkit produced service updates to ensure the service departments were up to date on any fixes or problems.

## Factory Service Modifications
## October 28, 1975
## HW-8 CW Transceiver
## Bulletin No. HW-8-1

## Service Data

## Operating Characteristics

1. Receiver preselector peaking is done with the preselector (C301) FCW (Minimum C) resulting in only broad peaks or no peaks being found when this control is adjusted.

Also, maximum sensitivity may not coincide with maximum noise when adjusting the preselector. For example, in trying to locate a generator signal, the preselector would be tuned for maximum noise. When the signal is found and the preselector adjusted for a maximum signal, the difference between the maximum noise point and the noise level at the maximum signal point could vary as much as 6 db (typical). Therefore, be sure to peak the preselector on the signal and not on the noise.

2. Internal spurious signals may be found at 3.55MHZ, 7.1MHZ & 14.1MHZ. The levels are approximately .7 to 8 uv.

3. Receiver sensitivity will increase when the selectivity switch is switched from the wide to the narrow position. This is due to the added gain of the bandpass filter IC-2B and it's associated circuity.

4. Microphonic levels as compared to the HW-7 have been reduced greatly, although some still appear on the 80 Meter band. These microphonics are noticeable at the lower and center areas of the band when more capacity is required from the preselector.

5. The receiver tends to pick up more hum on 15 Meters than on any other band. The hum levels on 15 Meters is much less than those present on the HW-7.

## RECEIVER CHECKS:

- Sensitivity: 1uv or less for 10 db S+N/N

| | | | |
|---|---|---|---|
| Typical Sensitivity: | 80 Meters | - | .5uv |
| | 40 Meters | - | .6uv |
| | 20 Meters | - | .7uv |
| | 15 Meters | - | .7uv |

Selectivity: Wide - 750 HZ at 6 db down.
Narrow - 375 HZ at 6 db down.

A rough check of the wide and narrow BPF can be made by tuning the receiver to a signal so that a high-pitched beat note is heard in the wide position. Switching to the narrow position should produce a noticeable decrease in the audio output.

## Service Notes

1. Poor Sensitivity: Poor sensitivity can be caused by either Q1 (Part # 417-169) or IC-1 (Part # 442-96). Poor sensitivity on one band only is usually caused by Q1.

2. 15 Meter Band Adjustments: The adjustments may be more critical on the 15 meter band than on other bands. It may be necessary to set the mixer coil, check the power output & sensitivity and then reset the mixer coil. Check the high & low end of this band and adjust coil L6 to bring up the end that has the lower output.

3. Receiver Oscillates on the 80 Meter Band: When operating the transceiver at DC input voltages greater than 12.5 VDC, the receiver may oscillate at points throughout the 80 meter band. To correct this problem connect a 10 K ohm resistor (Part # 1-9-12) across the 80 meter mixer coil L13. This resistor is soldered to the coil terminals on top of the circuit board. Install this resistor only when needed.

The receiver should not produce undesired oscillations except at internal spurious frequencies listed in operating characteristics -- when the DC input voltage is raised to as much as 15 VDC.

# The HW-8

## Final Check

The following is a list of physical & functional checks that must be made before returning the transceiver to the customer:

Physical Checks:
- All hardware installed & tightened
- Cabinet & windows clean
- Plastic feet installed
- Controls & switches operate smoothly
- Knobs properly indexed & secure
- Mark to the left of 0 on dial is aligned with black line on window. Mark stays aligned when tuning knob is turned further clockwise.
- Shake test - - - nothing rattles inside.
- Paperwork in order.

## Functional Checks:

- TX power output - 1 watt or greater on all bands. Connect a 50 ohm non-reactive load to the antenna jack. Tune the dial to 150, key the transmitter and measure the RF voltage across the load. The unit is within specs if the RFV is 7V rms or greater.

- Typical power output:

1.5W 80 Meters
40 Meters -
1.5 W
20 Meters -
1.5 W
15 Meters -
1.5 W

- TX frequency offset: Approximately 750HZ lower than the Receive frequency. Check what transmitter frequency is shifting below the receive frequency by approximately 750HZ +/- 200HZ. The amount of frequency offset does change from band to band.

Sidetone is heard in speaker or headphones when the transmitter is keyed.

---

## April 6, 1976
## HW-8 CW Transceiver
## Bulletin No: HW-8-2

Unit Chirps

A slight chirp problem has shown up on some of the HW-8 units which are now in the field. The problem has been traced to the heterodyne oscillator switching diodes which are apparently not isolating sufficiently in the off bands.

We are therefore changing the heterodyne oscillator switching diodes D22 through D29 from PN 56-24 to PN 56-56. The 56-56 diode has less capacitance and provides better isolation.

Second production lot will have the 56-56 diode.

---

## April 29, 1976
## HW-8 CW Transceiver
## Bulletin No: HW-8-3

VFO Alignment with frequency counter Using the following procedure to adjust the VFO with a frequency counter instaed of a receiver:

1. Connect the frequency counter probe through a 47 PF [approx] capacitor to the emitter of transistor Q3. Connect the counter's ground lead to the chassis.

2. Turn the HW-8 on and allow it to warm up for at least 30 minutes before you proceed.

3. Release all pushbuttons to out position.

4. Turn the HW-8 tuning dial to 0.

5. Use an insulated screwdriver and adjust C302B [on the side of the tuning capacitor] until the counter reads 8.895 MHZ.

6. Turn the HW-8 turning dial to 250.

7. Use a large plastic alignment tool and adjust the slug in coil L9 until the counter reads 8.645 MHZ.

8. Repeat steps 4 through 7 several times until the counter reads properly with no adjustment at each end of the dial.

---

# The HW-8

## July 13, 1976
## HW-8 CW Transceiver
## Bulletin No: HW-8-4

Q11 Installation

Q11, an S2091 transistor [PN 417-116], may be either of two body styles. Be sure this transistor is installed as shown in the drawing below.

((The small flat transistor matches small flat to flat of PC board; the larger transistor the flat is "opposite" the flat of the PC board. Both types have leads 1/4" from PC board to components)).

---

November 15, 1976
HW-8 CW Transceiver
Bulletin No: HW-8-5
Carrier Stays On, Will Not Turn Off With Key Open

Cure: The wires at points K and XX on the circuit board my be interchanged. Q8 will not shut off when the key is open.

---

## December 2, 1976
## HW-8 CW Transceiver
## Bulletin No: HW-8-6

Poor Sensitivity on 80, 40, 15 Meter Bands; Preselector Peaks At The Wrong Position

Check for proper installation of L1, L2, L3 and L4. These coils have been found to be installed in reverse order causing apparent good sensitivity on 20 meters, but poor sensitivity on 80, 40 and 15 meters.

---

## June 5, 1978
## HW-8 QRP Transceiver
## Bulletin No: HW-8-9

Voltage Chart Correction

The circuit board voltage chart in the HW-8 manual [PN 595-1754-07], page 80, shows IC2 pin numbers 1 and 14 interchanged. The voltages, as shown, are correct.

Future manuals will be correct

---

## November 20, 1978
## HW-8 QRP Transceiver
## Bulletin No: HW-8-10

PN 417-240 FET's supplied with shorting wire on leads

This unit may have been shipped with a shorting wire around the leads of the PN 417-240 device. The manual does not give instructions to the customer for the removal of the shorting wire.

When servicing this product, check for the possibility of the shorting wire still installed on this device.

The manual is being inserted with the proper instructions concerning the removal of the shorting wire.

Editors's note: I would find it almost impossible to find this problem today!

### *HeathTip*

*Many years ago, a friend of mine decided to build a Heathkit receiver. I told him the follow the instructions exactly and he would have no problems. Several weeks later, he called me and said that it seemed to be working ok but sure smelled funny. I asked him to bring it over and I would take a look at it. When I opened it up there was a huge glob of burned substance around many of the wires. When I asked him what it was, he said it was (Spaghetti). Whenever the instructions called out for putting spaghetti on a wire, he had cooked up some real spaghetti and covered the wires with.it. After a littile cleanup and re-doing some wires, the unit worked fine.*

*John Barkow*

*I heard this one too except the guy used macaroni because he couldn't make spaghetti work. It appears to be true as I have heard this story from several "Hams at Heath"*

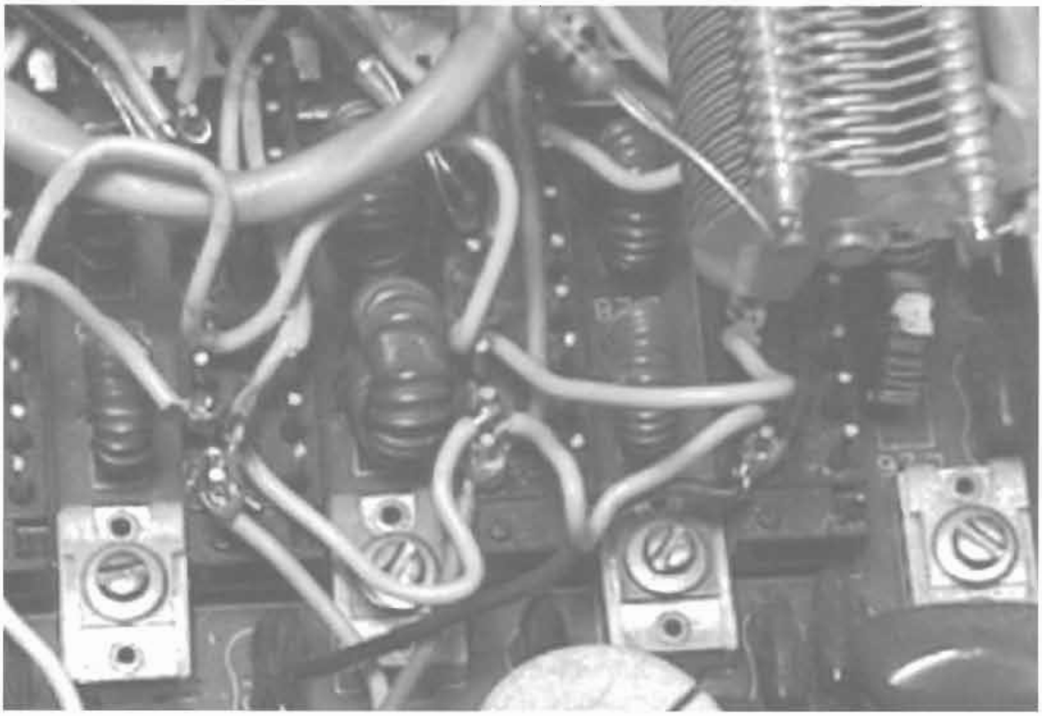
*I was also told from several of the "hams at Heath" that's why you won't find the words "install spaghetti over the leads." It was changed to insulating tubing instead!*

*Mike, WB8VGE*

# The HW-8

## A good friend of mine, WA8MCQ, found a rather strange problem with the HW-8 QRP transceiver. I've would never have found this one myself. Mike was kind enough to allow me to reprint this text from *The QRP Quarterly*

A couple years ago, W8KYD sent me his HW-8 for repair after sustaining a nearby lightning strike. Among other things, it had very low output on both 40 and 80 meters; a quarter and half watt respectively. I tried tuning everything up to no avail, followed by extensive troubleshooting over several weeks, and nothing made much sense. I even went so far as to put my own HW-8 beside it, and transmit with parts of both rigs--his VFO feeding my mixer, driver and amp, his mixer feeding me, etc. Everything kept pointing to the area of the final amplifier, and I finally gave up in desperation and replaced the toroid coils in the matching network, even though toroids never go bad. WRONG! The output shot up to normal, and I had to admit the unthinkable--the cores themselves were bad, something I would never have suspected. Toroid cores NEVER go bad! (Famous last words...)



*The toroid cores in the HW-8's transmitter filters*

The permeability of the cores had increased for some reason, perhaps from a surge due to the lightning strike, thus increasing the inductance. This in turn shifted the tuning ranges down below the bottom of the amateur bands; no problem if you have a license to transmit on, say, 3.1 or 6.7 MHz, but few of us have one of those!

Permeability of both powdered iron and ferrite toroids will change if they are overloaded. However, when they cool, powdered irons will return to approximately the original value, while ferrites will not. (See the Idea Exchange in the July 1990 issue of the QRP Quarterly,"Cooking With Toroids", which reported some experiments I did along those lines.) The HW-8 happens to use ferrites on 80 and 40 meters, with powdered irons on 20 and 15, which may explain why the latter bands were still good.

When I put the 80 and 40 meter coils from my HW-8 into his rig, both bands came up to normal output. Next, I peeled off two turns each from his 40 meter coils to reduce the inductance and put them back in--the output went up a bit from the original quarter watt. I peeled off a few more and the output was even higher. However, as I peeled off turns, his cores started running warm to the touch.

## The Cure

I wound new coils on fresh cores of the proper type, with the original number of turns, and his rig then put out normal power on both 80 and 40. The output nets on both

# The HW-8

bands use type 63 ferrite, which seems to be relatively uncommon in ham use. It has a permeability of 40, much lower than the commonly used 43 and 61 mixes (which are 850 and 125, respectively).

## COILS IN HW-8 OUTPUT NETS:

| Band | Coil | Nominal Inductance | Core |
|---|---|---|---|
| 80 | L26 | 15.5 uh | FT37-63 |
| | L27 | 27.5 uh | FT50A-63 |
| 40 | L28 | 7 uh | FT37-63 |
| | L29 | 7 uh | FT37-63 |

For those not familiar with the FT50A-63, it's the same as an FT50-63 except that it's taller. As with all "A" cores, the inner and outer diameters are the same as the "regular" cores of the same type, as is the permeability. However, the Al factor is greater due to the increased cross section of the "A" core.)

I later received an HW-8 from KM4ZH, another QRPer, which had low output on 80 meters only. Once again, it was a bad set of toroids in the output network, and some new ones fixed it right up. Interestingly, I did not get full power at first when I put in a fresh set. Wound with the same number of turns as the old one, the new L27 didn't allow much more than a watt output. I had to peel off several turns before it reached full power. Variations in permeability between nominally identical cores accounts for this, so be prepared to experiment a bit with the number of turns.

## Verifying the problem

Originally, I would have thought that bad toroid cores would be quite rare; however, as of June 1992, over two years into this, I have 7 confirmed cases (one DX and 6 domestic) of low power on 80 and/or 40 being cured by new toroids. It's almost a religious quest with me now; every time I hear of someone locally who has an HW-8, I offer to check it out for them and tune it up, just so I can get the chance to search for more bad cores to prove that it's not a fluke. (By the way, I've checked at least 15 HW-8s and none had low power on 20 and 15 attributable to bad cores.)

If you have low power on either of these bands, try all the usual things first, such as aligning the rig, checking for shorts and opens on the circuit board, cleaning the bandswitch contacts with spray cleaner, etc. If it doesn't respond to these, then suspect bad toroids in the amplifier output.

To confirm your suspicions, put an RF probe or scope on the collector of the 2N4427 final amp (Q9) and read the voltage while transmitting into a dummy load. If it is substantially lower on the band(s) with the low output, then the problem is somewhere before the final amp--there isn't enough drive. If the voltage is about the same as the other bands, yet the output is quite a bit lower, give the coils the evil eye--the power is being generated but isn't making it past the network.

## Peak voltages seen in bad HW-8:

| Band | Collector of Q9 | Output to 50 ohm load | Watts |
|---|---|---|---|
| 80 | 18 | 7.06 | 0.5 |
| 40 | 18 | 4.9 | 0.24 |
| 20 | 18 | 12.09 | 1.46 |
| 15 | 14 | 11.76 | 1.38 |

Putting the coils back on the board is a real pain, since the tuning capacitor gets in the way. You can take the front panel off to remove the cap, but here's a better method. Take two pieces of very small wire about a foot long. Stick the ends through the holes, from the foil side of the board, and push up past the components. Solder the coil leads onto them with a lap joint, and pull it down into place. (You may need to enlarge the holes slightly for the solder junctions to pass.)

## Big Volts In The Little Green Box

Unlike newer QRP transmitter designs, the HW-8 does not use a low pass filter after the transistor; it uses the output network shown in Figure 1. [not included in this electronic article] (The input capacitor to ground is only used on 80 and 40 meters.)

Surprisingly high voltages are present within the network, which has some high impedance points.

# The HW-8

For example, with a good HW-8 running well over 1.5 watts output to a dummy load I checked the voltages at various points, using a Tektronix 465B scope and X10 probe and saw the peak to peak voltages below. (It was necessary to retune for maximum output every time the probe was moved, due to its small but finite capacitance affecting the network.) These are similar to those seen in other HW-8s on these bands.

Yes, that really IS four hundred and ten volts peak to peak on 80 meters, or 205 volts peak and 145 volts RMS. Nonbelievers are invited to verify this for themselves with a high impedance probe. Lacking that, you can touch one lead of a neon bulb to the circuit board and watch it light up. The other voltages may not be enough to fire a neon, depending on the particular bulb used. During one test, a 22K resistor placed from Point D [rotor of front panel trans mit tuning cap] to ground reduced the voltage at the antennna connector from 28 volts P-P to 22 volts.

## PEAK TO PEAK VOLTAGES SEEN IN HW-8 OUTPUT NETWORK

| Band | A | B | C | D | E |
|---|---|---|---|---|---|
| 80 | 37 | 144 | 87 | 410 | 28 |
| 40 | 34 | 116 | 58 | 160 | 26 |

[Point A is collector of final amp; B is at the left side of the left coil in the net; C is the junction of the two coils; D is the right side of the right coil, also the rotor of the front panel cap; E is the stator of the tuning cap, which also appears at the antenna connector]

Voltages were lower on the other bands and not as impressive, but still rather high. Note that the highest voltage is at Point D, which is the rotor of the loading capacitor. If you take its knob off, you'll see that the last half inch of the shaft is plastic, not metal, for safety. Be careful where you put your fingers while transmitting with the covers off. You may not get fried, at this power level, but I'm sure you'll feel it!

For comparison, I checked a kit version of the W7EL Optimized QRP Transceiver (from Small Parts Center, which is no longer in business). That rig uses a 5-pole low pass filter between the output transistor (2N3553) and antenna connector. Running close to 2 watts output on 40 meters, I saw about 28 volts peak to peak at the collector of the 2N3553, in the center of the filter, and at the output.

## Use the right type of cores!

You may make one substitute for the type 63 material--type 67 has the same permeability and is an improved mix, and is replacing type 63. Otherwise, do not make substitutes. Since I was too lazy at first to order the type 63/67 cores, I tried an FT37-61 since I had some on hand. It has higher permeability, and I calculated that only 11 turns were needed to give the necessary 7 microhenries for L29 (40 meters). For L28, I used the good coil from my own HW-8.

Although it had the proper inductance, the -61 core only gave about a quarter watt output, and after 10 seconds it was almost too hot to touch! Obviously it was not the proper mix for this application. Avoid the temptation to use what's already on hand, and take the trouble to get the right cores.
I compared some bad cores with fresh ones, using a Hewlett-Packard 4276A LCZ meter at a test frequency of 1 KHz. (The number of turns used here is different from those used in the HW-8.)

FT37-63 cores, all 20 turns #28 wire:
- Core 1, bad, 9.9 uh
- Core 2, bad, 9.0 uh
- Core 3, bad, 10.0 uh
- Core 4, fresh, 5.7 uh

FT37-63 cores, both 15 turns #28 wire:
- Core 5, bad, 5.5 uh
- Core 6, fresh, 3.2 uh

FT50A-63 cores, all 20 turns #26 wire
- Core 7, bad, 13.0 uh
- Core 8, bad, 12.5 uh
- Core 9, fresh, 10.5 uh
- Core 10, fresh, 10.3 uh

When I fixed HW-8 number 6, I put the old coils on one of my Boonton 260A Q meters to check their specs. The nominal value for the 40 meter coils is 7 uh each; both of these coils measured about 10.1 uh, with Q values of 186 and 196 at 7.9 MHz. I pulled a few turns off each one to reduce them to approximately 7 uh, and the Q values stayed about the same. By comparison, a pair of new coils wound on fresh FT37-67 cores and trimmed to 7.0 uh had Q values of 300 and 337. (I checked them at 7.9 MHz since that

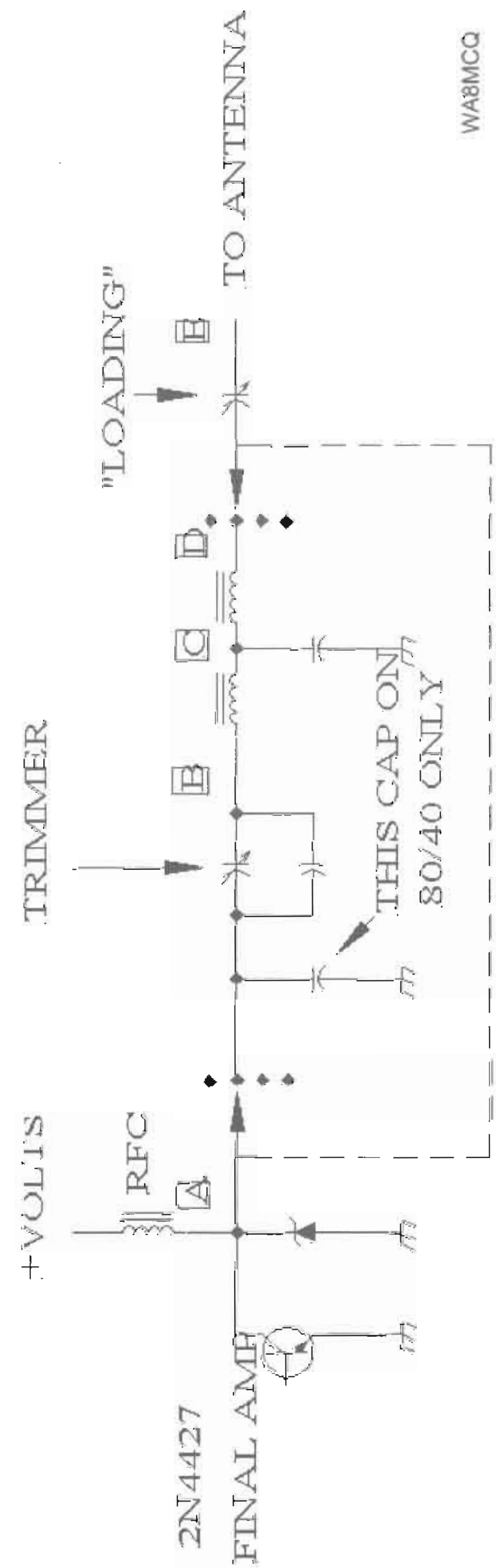
# The HW-8

is one of the "standard" frequencies on the 260A at which inductance can be read directly from a scale on the variable capacitor dial.)

As I mentioned earlier, there are many things that can cause low output on 80 and/or 40, and bad toroids are only one of them. However, having had 7 confirmed cases so far I think it's safe to say that it's not all that rare. If you have the output problem and all else fails, don't put on a fake-nose-and-eyeglass disguise and sell your beloved HW-8 at the next hamfest--try replacing the cores first and you might get a pleasant surprise.

Michael A. Czuhajewski WA8MCQ
7945 Citadel Drive
Severn, MD 21144

Here is a simplified schematic of the output filters for the HW-8. Each band has its own filter components. These are switched in and out of circuit by the front panel push buttons.




## Heathtip

*The Globar resistors used in the Heathkit Cantenna were originally made by the Globar Division of Carborundum Co. This facility survives as Kanthal Globar, 3425 Hyde Park Blvd. Niagara Falls, NY 14302, 716/286-7601. Check out the resistors at:*

*http://www.globar.com/resistors.highvoltage.html*

*73 de Bob N2PWP*
*Bob Radmore N2PWP*

# The Heathkit HW-9 QRP Transceiver

## The last one of the series. The HW-9 sports a new paint job, a superhet receiver and a transmitter that covers all the bands, including the WARC bands.

The HW-9 is a great little QRP rig. But for reasons unknown, it never became as popular as it's younger brother, the HW-8

The HW-9 was produced from 1984 to 1991. It was the last of the QRP transceivers Heathkit offered. In fact, the HW-9 was sold right up to the end of kit production by Heathkit. The bare bones HW-9 sold for $249.95 without the band pack. The HW-9 was one of the first kits Heath produced that appeared in the light brown color scheme.

The HW-9 was a complete redesign of the HW-8. Heathkit started out with a clean sheet of paper when working on the HW-9. The only thing they kept in the old design was the shape and size of the cabinet.

Out of the box, the HW-9 covers the first 250 kHz of 80, 40, 20, 15 meters. You could add on the optional band kit to get the WARC bands as well as 10 meters.


*The Heathkit HW-9 QRP transceiver*

Unlike the HW-8, there's no front-end amplifier used in the HW-9. Instead the HW-9 uses a balanced mixer and a broadband design. There's no front-end peak control to mess with like the HW-7 and HW-8, thanks to the broadband front end. Selectivity is provided by a 4 pole crystal filter and an active audio filter as well. Selectivity is 1 kHz at 6 dB down and 250 kHz (narrow setting) at 6 dB down. Sensitivity is rated at .2 uV

The transmitter is quite robust in the HW-9. Running at least 4 watts output on all band except for 10 meters, most HW-9 routinely produce over 7 watts of output. The RF output is continuously variable.

The HW-9 does not include an internal power supply. The HW-9 requires 12.6 volts at one amp. It will work from 11 to 16 volts.

Also included in the HW-9 was full break in CW. This worked ok until you got up around 20 WPM. For you see the keying got a bit sluggish and started to run the characters together.

In addition to the standard relative RF output meter, heathkit also included circuirty for an S-Meter to measure receive signal strength.

# The Heathkit HW-9 QRP Transceiver

## Building the HW-9

The HW-9, like any other Heathkit, needed to be assembled. For the HW-9 all you needed was a VTVM and frequency counter. Instead of counting parts and checking them off, this time Heathkit had the parts mounted on tape. You cut out the part and inserted it into its proper location on the PC board. You repeated the step until the tape segment was used up. I built a HW-9 using this method and although it is a lot easier than looking for a part in a pile of parts, it's not a much fun! Clearly there were changes coming down the road for Heathkit.

There are two PC boards inside the HW-9. On the top half of the HW-9 you find the oscillator board. And just as the name implies, all the oscillators used by the HW-9 are located on this PC board, including the VFO. On the bottom half of the HW-9 you'll find the T/R circuit board. Here the filters for the front end and band switches are located. Also the final amplifier transistors are located in a cramped corner of this board.

## Operating the HW-9

If you've work with a HW-8, the HW-9 superhet receiver will surprise you. No longer do you have to be sure you're on the correct sideband to make a contact. The audio filter works great and there's plenty of audio to drive a speaker if you desire. The QSK, while a bit sluggish at higher speeds, does work quite nicely. And over all stability is typically less than 500 Hz after a 30 minute warm up. The rig will settle down to 150 Hz per 30 minutes after a 90-minute warm up.

## Some common problems

You can't mention the HW-9 without talking about the VFO drive. They have a history of drive troubles. Mainly, the VFO slips as you try to tune the radio. Lucky for us, Heathkit quickly became aware of the problem and issued a fix.

### *HeathTip*

*I want to pass along something I learned by chance. I recently had a radio with three stuck coil slugs. One was cracked, the other two appeared not to be. The coil forms were plastic and I figured the plastic shrunk over the years and had a death grip on the slugs. I tried everything I could think of to free them, to no avail. The last thing I did was put a few drops of penetrating oil in each coil form and let it sit over night. The next morning they were no better. so I started to drill them out. I started with the smallest bit that wouldn't go through the slug, and increased one size at a time. I noticed they drilled real easy compared to some I had done before, dry. On the third bit the slug crumpled and came out in chunks and like dust. All I had to do was pass a Q-tip through each one to clean out the debris, and retap the coil forms with a 10-32 tap. New slugs went right in and turned easily.*

*I figure the penetrating oil softened the binder for the powdered iron and made it like putty. Give it a try .*

*Regards,*
*Ed Richards*

# The Heathkit HW-9 QRP Transceiver

## Here's some quick fixes for the popular Heathkit HW-9 QRP transceiver

## The HW-9 is a very good QRP transceiver. However it suffers from several problems.

## Low RF output

Besides the slipping VFO, the second most common problem with the HW-9 is low RF output on the higher frequencies. This problem is most notable on ten meters and 12 meters. Sometimes, the 15-meter band becomes unstable, but has more than enough RF output.

To fix the instability problem we need to look all the way back to the predriver.

"From the factory," Heathkit used MPS6521 transistors (Heath part number. 417-172) for Q401 and Q402. These are the pre-drivers that drive transistor Q404. Q404 is a 2N3866 (Heath pn. 417-205) that is more than adequate in power gain and frequency. Now, if you have ever built a QRP transmitter utilizing a 2N3866, you can relate to this. That transistor has a wild side to it. If the circuit is not designed correctly, a 2N3866 will become an amplifier and an oscillator at the same time. Looking into the radio, you'll see there are ferrite beads on the base leads of Q401 & Q402. This indicates there are some instability problems.

But the stability problem is not with the 2N3866 but rather the two predrivers, Q401 and Q402. In a nut shell they exhibit too much gain. The fix is to install something a bit tamer. For Q401, try a metal-cased 2N2222. Yup! For Q402 a 2N3904 works well. I've tried some 2N4401 but was not impressed. I Also tried MSPA20s and some 2SC1711s for Q401 also

With 13.8 volts, my HW-9 produces about seven watts on 80 meters and about three and a half on 10 meters. I've heard some people talking about getting upwards of nine watts out on 80 meters. Remember the idea here is clean power, not just power.

That amount of power is quite high for a QRP radio. If you're long winded, better check the temperature of the heat sinks on the HW-9's finals. Also, it's not a bad idea to install a heat sink on the 2N3866 as well.

I've talked to quite a few QRP ops and one of the questions they have about the HW-9 is lack of power on the higher frequencies. The drop off in power is especially noticeable on 10 meters. If you have done the fixes above and still can't seem to get 3-5 watts out on 10 meters, use your fingertip and gauge the temperature on the final transistor's heat sink. They both should be quite warm to the touch after a few minutes of key down. If one takes the skin from your finger and the other one is stone cold, you better order a replacement. The final transistors used in the HW-9 are a pair of MRF237s. You can obtain these from RF Parts.

## Better voltage regulation

I did not sit in the design meetings when the HW-9 was being born, so, I don't know why the engineers did not have the BFO and HFO oscillators run from the internal +9 regulated supply. Instead, the VFO and HFO oscillators are supplied by the unregulated voltage coming in from the outside world.

To improve the stability of the circuits that operate from the +9 volts, change U402 from a 78L08 to a 78L09 regulator, and replace D409 with a jumper wire. You'll see an overall improvement in operation. But the BFO and HFO are still running from an unregulated source. So, other than ripping up PC board traces, make sure you operate your HW-9 from a rather "stiff" power source.

## Fixing the keying problems

The HW-9 keys way too soft. In fact, speeds over 25 WPM are hard copy. Most QRP ops use a keyer with a weight control to help stiffen up the keying on the HW-9. A better way is to change out some parts.

The first place to start is by removing C578, a 47uf electrolytic, and replacing it with a 10 uF electrolytic capacitor. This shortens the trailing edge and effects the mute delay line. To fix this, change the value of resistor R444 from 180 ohms to 1500 ohms.
Try the HW-9 out again. If you find the LEADING edge of the CW wave form is too hard, change capacitor C435 from 2.2 uf to 4.7 uf.

# The Heathkit HW-9 QRP Transceiver

## Some audio improvements

In my earlier edition of the "HW-8 Handbook" one modification to improve the HW-8 audio was as simple as removing a capacitor and turning it around. You can do the same with the HW-9. Unsolder capacitor C336, a 2.2 uf electrolytic, and install it backwards for polarity. It should be reversed from what is shown in the manual, schematic, and PCB silk-screening.

Some operators have had improved audio by subsitituting a TL084C quad FET op amp for the LM324 used at U304. Since this op-amp is in a socket, it only takes a few seconds to swap out. I can't tell any difference in my HW-9. But others say the change was well worth the effort.

While you're messing with the active filter, you might want to check the values of these parts; resistors R354 and R359 and capacitors C339, C341, C344, and C345. They should all be as close to value as possible. And as in any audio filter, only the best quality parts should be used. Leave the cheap stuff in the junk box. The better the quality, especially the capacitors, the better the filter will perform.

## Modifying the AGC loop

Some operators find the AGC a bit too fast for them. You can alter this AGC loop by changing the value of either C317, a 3.3 uf electrolytic; or by increasing the value of R312. You might want to play with the values of these two components.

The HW-9 is a great radio. It's easy to work on, and has plenty of features. Aside from problems (and what radio does not have a bug or two) listed above, the HW-9 would be at home in any QRP operator's shack.

Mike, WB8VGE

### *Heathtip*

*Getting that magic marker off of the front panels of the HW series QRP rigs*

*First, I tried simple 409 soaking with a napkin. You'd be surprised how much but not all that removes. Standard cautions about 409- it may remove lettering etc. Repeated applications required.*

*Second, and possibly better is a product called "oops". It's made to remove all sorts of stuff including markers. Sold through True Value hardware and others. Works very well even on cured latex paint.*

*The can specifically mentions magic marker. It works very well.*

*Mike*

# HW-9

## Heathkit produced service updates to ensure the service departments were up to date on any fixes or problems.

## August 10, 1984
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-1

Schematic Correction - RIT Circuit

In manual [PN 595-3059], make the following schematic corrections:

At the RIT control, R1, the jumper should be between lug 1 and 2 instead of 2 and 3.

At the junction of R132 and C191 in the base circuit of Q103, P101-4 should read P101-2.

---

## October 26, 1984
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-2

Schematic Correction - T/R Board

In manual [PN 595-3059], make the following corrections to the T/R board schematic.

Change:

C330 from 100 pF to .001 uF
C341 from 100 pF to .001 uF
C452 to read C552

L405 from [PN 40-2070] to [PN 40-2071].
L411 from [PN 40-2072] to [PN 40-2076].

R354 from 15 megohm to 1.5 megohm
R418 from 27 ohms to 2.7 ohms

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## October 31, 1986
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-4

Frequency Stability Specification Change

The specification for the frequency stability is changed:

From: "Less than 150 Hz per hour after 30-minute warmup."
To: "Typically less than 500 Hz/hour after 30-minute warmup. Typically less than 150 Hz/half-hour after 90-minute warmup."

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## December 12, 1986
## HW-9 QRP CW Transceiver
## Bulletin No:HW-9-5

Manual Correction - Transmitter Frequency OffsetSpec

On page 97 of [PN 595-3059] manual, the transmitter frequency offset specifications should read "700 Hz higher" instead of "700 Hz lower."

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## December 23, 1986
## HW-9 QRP CW Transceiver
## Bulletin No:HW-9-6

Spurious Emissions On 10 And 12 Meters At Various CW Level Control Settings

If excessive spurious emissions occur on 10 and 12 meters at certain CW Level control settings, change Q402 on the T/R board from a [PN 417-172] transistor to a [PN 417-293] transistor.

Make this transistor change only if needed.

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# HW-9

## April 30, 1987
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-7

VFO Drifts

Use a heat gun to heat the VFO coil, L118, for about 3 minutes. This will bake the coil and reduce the inductance change caused by ambient temperature changes.

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## May 29, 1987
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-8

VFO Dial Slips Or Binds

Since the introduction of the HW-9 Transceiver, its had a history of VFO dial slipping or binding problems. These problems are caused by different parts of the VFO assembly. Here are some of the areas of the VFO assembly which cause the slipping or binding problems and some fixes to correct them. Also given is the new method of mounting the VFO capacitor. If all else fails, make the changes given in the "New VFO Capacitor Mounting Procedure."

The vernier drive assembly [PN 100-1839] in the first production run of HW-9s didn't meet torque rotation specs. This caused the dial to slip. To identify this vernier drive assembly, see if it uses #6 setscrews. If so, it's an earlier drive assembly. Replace it with a vernier drive assembly that has #4 setscrews installed. These drive assemblies meet torque ratio specs. The drive assembly with #4 setscrews are in second production and later HW-9s, and also in Heath Part Replacement stock.

In some cases, the dial will slip or bind only after installing the VFO shield [PN 206-2692] over the drive bracket [PN 204-2692]. Engineering corrected this problem by changing the thickness of the drive bracket from .041" to .030." Because of the small change, it's difficult to tell which drive bracket is installed. If the dial slips only when you install the shield, move the lockwasher on the vernier drive from the inside of the drive bracket to the outside of the bracket. This will allow the VFO shield to slide easily over the drive bracket, removing tension on the drive.

Misalignment of the shafts of the variable capacitor and the vernier drive assembly will also cause dial slippage. If the capacitor frame is not bent at a right angle at either corner , the shaft will be misaligned and the dial will slip. To correct this, install a #6 flat washer [PN 230-60] between the rear of the capacitor frame and the drive bracket at the two locations shown in Drawing 1. ((Drawing shows the 6-32 x 1/8 screw into the drive bracket, then the flat washer placed on the screw before it is attached to the capacitor frame)).

New VFO Capacitor Mounting Procedure

The following method is used to mount the VFO capacitor in the HW-9 transceiver to minimize dial slippage and binding. This change will be installed in the next production run of HW-9s.

Parts Required:

| QTY | Description | Heath Part No |
|---|---|---|
| 1 | Drive bracket | 204-2909 |
| 1 | 4-40 x 15/16" screw | 250-480 |
| 1 | 4-40 nut | 252-2 |
| 1 | #4 Lockwasher | 254-9 |
| 1 | Rubber grommet | 73-53 |

Procedure

-- Install the rubber grommet at hole GA of the new drive bracket.

-- Push the 4-40 x 15/16" screw through the grommet at GA. On the inside of the bracket, place the 4-40 nut and the #4 lockwasher on the screw. Turn the nut about 1/4" onto the screw.

-- Set the capacitor/drive assembly into the bracket. Turn the 4-40 x 15/16" screw into the indicated hole of the variable capacitor until the screw end is flush with the inside edge of the capacitor frame. Tighten the 4-40 nut against the capacitor frame.

-- Tighten the control nut and rotate the shaft to make sure it turns smoothly.

---

# HW-9

## January 29, 1988
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-9

Wrong Polarity Screen At C336

The polarity marks screened on the T/R board [PN 85-2957-1] at C336 are wrong. This causes the 2.2 uF electrolytic capacitor [PN 25-924] to be installed backwards, increasing receiver noise. Install a new capacitor with the positive lead toward R347.

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## February 29, 1988
## HW-9 QRP CW Transceiver
## Bulletin No: HW-9-10

Low Power Out And Low Sensitivity - Low RF Level At TP101

On the oscillator board, check the position of the slug in L118 in the VFO. Two slug positions will peak the coil; at the top and near the middle. The correct peak is when the slug is near the middle of coil.

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## August 31, 1989
## HW-9 QRP CW Transceiver
## Bulletin No:HW-9-11

Low Power Output - All Bands

Lift one lead of D407. If normal power returns, replace the diode [PN 56-56].

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## October 27, 1989
## HW-9 QRP CW Transceiver
## Bulletin No:HW-9-12

VFO Range Too Wide

If you adjust the trimmer on C1 all the way out and the VFO range is still too wide, change:

C186 from an 18 pF capacitor to a 10 pF NPO capacitor [PN 21-3]

This capacitor change allows the VFO to cover the proper range. Make sure the VFO meets the drift specs.

Install this change only when needed.

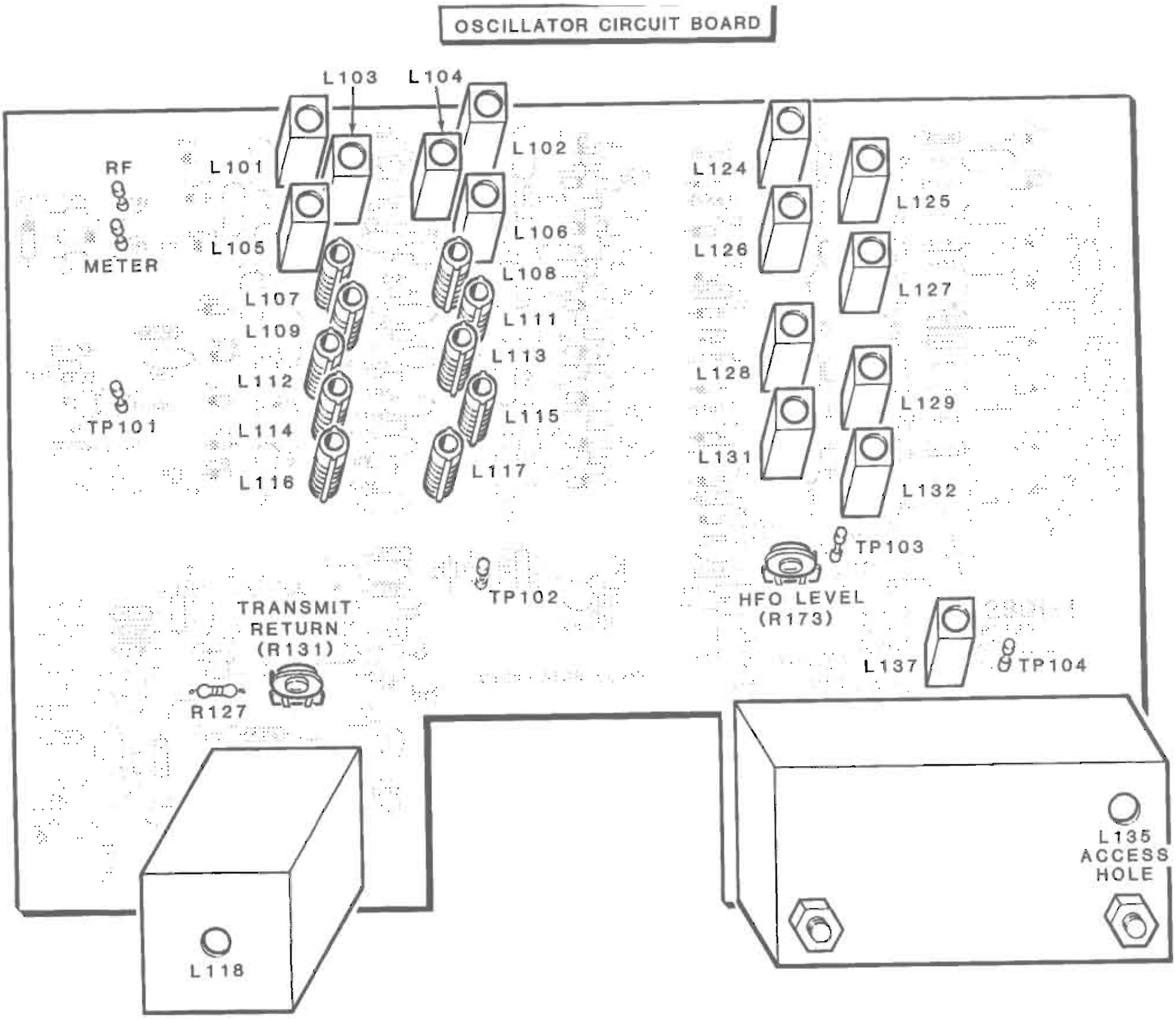
---

## Heathtip

*To remove a stuck set screw in a knob,take a heat gun-hair dryer etc, warm the knob at the screw hole, heat expansion should help free them or use free.ze spray and cool the screws. If you have a big weller soldering gun, apply heat to shaft from inside the radio as close to front of shaft. its tedious but can be done, once you get them out stainless steel set screws are nice, MSC has them/ put back with some wax on the threads!*

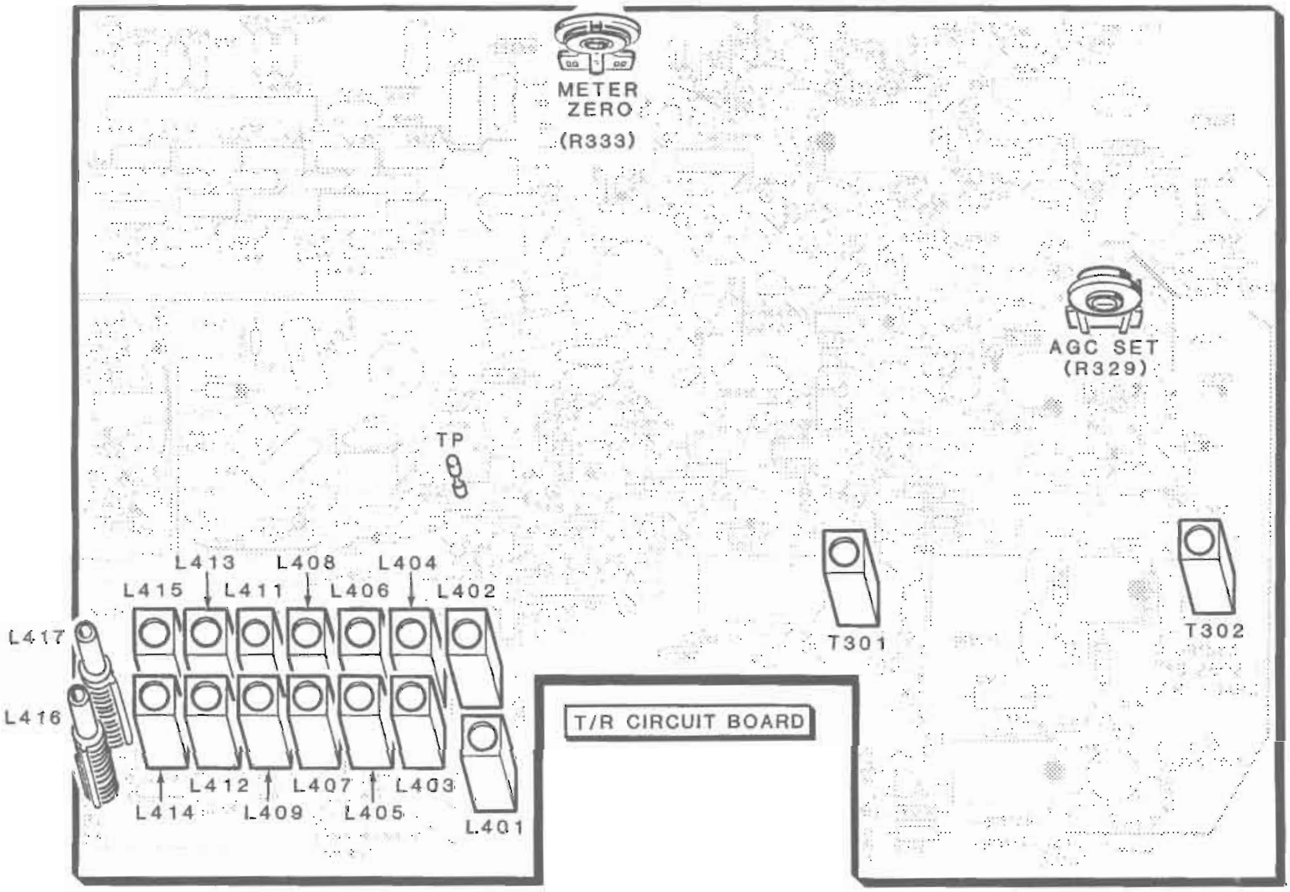
*Mike ke4lgx*

# The Heathkit HW-9 QRP Oscillator circuit board



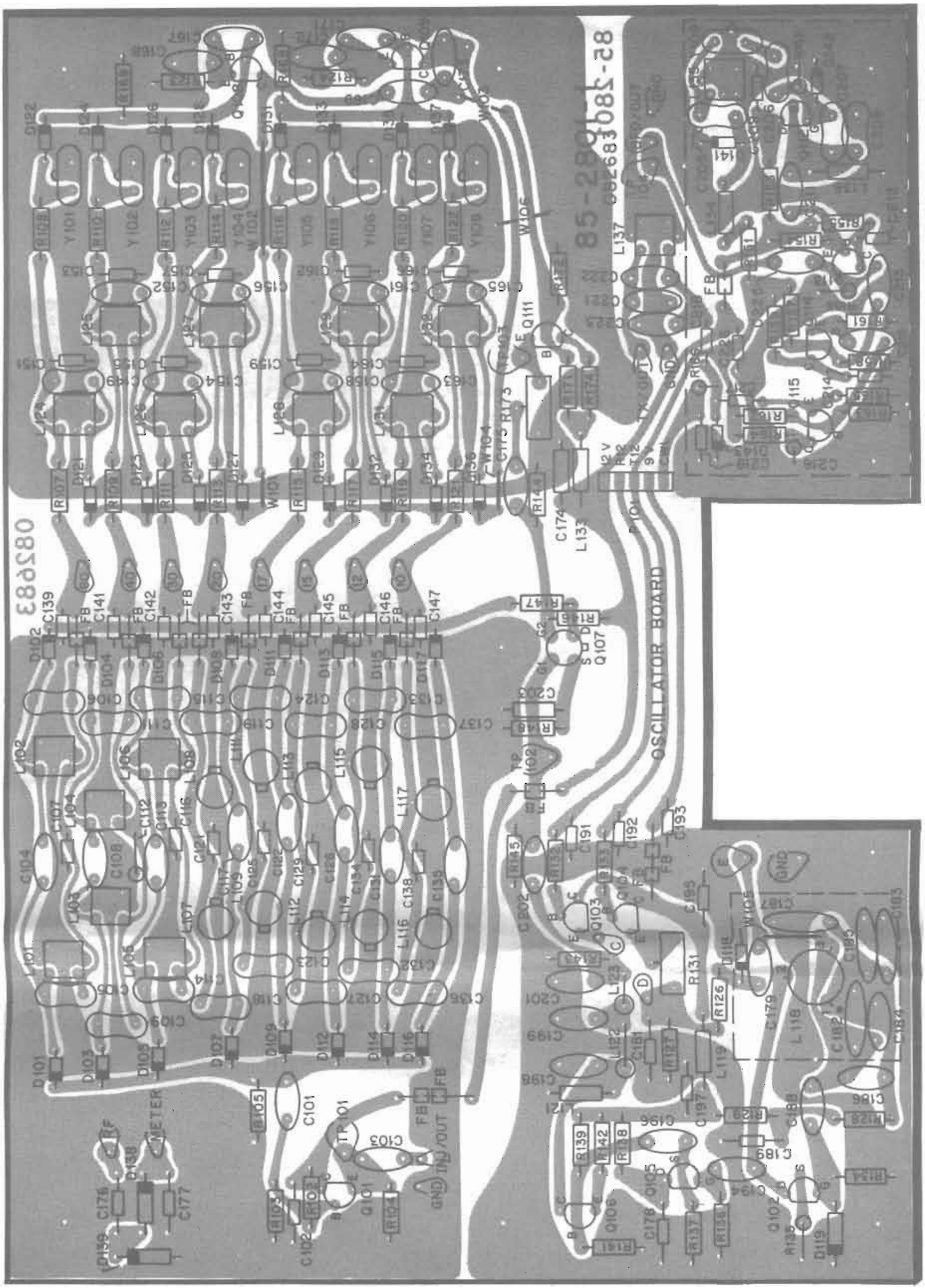

**PICTORIAL 5-3**

# The Heathkit HW-9 QRP RF circuit board

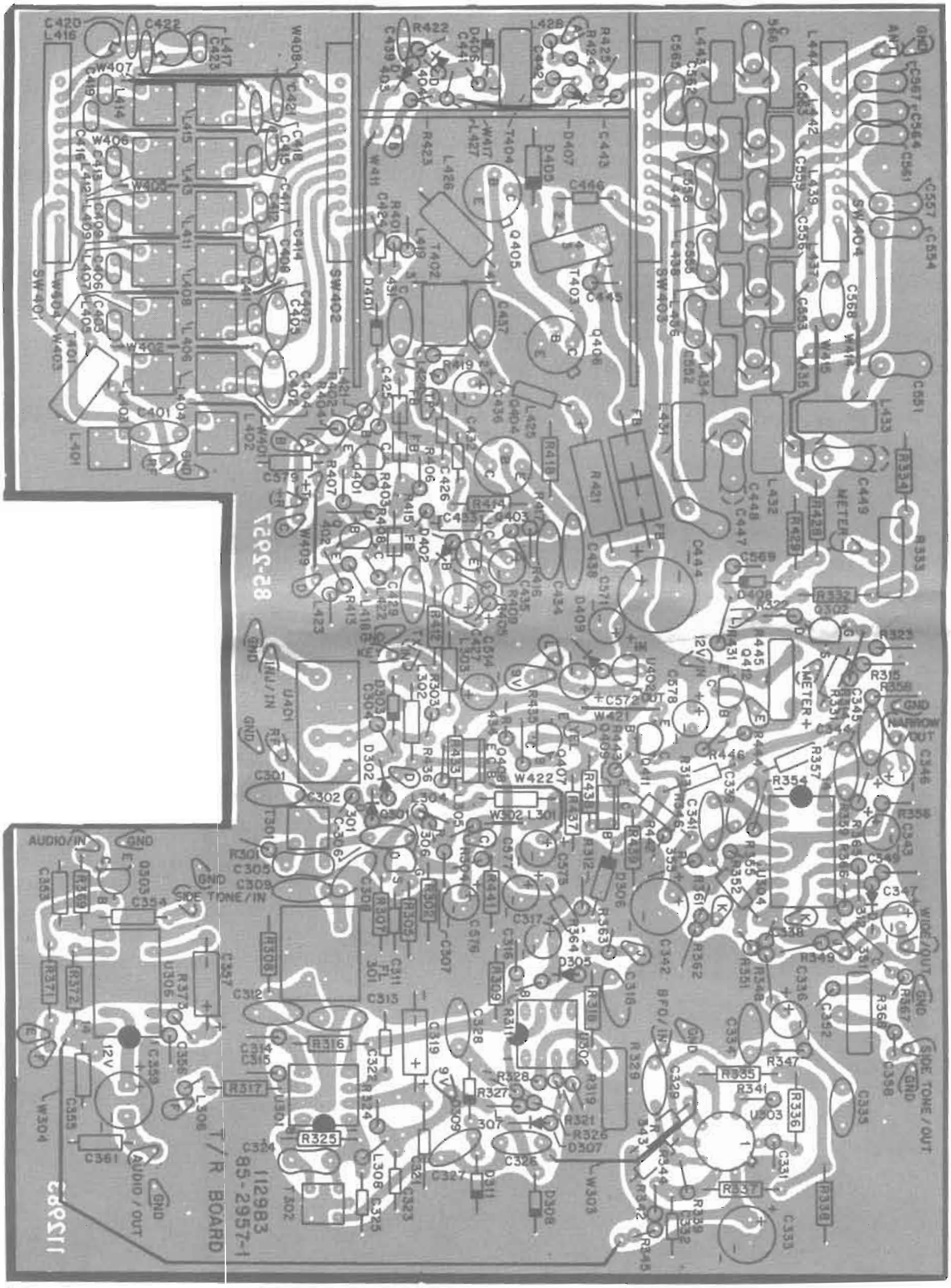



**PICTORIAL 5-4**

# The Heathkit HW-9 QRP Oscillator circuit board



# The Heathkit HW-9 QRP RF circuit board




**T/R Circuit Board**
**(Shown from the component side.)**

# The HWA-7 Power Supply

Heathkit sold a simple AC line operated power supply to match the HW-7 and HW-8. The power supply is the HWA-7. It will produce up to one amp of current at 13.5 volts.

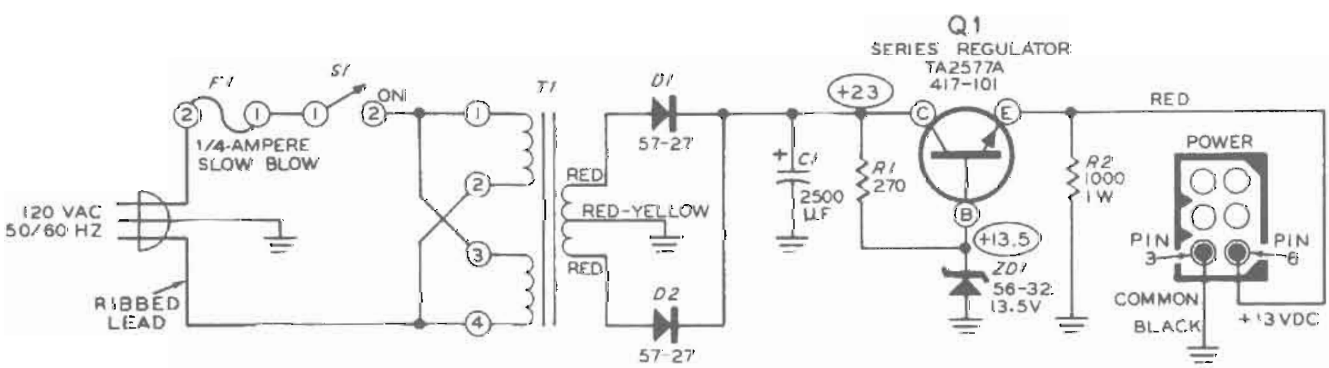
As you can see, there's not much that can go wrong with this supply.

Aside from the filter capacitor going bad, the only other two active devices are the pass transistor and the zener diode.

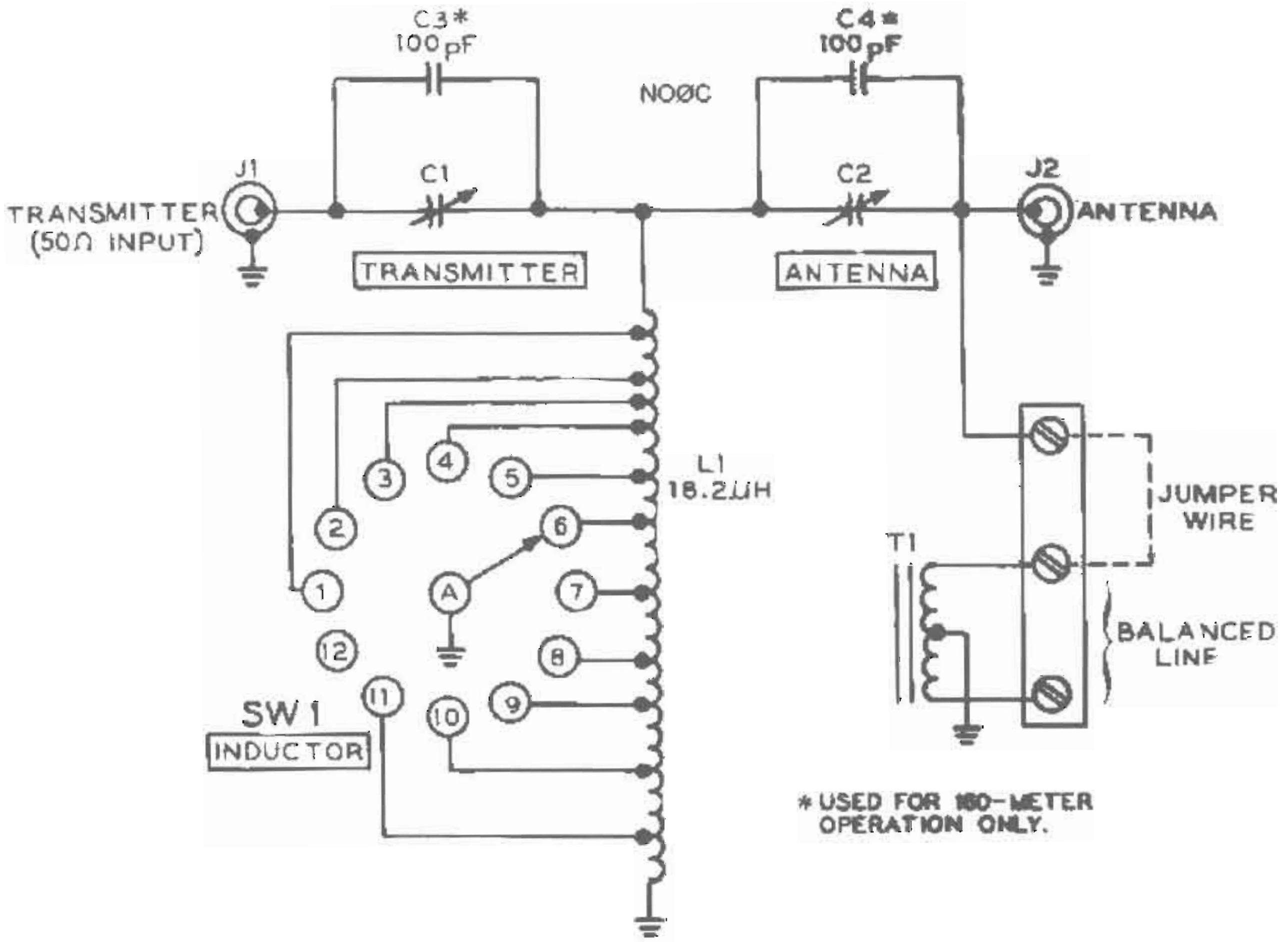
There is no short circuit protection built into the supply. If you short the output to ground, more than likely the pass transistor will be destroyed.

If you pick up one of these supplies, always check it for the correct voltage before hooking it up to the HW-8.

An overvoltage condition will surely cook your HW-8.



# The HFT-9 Antenna tuner




Heathkit produced this small antenna tuner to match the HW-9. It is one of the so called "Brown box" series. Again, there's very little to go wrong. I would suspect most of the problems with this tuner would be caused by someone running too much power into it. A good contact cleaner would more than likely fix any problems. Watch for burnt switch contacts, too.

# HW-9 Alignment

An RF detector circuit is built into the Transceiver to aid you in the alignment procedure. The only equipment you will need is a VTVM or DVM with a 1 to 2 volts scale and a 15 volt scale, and a frequency counter with a range to 10 MHz and an accuracy of .01%.

## INITIAL CONTROL SETTINGS

Refer to Pictorial 5-1 (Illustration Booklet, Page 34) and set the front panel controls and switches as follows:

( ) CW LEVEL – fully counterclockwise.

( ) RIT – center (detent) position.

( ) AF GAIN – fully counterclockwise (OFF).

( ) BAND switch – 80.

( ) TUNING DIAL – 250 KHz.

Refer to Pictorial 5-2 (Illustration Booklet, Page 34) and set the T/R circuit board controls as follows (as viewed from the front of the Transceiver):

( ) METER ZERO (R333) – 12 o'clock position.

( ) MUTE DELAY (R445) – 3 o'clock position.

( ) SIDETONE LEVEL (R368) – 3 o'clock position.

( ) AGC SET (R329) – 3 o'clock position.

Refer to Pictorial 5-3 (Illustration Booklet, Page 35) and set the oscillator circuit board controls as follows:

( ) TRANSMIT RETURN (R131) – 9 o'clock position.

( ) HFO Level (R173) – 3 o'clock position.

# HW-9 HFO Alignment

During the alignment, you will use the two test wires that you prepared earlier.

Refer to Pictorial 5-3(Illustration booklet, page 35) for the following steps

( ) Push the PCB connector an one end of the meter test lead (with an alligator clip on the other end) onto the circuit board pin at METER on the oscillator board.

( ) Connect the alligator clip of this test wire to the positive (+) lead of your VTVM (or DVM). Then connect the negative or common lead of your meter to the Transceiver chassis.

( ) Set your meter to measure 4-volts DC and turn the meter on.

( ) Push the PCB connector on one end of the test lead (assembled earlier) onto the pin at RF.
When a test point is called out in a step, insert the bare end of the test lead wire into the wire socket at that test point on the circuit board.

( ) Connect the Transceiver to a 12.6-volt DC source. Then turn the AF GAIN control on the Transceiver clockwise until it clicks on.

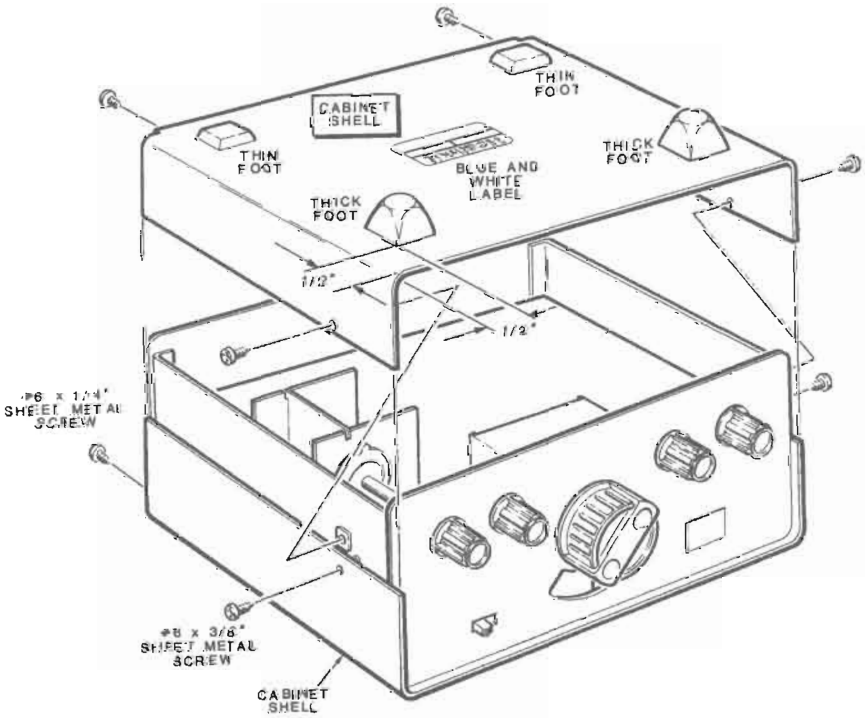
( ) Connect the free end of the test lead wire to TP103 (near HFO Level control R173).

NOTES:
1. When you adjust the coils in the following steps, be careful not to exert any downward pressure on the slugs. Also do not turn the slugs more than two turns clockwise. Too much pressure, or turning the slug too far clockwise, could dislodge the slug from the coil.

2. Adjustments must be made in the following sequence for proper alignment. Use the small end of the red alignment tool to adjust each coil, in order, for a maximum reading on your meter (you may not have a reading when you start). Set the BAND switch to the band indicated for each adjustment. Some adjustments may seem very sharp; make them slowly and carefully. No coil should require more than 1-1/2 turns in either direction. Increase the range of your voltmeter as necessary. If you do not have the optional bands installed, omit the steps that have an asterisk.

| BAND | ADJUST |
|---|---|
| 80 | L124 |
| 40 | L125 |
| 30 | L126* |
| 20 | L127 |
| 17 | L128* |
| 15 | L129 |
| 12 | L131* |
| 10 | L132* |

( ) Repeat the preceding steps until no further increase is indicated on your meter. Then disconnect the RF wire and your meter, and re-turn the BAND switch to the 80 Meter position.




*How the HW-9 cases go together*

# HW-9 VFO and BFO Alignment

## VFO ALIGNMENT

( ) Refer to Pictorial 5-2 (Illustration Booklet, Page 34) and use the blade of the shorter alignment tool to turn the trimmer of main tuning capacitor (Cl) clockwise until it is just snug. Then turn the trimmer counterclockwise one full turn-Position all wires in the area of the VFO circuit away from coil L118 and the VFO tuning capacitor.

( ) Connect your frequency counter to test point TP102. NOTE: The coil that you will adjust in the next step been preset close to its correct setting at the factory. When you adjust this coil, be sure the slug remains in the lower half of the coil.

( ) Set the Transceiver TUNING DIAL at the 250 mark and adjust L118 for a reading of 5.7493 MHz.

( ) Turn the dial to the zero mark and adjust the trimmer of tuning capacitor (Cl) for a reading of 5.9993 MHz.

( ) Repeat the previous two steps until your frequency counter indicates exactly 5.7493 MHz with the dial at 250, and 5.9993 MHz at zero. Then disconnect your frequency counter.

## TRANSMIT RETURN ADJUST-MENT

( ) Set your VTVM or DVM to a 15 volt range and connect its positive (+) test lead to the lead of 33 k ohm resistor R127 nearest TRANSMIT RE-TURN control R131.

( ) Make sure the CW LEVEL control (on the front panel) is fully counterclockwise, and the RIT control is in the detent at the center of rotation. Then note the voltage indication on your meter.

( ) Key the transmitter by shorting the KEY input on the rear panel, or by holding down a regular key connected to the KEY input.

( ) Adjust TRANSMIT RETURN control R131 until the transmit voltage equals the voltage you observed in the receive mode. Then disconnect your meter.
This completes the VFO alignment and Transmit Re-turn adjustment. Proceed to "BFO Alignment."

## BFO ALIGNMENT

Refer to Pictorial 5-3 (Illustration Booklet, Page 35) loca-tion of the test point and adjustment used BFO alignment.
( ) Connect your frequency counter to TP104 on the upper right-hand side of the BFO shield.

( ) Insert your alignment tool through the L 135 access hole in the top of the BFO shield and to the core of L 135.

( ) Key the transmitter and adjust L135 for a frequency counter indication of 8.8307 MHz.
( ) Unkey the transmitter and the frequency indication should be about 8.8314 MHz. Disconnect the frequency counter from TP104 and remove the alignment tool.

# HW-9 mixer filter Alignment

## MIXER FILTER ALIGNMENT

( ) Push the PCB connector on one end of the meter test lead (with an alligator clip on the other end) onto the circuit board pin at METER on the oscillator board.

( ) Connect the alligator clip of this test lead to the positive (+) lead of your VTVM (or DVM). Then connect the negative or common lead of your meter to the Transceiver chassis.

( ) Set your meter to measure 1.5 volts DC.

( ) Push the PCB connector of the test lead onto the pin at RF and insert the bare end of the RF wire into the wire socket at TP101.

To align the mixer filters (LlOl through L117), you will first adjust two coils for the 80 Meter band; LlOl with the dial set at zero and L102 with the dial set at 250. Then you will repeat the two adjustments until the VTVM or DVM reading shows no further improvement before you proceed to adjust the next band. NOTE: The two readings on each band may or may not be the same.

Coils LlOl through L106 will peak when the slugs are approximately 1/16" down from the top of the coil form.

Coils L107 through L117 will peak with their slugs approximately 1/8" down. Preset these slugs in the following manner before you begin the filter alignment.

( ) Insert the alignment tool into the slug of the coil and turn the slug counterclockwise until it is even with the top of the coil form. Then turn the slug clockwise two complete turns for 1/16" (LlOl through L106), or four turns for 1/8" (L107 through L117).

NOTE: If you do not have the optional bands installed, omit the steps that are marked with an asterisk.

| Band | dial 0 | dial 250 | |
|---|---|---|---|
| 80 | L101 | L102 | repeat |
| 40 | L103 | L104 | repeat |
| 30* | L105 | L105 | repeat |
| 20 | L107 | L108 | repeat |
| 17* | L109 | L111 | repeat |
| 15 | L112 | L113 | repeat |
| 12* | L114 | L115 | repeat |
| 10* | L116 | L117 | repeat |

This completes the alignment of the circuits on the oscillator circuit board. Disconnect the test leads. Then proceed with "T/R Board Adjustment

### *Heathtip*

*Back in the 70's, I purchased my first kit: SB-303. I figured I'd go with the best so I had an incentive to get my ham license. I built the kit and everything looked perfect...I was quite proud. Then I decided to give it the "smoke test". I stood back at arms length and turned it on. No smoke! The lights lit and a hiss came out of the speaker, but I couldn't "hear" a thing on the air.*

*Being new to amateur radio and not too smart about electronics, I took the only approach I knew to troubleshooting: I reheated EVERY solder joint. Didn't help. I did that again. Nothin'. Now I had done everything I knew...twice...I called Heathkit for help. I exhausted several techs until one asked, "Did you remove the shorting springs from the FETs?" Ahhhh, 'no...but I don't see any'. Well, upon careful examination, I found a number of really fine spring like wires around all the leads of the FETs....just like the manual said. I remove the wires and it worked! This was the first of many times I lucked out after messing something up. Those kits were tough!*

*Thanks to all the Heathkit techs for the patience you all seemed to have for some of us who had no idea what we were doing.*

*Bill Boutwell, KB0BK*

# HW-9 T/R board adjustments

## T/R BOARD ADJUSTMENTS

### RECEIVE IF ALIGNMENT

This adjustment is located on the transmit/receive (T/R) circuit board as shown in Pictorial 5-4 (Illustration Booklet, Page 35).

( ) Connect a speaker to the SPEAKER jack on the rear panel, or connect headphones to the PHONES jack on the rear panel.

( ) Use the alignment tool to turn the slug in transformer T301 for the loudest noise. Then turn the slug counterclockwise 1/4 turn. NOTE: You may have to use an external antenna to hear a noticeable change in the noise (this is a broad adjustment).

( ) Adjust the AF GAIN control (on the front panel) until you hear noise in your speaker or headphones.
( ) Adjust transformer T302 for the loudest noise.

## AGC ADJUSTMENT

( ) Observe the front panel meter and adjust METER ZERO control R333 until the meter pointer indicates zero.

( ) Slowly adjust AGC SET control R329 counter-clockwise until the meter pointer just indicates above zero. Then turn the control clock-wise until the meter again indicates zero. Now turn the control about 1/8-turn further clockwise.

( ) Turn the Transceiver off.

## TRANSMIT BANDPASS ALIGNMENT

While you adjust the transmitter circuits in the following steps, we recommended that you connect a dummy load to the ANTENNA jack. This will reduce the possibility that you will cause interference on the air.

( ) Connect a 50-ohm load to the ANTENNA jack on the rear panel.

( ) Push the PCB connector on one end of the meter test lead (with the alligator clip on the other end) onto the pin marked "Meter" on the oscillator board. Then connect the alligator clip to the positive (+) lead of your VTVM or DVM.

( ) Connect your meter's common or negative lead to the chassis and set the meter to measure 15 volts DC.

( ) Push the PCB connector on one end of the test lead onto the pin marked "RF" on the oscillator board.

( ) Insert the bare end of the RF wire into the wire socket at TP on the T/R circuit board.

( ) Set the BAND switch to 80, the TUNING DIAL to 100, and the CW LEVEL control fully counterclockwise.

( ) Turn the Transceiver on.

( ) Key the transmitter as you observe your VTVM. If the meter indicates less than 1 volt, switch to a lower range or increase the CW level slightly. Then unkey the transmitter

# HW-9 T/R board adjustments

In the following steps you will adjust a pair of coils for each band. If you do not have the optional bands installed, omit the steps that have an asterisk.

Leave the dial set at 100 for all of these steps. Set the BAND switch as indicated, and then key the transmitter and adjust the listed coils alternately for a peak voltage reading. Repeat each step at least once until there is no further increase. Unkey the transmitter between steps while you change to the next band.

| BAND | ADJUST |
|---|---|
| ( ) 80 | L401, L402 |
| ( ) 40 | L403, L404 |
| ( ) 30* | L405, L406 |
| ( ) 20 | L407, L408 |
| ( ) 17* | L409, L411 |

NOTE: For access to the 15-meter band coils, you must remove the shaft from the BAND switch. To do this, Refer to Detail 5-4A and perform the following steps.

( ) Turn the Transceiver off.

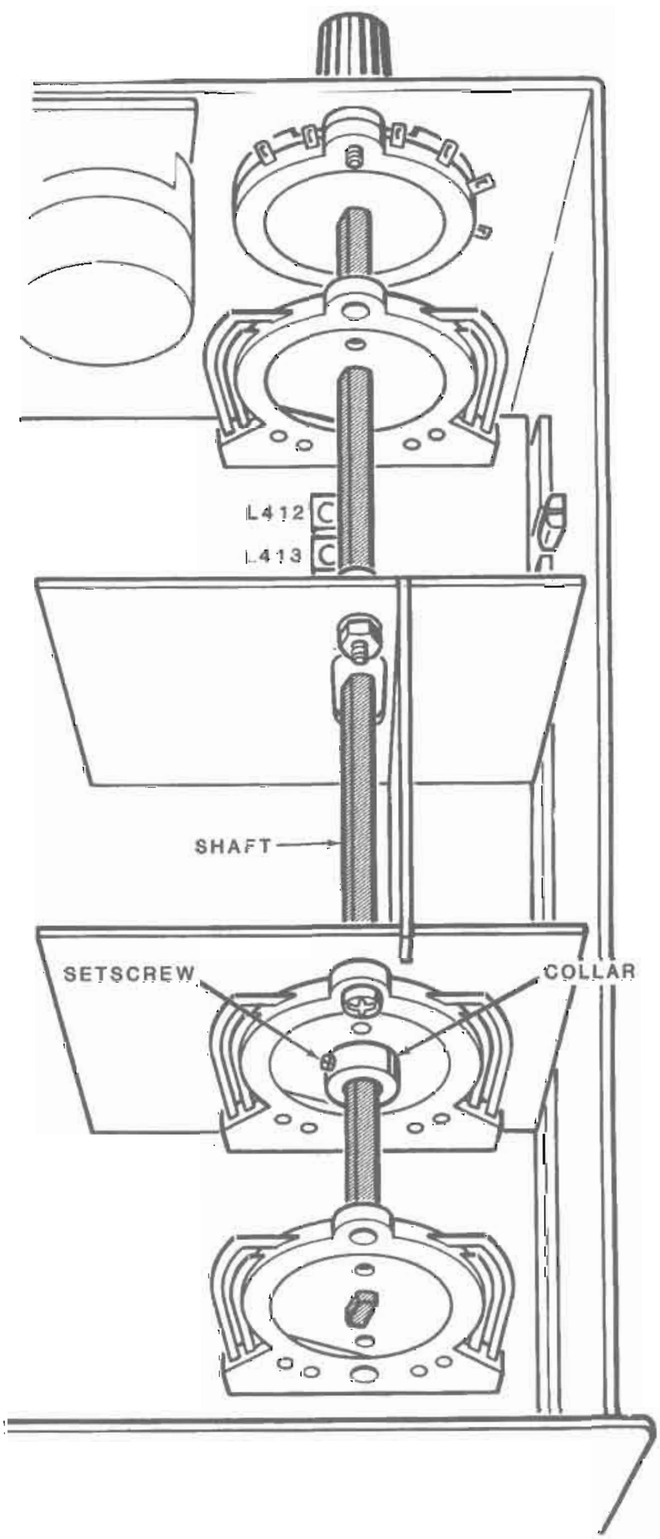
( ) Turn the BAND switch to 15 and loosen the setscrew in the collar on the bandswitch shaft.

( ) Carefully slide the shaft part way out through the front panel and remove the collar from the shaft. Then slide the shaft out until coils L412 and L413 are exposed.

( ) Turn the Transceiver on.

( ) Adjust L412 and L413 for a maximum reading on your meter.

( ) Reinsert the bandswitch shaft all the way into the wafers. Do not reinstall the collar yet.




**Detail 5-4A**

# HW-9 T/R board adjustments

NOTE: If you do not have the accessory bands installed, omit the next two steps.

( ) Turn the BAND switch to 12 and adjust L414 and L415 for a maximum indication on your meter.

( ) Turn the BAND switch to 10 and adjust L416 and L417 for a maximum indication.

( ) Turn the BAND switch to 80.

In the following steps, you will readjust coils L401 through L417, in pairs, with the dial alternately set at 250 and zero. For each step, select the band and set the dial at 250. Then key the transmitter and adjust the indicated coil. Change the dial to zero, key the transmitter, and adjust the second coil of the pair. Repeat the step until your meter readings are as high as possible and the two readings are nearly equal before you perform the next step. If the two readings are not close when you finish adjusting them, adjust the coil at the end of the band that produced the higher reading for a slightly lower reading (at its end of the band). Then readjust the other coil at the end of the band that produced the lower reading. When the readings at both ends of the band are nearly equal, proceed to the next step. Omit the steps that have an asterisk if you do not have the accessory bands installed.

| BAND | DIAL 250 | DIAL 0 | |
|---|---|---|---|
| 80 | ( ) L402 | ( ) L401 | ( ) Repeat |
| 40 | ( ) L404 | ( ) L403 | ( ) Repeat |
| 30* | ( ) L406 | ( ) L405 | ( ) Repeat |
| 20 | ( ) L408 | ( ) L407 | ( ) Repeat |
| 17* | ( ) L411 | ( ) L409 | ( ) Repeat |

( ) Turn the BAND switch to 15 and slide the band switch shaft out through the front panel to expose coils L413 and L412.

| | | | |
|---|---|---|---|
| 15 | ( ) L413 | ( ) L412 | ( ) Repeat |

( ) Turn the Transceiver off.

( ) Reinsert the bandswitch shaft into the switch wafers, with the collar on the shaft as shown. Press the collar against the wafer and tighten the setscrew.

( ) Turn the Transceiver on.

| | | | |
|---|---|---|---|
| 12* | ( ) L415 | ( ) L414 | ( ) Repeat |
| 10* | ( ) L417 | ( ) L416 | ( ) Repeat |

( ) Disconnect the test leads from the Transceiver.

This completes the bandpass alignment. Proceed to "BFO Filter adjustment."

## BFO FILTER ADJUSTMENT

( ) Set the BAND switch to 80 and the CW LEVEL control to the center of its rotation.

( ) Key the transmitter and adjust the CW LEVEL control until you obtain a meter reading. Then adjust L137 (on the oscillator circuit board) until the front panel meter indicates as high as possible. Then adjust the coil in the opposite direction until the needle just starts to move down scale. Unkey the transmitter.

( ) Turn the Transceiver off.

## HFO LEVEL ADJUSTMENT

( ) Tune in a clear signal on any band and set the AF GAIN control for a normal listening level.

( ) Turn control R173 (on the oscillator circuit board) counterclockwise until the received signal disappears. Now turn the control clockwise until the signal reappears. Continue turning the control clockwise to a point where there is no further increase, and 1/8 turn beyond. NOTE: Do not turn this control any further clockwise than the 3 o'clock position (as viewed from the front of the control).

This completes the Alignment of your Transceiver. Proceed to "Final Assembly."

# The Modifications

Warm up the soldering irons! Listed below, and in no particular order are some modifications to the HW-7, HW-8 and the HW-9. Enjoy!

**A word of caution: Not all of these modifications have been tried by the editors. The fact that they appeared in print elsewhere indicate work, but there is no guarantee, written or implied, to that effect. Second, there is some duplication in the kinds of circuits (RIT, audio amplifier and conversions to other bands) offered. Look them over carefully and pick the one which will best suite your needs. Also, the installation of one mod might preclude the use of another mod. Check the circuits and their possible effect carefully before proceeding.**

***Do only one modification at a time. Check the radio for proper operation before installing another modification.***

## Fixing the main tuning vernier

Since the HW-8 is almost 25 years old, the vernier drive for the main tuning may have dried out. If it has, then you risk twisting the VFO capacitor apart if you tune into either end stop. Fixing the VFO capacitor is harder than a bag full of jawbreakers! The best fix is to not rip out the VFO plates in the first place. To keep this from happening, you should remove the vernier drive and relub it. The drive comes apart, but you first have to remove it from the HW-8's chassis. Once it's out and in your hands, you can see how it unscrews. There's a set of ball bearings inside, so watch you don't loose them when the two ends are removed.

Use some solvent to remove the old grease and other gunk that lives inside the drive. Then repack the drive with some bicycle grease. This stuff won't ooze out and won't dry out either. Cheap, too! Once you have reassembled the drive, install it back into the HW-8. You'll be rewarded with a smooth turning VFO again. If you find the vernier drive is shot, then you can get a replacement from several sources.

Mike Bryce, WB8VGE

## Covering HW-9 cabinet scratches

It's been my experience that the HW-9 cabinet and panel surfaces scratch easily. Quite by accident I discovered that brown Kiwi Scuff Magic for cleaning up shoes will hide scratches and match the color well. I had several scratches on my front panel above the dial and after application of Suff Magic I can no longer see them. Several coats applied and rubbed with fingertips is the best approach.

Dick McIntyre, K4BNI The QRP Quarterly, October 1990

# Internal dial lights for the HW-9

I've always liked to be able to tell at a glance if a rig is on. In the HW-8, the most popular method of using a "power on" indicator is to backlight the meter by mounting a small grain-of-wheat bulb behind the meter. The meter will take on a nice soft glow.

I tried the same method on the HW-9. Guess what? It didn't work! It seems that this time Heath has painted the back of the meter, and you can't get a light bulb to shine through. Rats!

Not being one to give up easily, I took a closer look. It you have a HW-9, remove the top case. Notice that the front panel and the inside chassis are two different pieces. Notice also the small gap between the two. Whoa! Right there is the place to install some small lights to illuminate the meter. In fact, there is room enough for a second lamp for the dial. My junk box was out of small lamps, so a trip to the local Radio Shack was needed. Radio Shack sells a pack of multicolored miniature lamps, 12 volts or 6 volts, for under two bucks per pack. I removed the colored paint with a dab of fingernail polish remover, then I applied a small drop of Superglue to one side of the bulb. I mounted the bulb between the two panels just above the meter face. I also installed a second lamp just above the dial being sure to center both lamps. Since I had picked the 12-volt units, I wired them in parallel and ran a small piece of wire from the topside of the HW-9 to the power switch on the bottom. I followed the routing of the main cable harness leading to the bottom board. I found that the lamps generate quite a lot of light, with little heat build-up. To prevent the bulbs from being smashed if the front panel were pushed in, I installed a small rubber "foot" on the left side of the meter. This rubber "foot" acts like a shock absorber, protecting the lamps. With both lamps running, they will draw an extra 100 mA or so. If you plan to operate the HW-9 via battery, you might want to consider installing a switch on the rear panel to turn off the lights. Also, when working with Superglue be EXTREMELY careful when installing the lamp over the dial. You don't want to get any of the glue down inside the dial or dial drive. If the lamps are a bit too bright for your liking, just add a current limiting resistor in series with the bulbs. Be sure to keep that resistor away from heat-sensitive circuits (VFO) inside the HW-9.

# VFO alignment improvement for the HW-8

On my HW-8 and several that I have worked on, I discovered that when the VFO is properly aligned, the small trimmer capacitor at the top of the VFO tuning capacitor ends up in a loose condition.

I removed the trimmer capacitor screw and the mica. I then mount a solder lug, using the screw re-inserted in the hole. Next I solder the rotator of a small ceramic trimmer (VHF type, about 3-15 pF) to the lug and use the brass strap from the old capacitor, which is still connected to the stator of the main VFO capacitor, to solder to the stator of the new, small rotary ceramic trimmer.

This arrangement is mechanically very much more stable. A piston trimmer can also be used. One QRPer just inserted a thicker piece of mica so the screw ended up tighter. With either of these modifications, the rig is very stable and can be transported without needing realignment.

Jerry Totten, K8JRO

# Improved 40 meter performance for the HW-8

I found in comparing signals with other receivers that my HW-8 seemed to leave a lot to be desired on 40 meters, although it was very sensitive on the other bands. A ham friend in a nearby city said he had encountered the same problem in his HW-7. It turned out to be the RF amplifier coil was to high in frequency.

I removed leads 3 and 4 of coil L2 from their solder points and using a grid dip meter found I had the same problem. Not wanting to fool with L2 itself, I pursued capacitor C4, obviously aiming at increasing its value to reduce the over-all resonance of the tuned circuit. The value of C4 was 68 pF. I ended up needing about 250 pF. I used a frequency counter for fine measurement and got the circuit right on resonance. What a difference now!

Tinkering with a Lighting Calculator, I find now that L2 must be about 2 micro-henries instead of 4.7 like it calls for, and that it would have been resonant at about 13 MHz. Yes, I did check the color dots on the coils, but I'm thinking the factory screwed up and I got another 1.8 micro-henry coil instead of the 4.7, uH.

Dale Kretzer, K6PJV

# Drift fix for the HW-9

I finally cured the warm-up drift in my HW-9! After considerable experimenting, I discovered that the frequency versus temperature characteristic of the VFO is heavily (but not entirely) controlled by C184. This is a 33 pF, N750 disc ceramic cap. Since the output frequency of my rig decreased with temperature which indicated the VFO was being over compensated by C184. The logical cure for the problem would be to replace C184 with a cap having a smaller temperature coefficient, but since I have no supply source for such caps, I had to improvise. Luckily, I do have a source of supply of high quality temperature stable ceramic caps (NPO type with a temperature coefficient of less than 30 ppm/degree).

The "final solution" to the drift problem was as followed: A 150 pF NPO cap was added in series with C184, C182 (originally 50 pF, type N150) was replaced by a 56 pF NPO capacitor. The replacement of C182 was done to keep the parallel capacitance of C182, C184 and C186 essentially unchanged so that the output frequency could still be made to track with the VFO dial scale. The end result was phenomenal: warm up drift of less than 100 Hz in the first 15 minutes of operation for a "cold start", and log term drift of less then 50 Hz per hour.

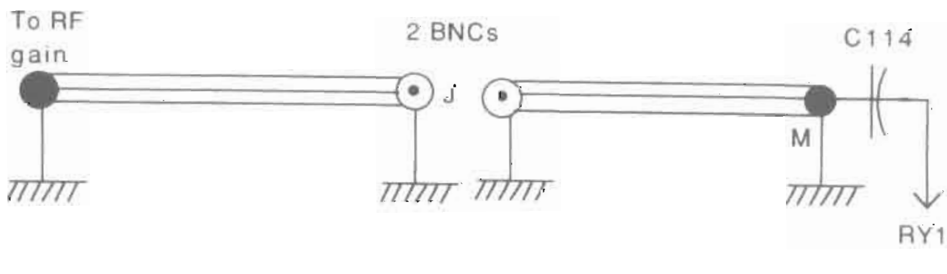
The "cure" may not be the same for all HW-9s, since normal parts tolerances can cause different drift characteristics from rig to rig. However, C184 is probably a good place to start.

Larry East, W1HUE

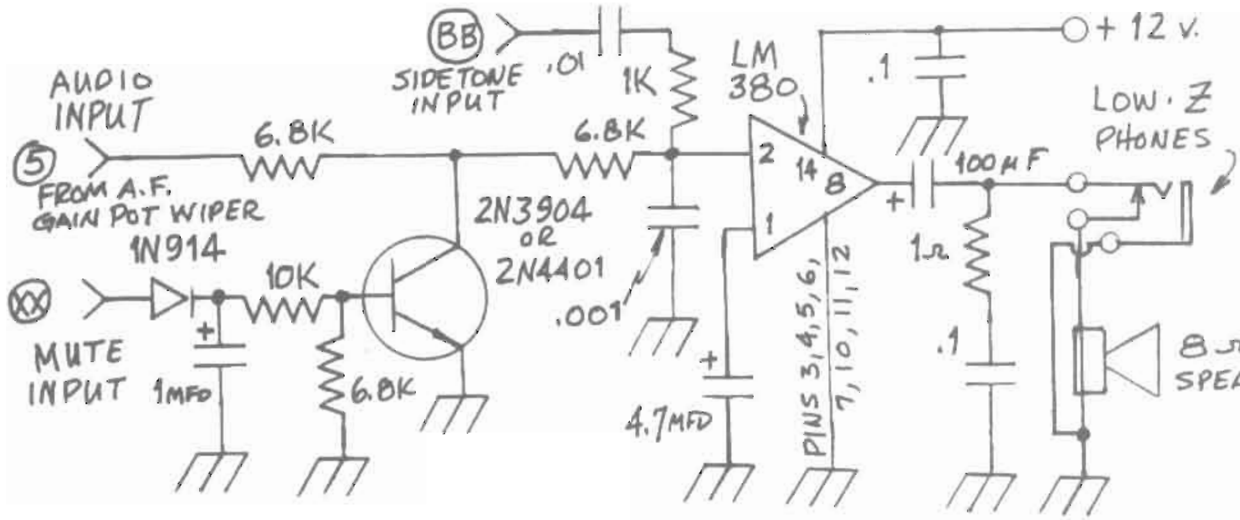
# Preselector input for the HW-7

Split the RG-174IU coax from points "M" and "S" in order to gain access to the HW-7 front ends. Then add two BNC connectors to the rear panel. This provides direct access to the receiver input. Jumper across the BNCs for normal operation. This point provides for insertion of preselector, series traps (band stop filters), attenuators, etc. Although the HW-8 is not as bad as the HW-7, out of band or adjacent BIG signals can cause problems.

Rich Arland, G5CSU



# Internal one watt audio amplifier for the HW-8




This simple audio amplifier was built on a small piece of perf board and mounted where the original AF amplifier board was located. The original board was removed and discarded to the junk box. This circuit results in the HW-8 being muted in two places in the key-down mode. I also installed a small, 8 ohm speaker on the right chassis wall next to the new amplifier, by cutting a hole in the chassis with a chassis punch. I then cut a square opening in the outer cover where it fits over this speaker opening, cover the hole with grill cloth, and bolt the cover in place.

D.A. "Mike" Michael, W3TS

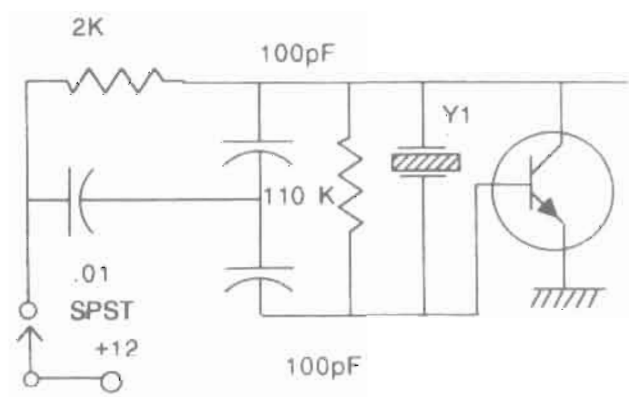
# Cheap and dirty QSK for the HW-8

While you have your HW-8 on the bench, there's another modification worth trying. Replace the noisy relay that comes with the rig with an SPDT 12 volt mercury-wetted relay. This makes for silent keying and a very fast break-in (near QSK) can be had by adjusting the T/R delay pot to its minimum position.

Howell Ching, KH6IJS, QRP Quarterly April 1884

# The HW-8 netter

Here's a handy, simple ,inexpensive calibrator to help you make sure of getting on the net frequency. The radiator is a piece of wire taped on the rear wall inside the radio. Any NPN general purpose transistor will work. The radiator is connected to the collector of the transistor.



# More RF output for the HW-8

One may ask, "Why more power from a QRP rig?" The reasons for my search for more power were two fold: first is the declining sunspots and the worsening conditions, and second is that much QRPing is done mobile from my fishing campsite on the beach using a Hustler mobile antenna mounted on the right rear of my Toyota Landcruiser. Every milli-watt of power helps on this kind of set-up.

After checking the specifications of numerous transistors, I found that the Sylvania ECG 488 showed great promise. I simply replaced Q9 (2N4427) with the ECG 488 and retuned L13 through L16 and L95, 99,103 and 106.

Now I get as much as 2 watts output on 15 meters and between 3.0 and 3.7 watts out on 20, 30 and 40 meters using a 12.5 volt power source. Over 4 watts was obtained on some bands using 13.5 volts. All power measurements were made using a dummy load and a Bird wattmeter.

I had already modified my HW-8 as per WB7OVJ's article. This mod might not be needed to handle the higher power.

Editors note: try using the transistor from the final amplifier of an old "CB" radio. Many times an old CB can be purchased for less than the cost of the "new" ECG 488

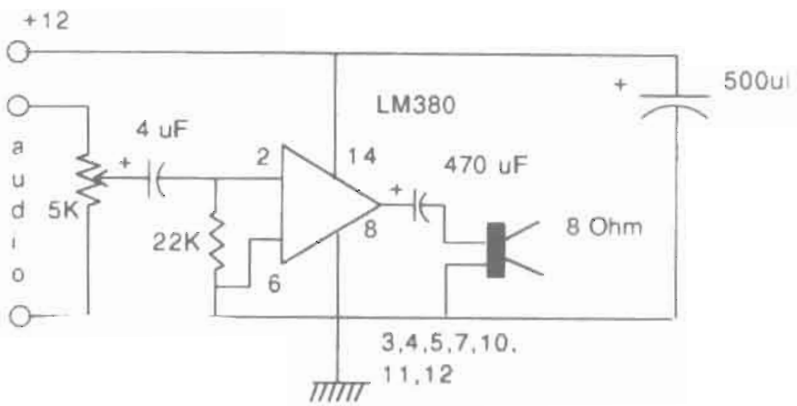
Howell Ching, KH6IJS QRP Quarterly October 1984

Editor's note: Since this mod has appeared, ECG has been purchased by NTE electronics. They appear to no longer stock this device

# Audio amplifier for the HW-7 or HW-8

This audio amplifier for the HW-8 or HW-7 works very well and requires no holes to be cut in the rig. It is built into a speaker box with three leads to the rig using spare pins on the power socket on the back panel.

Tom Sorbie, GM3MXN




## Heathtip

*I've used an automotive polish called Liquid Glass several times and it works well to remove marker and other ink stains from Heath and other faceplates. It's a little expensive (about $15 a can) but it looks good on the car also! Around Chicago you can purchase it at Pep Boys.*

*Mike McGue*
*N9HHG*

# Improved stability and dial calibration

The HW-8 transceiver exhibits approximately 150 Hz drift in transmit and receive frequency when the supply voltage varies over a range of 10 to 13.5 volts DC. This results in a CW chirp when using a poorly regulated supply, such as weak batteries. Additionally, the VFO dial calibration is in error on all but the 7 MHz band.

Most of the drift and chirp problem is caused by the heterodyne oscillator, Q6. The reverse-biased switching diodes in the tuned circuits of all but the selected band exhibit a capacitance which varies with the supply voltage. This capacitance, essentially in parallel with the selected crystal, caused pulling of the oscillator frequency. This causes pulling of the oscillator frequency. The solution is to regulate the supply voltage to Q6. The small amount of shift which still remains after Q6 is stabilized is caused by the inability of the Zener diode (ZD-1) to stabilize fully the voltage for the VFO. This can be corrected by replacing the Zener diode regulator circuit with a Motorola MC7808 three-terminal regulator IC.

The VFO dial calibration problem is a matter of fine tuning the VFO and HFO in accordance with the procedure described here. The Heathkit procedure does not calibrate the frequency of the HFO; it also does not switch the offset capacitor, C55, in during VFO calibration so that the dial will read transmit frequency.

**Modification procedure**:
Remove the following resistors:
1). R78, R81, R82, R84 R85, R87, R88 and R91.

2). Install a 7.5 volt 1-watt Zener diode (anode lead to ground) in the positions formerly occupied by R81, R84, R87 and R91 (100K resistors).

3). Install 470 ohm 1/2 watt resistors in the positions formerly occupied by R78, R82, R85 and R88 (1 K).

4). Install a .01 uF, 25 VDC ceramic capacitor on the foil side of the main PC board. Solder one lead to the junction of R36 and the yellow wire which attaches to point "B." Solder the other lead of the capacitor to a nearby ground foil.

5). Remove ZD1 and R33 (470 ohms). Drill a 11/32 inch hole midway between the two holes from which R33 was removed.

6). Install the MC7808 voltage regulator as follows:

7). Input "B" lead to R33 hole which ties to 13.4 volts line. Insert common "C" lead through the drilled hole and output "E" lead to R33 hole which ties to C52 and R3 (47 ohms).

8). Solder and clip the excess from the "B" and "E " leads. Slip a piece of insulation over the "C" lead and solder the lead to a nearby ground foil. Be sure that it does not short to other foil leads.

# Fine alignment procedure:

1). Make a pickup loop (this consists of a length of RG-59 coaxial cable with a 2-turn loop, one end soldered to the center conductor and the other to the braid) and place it around L19- L21.

2). Connect the opposite end to the antenna terminals of a calibrated receiver capable of tuning 12 to 30 MHz. (Note: a frequency counter may be use here also. The output of the HFO can be picked off at the emitter of Q7, preferably through a .001 to .01 uF coupling capacitor. The pickup loop likely will not provide enough signal to drive the counter)

3). Press the 3.5 MHz bandswitch. Tune the calibrated receiver to 12.395. Adjust L17 (bottom slug) for zero beat.

4). Press the 7 MHz bandswitch. Tune the calibrated receiver to 15.895. Adjust L18 (top slug) for zero beat.

5). Press the 14 Mhz bandswitch. Tune the calibrated receiver to 22.895 MHz. Adjust L19 (bottom slug) for zero beat.

6). Press 21 MHz bandswitch. Tune calibrated receiver to 29.895 MHz. Adjust L21 (top coil) for zero beat.

7). Temporarily attach a 10 inch piece of wire to the end of R29 (22K) which connects to point "W." Connect the other end of the wire to one of the on/off switch terminals. This will cause the antenna relay to close and the receiver to mute.

8). Realign the VFO as described in the Heathkit instruction manual, page 62

9). Remove the temporary wire and reinstall the cabinet cover. This completes the modification and alignment.

Robert W Lewis, W3HVK Ham Radio November 1983, page 103

# Portable battery operation with internal ni-cads

By using NI-CAD battery "sticks" glued to the inside top case, portable operation is possible without carrying a separate supply with you. Recharge the pack using solar/wind or geothermal energy via the extra pins on the power connector.

# Audio filter for HW-9

The LM324 used at U304 in the audio filter loads down the high impedance filter network. This can be corrected by replacing the LM324 with a TL084 or another FET input quad op amp. No other modifications are necessary to use the TL084. This FET op amp is much quieter than the LM324.

Tim Groat, KR0U, QRP Quarterly July 1988

Here's a HW-7 with an internal lead acid battery install on the bottom of the top cover. This battery has a rating of 4 amp hours. Should run the HW-7 for weeks on end.

Mike, WB8VGE

# 30 meters for the HW-8

When considering the addition of the 30 meter band to my HW-8, I knew one thing for sure: I did not want to give up either 40 or 20 meters to acquire performance on 10.1 MHz. Since 80 -meters is a rarely used band out here in Hawaii, I decided to sacrifice it rather than any of the others.

With the help of Zach Lau, KH6CP, I got to work on a conversion for the HW-8 to 30 meters using available components plus a crystal and a handful of replacement capacitors. I've converted two HW-8s this way. The first one took the better part of a day. The second was completed in less than three hours.

This conversion is straightforward, and I encountered no problems. I should caution, however, that spacing of the windings on the toroids affects inductance, so keep turns as uniform as possible. I used a grid dip meter to check the rewound coils resonant frequencies and then dipped them in hot candle wax to hold the turns in place. OK, here are the simple steps, starting with the receiver:

**Receiver modification**

1). Remove Cl, C15 and C16 (trimmer) and snip off R50.
2). Disconnect C3O1A from the circuit.
3). Replace Y1 crystal with a 8.895 Mhz rock in an HC-6/U holder with 30 pF loading and a .005 % tolerance.
4). Replace C116 with a 43 - 47 pF capacitor (I used 47 pF and replace C64 with a 27 -33 pF capacitor (I used 33 pF).

**Transmitter modification**

1). Remove C94
2). Replace C77 with a 150 pF capacitor
3). Replace C78 with a 150 pF capacitor
4). Replace C96 with a 85 pF capacitor
5). Replace C97 with a 270-300 pF capacitor (I used 270 pF)

**Remove, alter and replace the original coils as follows:**

L22, unwind 10 turns and adjust the remaining 15 turns evenly around the core.

L26, unwind 19 turns, but do not respace the remaining 12 turns

L27, unwind 23 turns and adjust the remaining 13 turns around the core evenly. In all cases, the changed coils should have an inductance of 3 uH. When unwinding the toroids, do not trim excess lead length until the coil has been resoldered to the proper spot on the PC bard. The long leads make them easier to thread back into place.

**Realignment.**

Adjust L17 until the new crystal oscillates properly. Check alignment of L18 (40 meters), since there is some interaction between these coils.

L13 in the mixer section will have a broad peak. I got the best rejection of unwanted signals with the slug turned counterclockwise until it was nearly level with the top of the stack.

Initially, I found the frequencies generated by the HW-8's VFO (8.645 to 8.985) could be heard quite loudly in the new 30 meter band. I used my grid dip meter to generate a signal in that range and then adjusted L13 for the best rejection of these frequencies.

Howell Ching, KH6IJS, QRP Quarterly April 1984

# Choppy CW fix for the HW-8

My HW-8 exhibited an excessively long RF output decay time. This resulted in choppy sounding CW at the higher keying speeds. Above 25 WPM the output became a steady carrier even though the sidetone sounded good.

The problem was traced to the break-in delay circuit. Capacitor C92 was discharging through Q12 causing keying transistor Q11 to remain in conduction for over 100 milliseconds after the key was released. The solution was to reconfigure Q12 to function as an ordinary diode. When the key is up, Q12 is reverse biases, effectively disconnecting C92 from the keying circuit.

To make the modification, simple remove resistors R66 and R67 (both 4700 ohms). Then solder a jumper wire between the base and collector of Q12. This modification had no noticeable effect on the break-in delay circuit or the setting of the delay control.

Robert Lewis, W3HVK

# Curing transmitter stability problems in the HW-9

Some, but not all HW-9's exhibit stability problems to some degree on the high bands. The output meter on my rig would slam hard-right at the power levels above about 3 watts on 15 meters. Observation of the 10 meter output on a 'scope showed evidence of instability under some power level and loading conditions. Heath is aware of the problem, and will supply a 2N5770 upon request to replace Q402. This will probably cure the problem, but it will also reduce the transmitter output on the high bands. In my case, to about 1 watt on 10 meters. After trying a number of things, I found that replacing Q402 with a 2N4401 cured the instability problem without decreasing output on 10 meters. In fact, output increased slightly. HW-9 owners experiencing stability problems should try replacing Q402 with a 2N4401. Since the circuit seems to be quite sensitive to transistor parameters, more than one might have to be tried. In real stubborn cases, try also changing C434 to a slightly smaller value; or better yet, replace 0434 with a 51 or 68 pF fixed cap in parallel with a small 5-50 pF trimmer cap and "tune" it for best stability and reasonable 10 meter output.

Larry East W1HUE

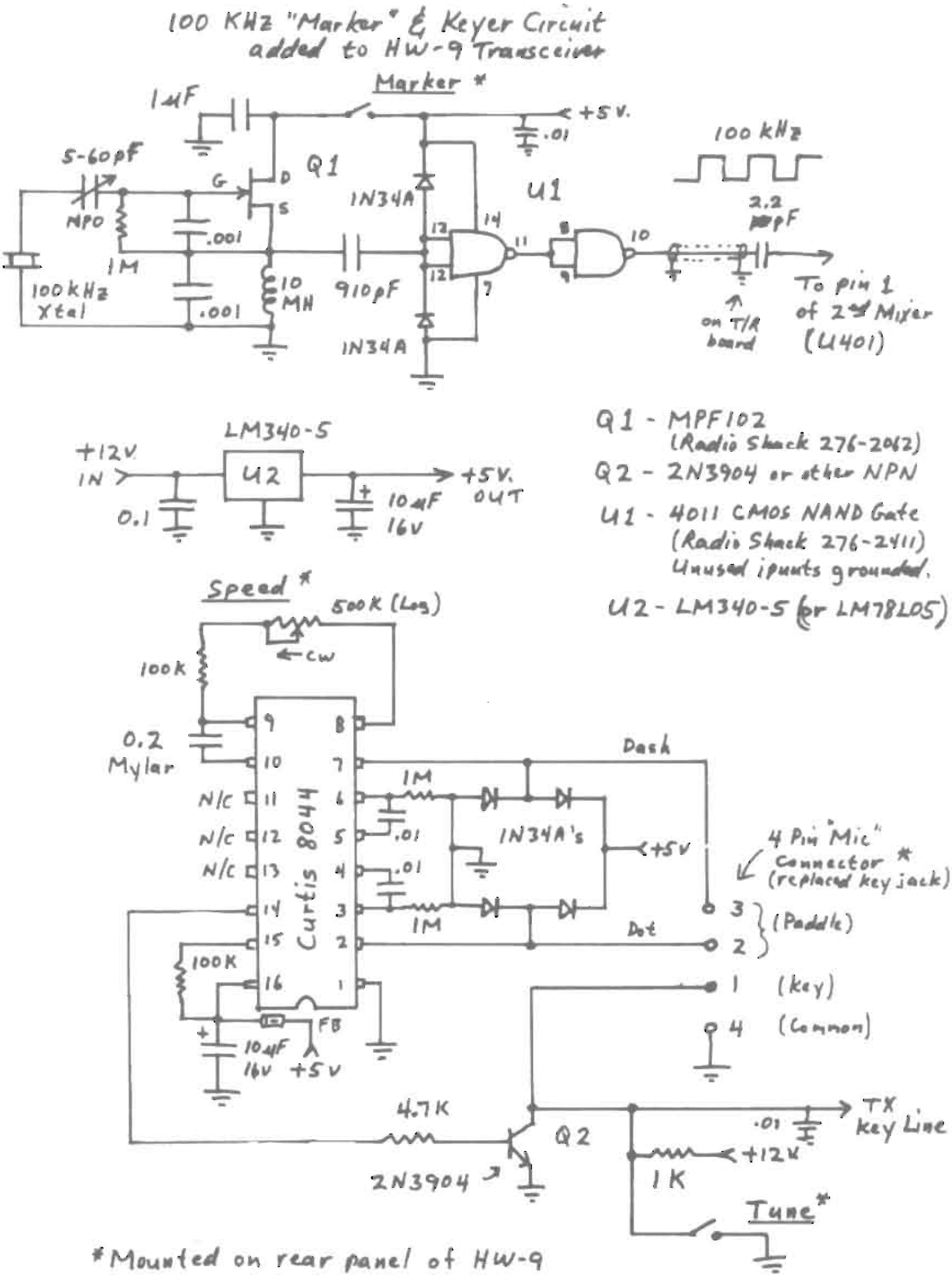
# Internal keyer and calibration oscillator for the HW-9

The first enhancement that I made to my HW-9 was to add an on-board keyer (using a Curtis keyer IC) and 100 kHz calibration oscillator. The circuit was published originally in the Technical Correspondence column of the October 1988 issue of QST. The circuit was built using "ugly construction" on a small perf board. The board was mounted above the oscillator board in the left rear corner of the rig. I replaced the key jack with a four pin mic jack for connection to a paddle as well as a straight key. A toggle switch for the panel lamps, small push button switches for "tune" and keying the calibration oscillator and keyer speed control were all mounted on the read panel.

After installing the keyer, I noticed that the weighting was a little heavy. Investigation revealed that this was caused by the slow return to +12V of the transmitter keying line. This was fixed by adding a 1 K ohm pull-up resistor from the keying line to +12V. I recommend this simple mod, whether a keyer is being used or not. The pull-up resistor can be installed on the T/R board between the top end of R434 (the end that connects to C514) and the left end of R435 (the end that connects to the emitter of Q407) without removing the board. Or, it can be included in a on-board keyer as shown on my schematic.

Larry East W1HUE

# 100 kHz "marker" & keyer circuit






**Schematic for the internal key and calibrator for the HW-9**

# Attempts to improve receiver sensitivity for the HW-9

An article in 73 Magazine (Feb.1988 page 50) indicated that receiver sensitivity,particularly on 10 meters, could be improved by replacing the T/R switching diodes in the receive path with Shottkey diodes and replacing Q107 (the first mixer) with a hotter MOSFET. I replaced D301, D303, D404 and D407 with 1N6263 Shottkey diodes and Q107 with a 3N201. Very little, if any, improvement was noted. I do not believe it is worth the effort (particularly changing the diodes). However, some improvement might be gained by using a 3N311 instead of the slightly lower gain 3N301 for Q107. A note of caution: The 73 article recommended HP 5082-2835 diodes, but this type has a very low voltage rating and should not be used to replace D407. Low voltage devices are probably OK for the other diodes, but a diode with at least a 50V rating should be used for D407 which has a lot of RF across it during transmit.

Larry East W1HUE

# Audio improvements for the HW-9

An article in QST a while back (Improving the HW-9 transceiver April 1988 ) described a circuit consisting of an FET linear gate in series with the audio amplifier input (U306) designed to suppress audio "thumps" during keying. However, I found a simpler solution. Add a 1 K resistor in series with the wiper of R3 (the volume control) and the collector of Q303. Set the "mute delay" control (R445) for a slight delay in restoring receiver output. This does not entirely eliminate keying thumps, but it does reduce them to an acceptable level (for me at least) and requires very little effort. The resistor can be easily inserted between the middle solder lug of R3 and the shielded lead to the circuit board. Adding this resistor also cured another problem in my rig: a tendency for the audio amplifier to oscillate during keying with R3 set for maximum volume.

The maximum audio output can be increased by replacing R373 with a smaller value resistor; I found 220 Ohms to be about right. However, I have not tried replacing C336. (editors note. Reversing the polarity of C336 will increase audio level)

The QRP Quarterly, July 1988, suggested replacing U304 with an op-amp with a higher input impedance, such as a JFET TL084, in order to reduce loading of the audio filter network. Since I just happened to have a couple of TL804's, I gave it a try. Well better ears might be able to tell a difference, but mine couldn't. This is a very easy mod, just pop the old IC out of its socket and plug the new one in, so nothing is lost in giving it a try.

Larry East W1HUE

# AGC time constant

If the AGC release time is to short for your liking, it can be lengthened by increasing the size of R312 and/or C317. I increased C317 to 10 mF (originally 3.3 mF), and found the slightly longer release time to be about right. This change is probably not worth the effort unless the T/R board has to be removed for some other reason.

Larry East W1HUE

## Heathtip

*Need Hot carrier diodes - 1N191's? The HP2800 series work fine, and they are carried by "Dan's small parts"*

*Mark WB8JKR*

# Transmitter frequency offset problems

The unduly large value of R131 (lOOK) makes adjustment of the VFO "transmitter return" (actually, transmit/receive VFO frequency offset) very touchy. The situation can be improved by shunting R131, the adjusting pot, with a 20K fixed resistor. This can be done without removing the circuit board by (carefully) soldering the resistor across the outer legs of the pot next to the circuit board.

The BFO should also be checked with a frequency counter for proper receive/transmit offset: it should be between 700 and 800 Hz. On my rig, it was about 550 Hz. I had to reduce C206 to 68 pF (this required removing the oscillator board), add 10 pF in parallel with C205 and readjust L135 to get it within range. The resulting BFO frequency is now 8.83153 MHz on receive and 8.83075 MHz on transmit, for a difference of 780 Hz. An almost perfect match to the measure peak response of the narrow audio filter at 770 Hz (Heath claims 700 Hz) and better centering within one of the peaks of the IF filter passband. The IF filter is rather "lumpy" as well as not very sharp.

Larry East W1HUE

# Reversed power polarity protection

I added a 3 amp diode (forward biased) in series with the power lead at the power switch. This results in a slight supply voltage drop (between 0.5 and 0.7 volts depending on the type of diode; I used an old GE diode rectifier), but it could save a lot of burnt transistors if an external battery is inadvertently connected backward! (Editors note, This is very important if you're planning to operate the HW series radios from battery or solar panel. The drop from the diode will affect output power)

Another option would be to install a high-current diode from the power lead to ground (reverse biased) and add a fuse, 2 amp or so, in the line between the diode and the power connector. This would provide protection without affecting the supply voltage.

Larry East W1HUE

# Vernier drive

Everyone has something to say about this one! The original drive on my HW-9 slipped very badly, so I obtained another one from Heath. The new one worked for awhile, and then started to slip. I found that the nut on the mounting flange had worked lose. I tightened it and added a drop of Lock Tight to the flange and nut. That was about two years ago and it hasn't slipped since. I also greased the drive gears which made operation a little smoother. One problem remains; the small gear is a little loose on its shaft, resulting in an annoying amount of backlash. I don't see any way of fixing it, short of replacing the tuning capacitor.

Larry East W1HUE

# Audio fixes

While you're at the Radio Shack store, pick up a speaker for the HW-9. It's a Radio Shack Minimus 0.03, catalog number 41-1250. I added four large rubber feet to the bottom of the speaker. The speaker is now just as high as the HW-9. The dark walnut color matches quite well with the HW-9. The speaker sounds great, and is a lot cheaper than the Heath speaker.

If you noticed that the audio sounds "kinda funny" from you HW-9, try this fix. Capacitor C336 couples the product U303 with the low-pass filter U304B. The capacitor value is not especially critical and any unit of 10 uF or less, with a voltage rating of 15 volts or more, will work fine. In my HW-9, I installed a 4.7 uF capacitor and had great results. The "fix" here is to install a new capacitor backwards from the original way. Heath designed the circuit in reverse polarity. You'll get an increase of audio, providing a significant improvement in the signal-to-noise ratio.

# Increasing transmit output for the HW-9

To correct for low output on 10 and 15 meters change capacitors C563 and C566, using Arco trimmer capacitors. Keying the rig into a dummy load, adjust the trimmers for maximum power output. After you're done, measure the value of the trimmers and substitute silver micas for the trimmers. You'll gain 1 to 1.5 watts on 10 and 15 meters. You don't have to mess with the filters for the other bands.

The driver stage, Q404, uses inverse feedback in the form of R414 and C432. To get more drive, increase the value of R414. Be careful - too much gain and you'll have instability in the stage. Start with 1.8k Ohm and increase the resistance in small steps. I stopped at 2.7K and had a power increase to about 5 watts on 80 meters. This modification has little effect on the higher bands, so monitor your success on 80 meters. In working with such a high FT, the transistor can become very unstable. The front power control should provide smooth output with no sudden pops or sluggish responses.

The finial modification to the driver stage is to remove resistor R415 with a jumper and a ferrite bead. Again, watch for signs of instability. By careful selection of components, you'll be able to have in excess of 6 watts output on 80 meters.

# Fixing the drifting VFO in the HW-9

Remove the shield from the VFO and arrange the components so that none touch each other or the shield can when its replaced. This includes the VFO coil Li 18. Bend the top of the can if necessary to allow coil clearance Also, I've been told (but have not tried this myself) that you should paint the inside of the shield black. It seems that the black paint will absorb the heat, and thus prevent any effects on the components.

# Transmit offset adjustment for the HW-9

A simple and easy to do transmit offset adjustment is just that, an adjustment. You'll need another radio, and not the HW-8 or another HW-9. Connect the regular station radio to a dummy load. Set it up for normal CW operation and switch in the sharpest IF filter available. Next, key the rig and peak the signal in your HW-9. Be sure to have the selectivity switch in the "narrow" position. Now, un-key the station rig and key the HW-9 also into a dummy load. While it's keyed, turn R131 on the oscillator board until the signal peaks in the station rig. That's it You've just set the transmit offset for the HW-9. Now, when you work a contest, those ops with the super high-tech filtered rigs will be able to hear you.

Mike Bryce, WB8VGE

# QRP/QRO for the HW-7

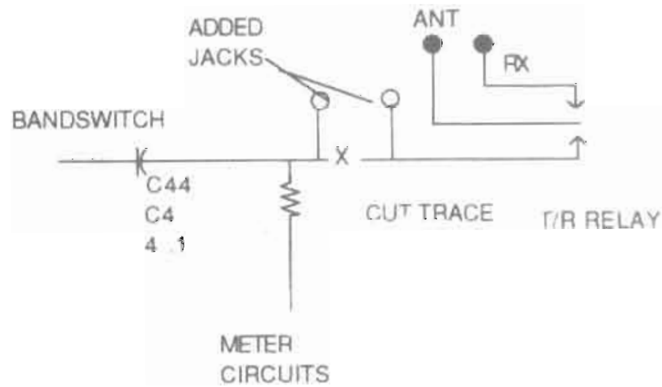
It can be fun to use an attenuator on the output of a QRP rig to try milliwatting, and some people like to run an outboard amplifier at times. The problem in doing these with the HW-7 is that there is no access to the transmit signal before it gets to the antenna jack, by way of the T/R relay. Anything done to it must be accomplished externally. You could use an attenuator in the antenna lead, but it has to be switched out every time you go from transmit to receive, or put up with the attenuation on received signals. On the the other hand, when using an amplifier you need some way to bypass receive signals around it. While you could use an external relay to do these things, the best solution would be to insert the devices between the transmitter and internal antenna relay.

To do this, I broke the connection and installed a pair of BNC connectors as shown in the diagram. For normal operation, I place a jumper cable between them, which I can easily remove to insert my attenuators. If I should ever feel the need to add a small amplifier, it's just as easy. I don't know the current rating of the existing relay but it looks like it should certainly be more than adequate to handle the typical 5 or 10 watt amplifier. While I used BNC connectors, you could also use UHF or phono plugs, depending on your preferences. I used RG-174 miniature coax to connect them to the circuit board.

I also replaced the relay in my HW-7, although it had nothing to do with the possibility of adding an amplifier later. I used a DPDT, 12 volt coil DIP relay obtained from KM8X's Small Parts Center. It's quieter, has more than enough current capacity (2 amps) and best of all gives me an extra set of T/R contacts. Although I don't have anything definite in mind yet, some future modification will make good use of them This type of relay is similar to those used by Kenwood for RF switching in some of their transceivers and antennas at the 100 watt output level.

I installed the relay in the area vacated by the old one, which required some butchering of the circuit board. It would be much easier to put the relay on a scrap of perf board and mount it on the side or rear wall, but I wanted to keep those areas open for future mods.

Mike Czuhajewski, WA8MCQ




## Heath PSA-9 power supply modification

The PSA-9 is the matching accessory power supply for the HW-9 transceiver. Voltage regulation is accomplished by a low current 12 volt regulator IC (UI) and a pass transistor (Q1). The regulator in my supply failed, taking with it a 1 ohm , 2 watt limiting resistor (R1). In looking for a replacement, I discovered the 7812 regulator IC (Radio Shack # 276-1771). With its 1 amp capacity and internal overload protection, I was able to replace not only the original regulator, but also the pass transistor and limiting resistor with a single component. Since the original pass transistor and the new 7812 are both housed in TO-220 cases, I reused the transistor socket with only minor rewiring. I retained the diodes, D5, D6 and D7 which maintain the regulator ground at 1.8 volts and increase the output voltage to 13.8.

Mark Miller K5DP

## Simple remedy for drifting HW-7

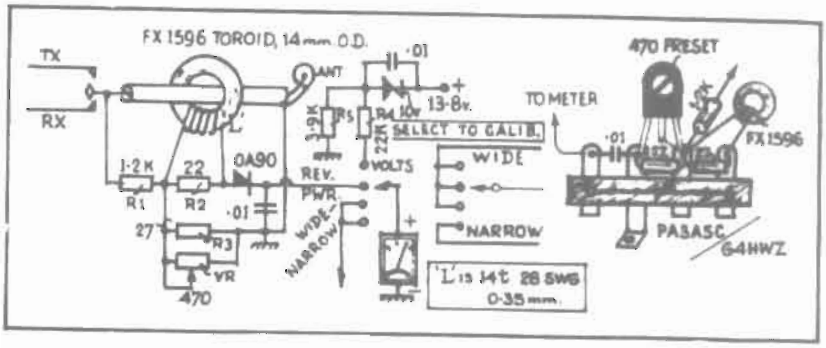
My HW-7 would drift so rapidly that I had great difficulty maintaining contact once a QSO was initiated. I tried every remedy I could think of with no results. Then I found a solution in Solid State Design by DeMaw and Hayward. Nearly all of the FET VFO circuits in the book included a diode across the gate bias resistor but the HW-7 lacks it. I soldered a 1N914 diode on the foil side of the printed circuit board across the 47K resistor R21. Now the rig is nearly as stable as my old Tempe One: drift is detectable over long periods of time, but is slow enough to be tolerable.

Jerry Bartachek, WD0CA

# Reflected power measurement

The front panel meter of the HW-8 can be used to measure reflected power using the circuit below, which has been designed for a 50-ohm output. The principle is well known. Antenna current passes through a short piece of coax, which is encircled by a high-mu ferrite toroid suitable for the frequencies involved. The toroid samples the current, and the secondary winding develops a voltage across R2, which should be about 300 mV for full RF output ( a good test to see if the ferrite is stable). The braid acts as an electrostatic shield and must be earthed (grounded) only at one end. Voltage is sampled by R1 and R3 and added to the voltage across R2. The result is rectified and fed to the meter via a switch.

Installation is as follows:




Remove the front panel. Replace the front panel and reconnect the "RF output" and "wide/narrow" functions. Remove the lead from the antenna socket to the relay. Construct the SWR circuit on a tag strip, keeping all leads as short as possible. Drill a 3mm hole in the rear panel near the antenna socket and mount the tag strip. Make a good ground connection to the chassis. Connect the lead from the diode to the switch. Wind 14 turns onto the toroid and slip it the outer PVC sheath and insulate the toroid with a thin layer of tape. Ground the braid at the antenna socket and connect the relay to the antenna output. Connect the toroid and R1, and set VR to maximum. A Zener diode and a resistor network may be used to check the supply voltage, useful for portable operation. Calibration is impractical. Components may be mounted on at tag strip secured by one of the bolts holding the meter in place.

Mike Perry, PA3ASC/G4HWZ-SPRAT, Autumn 1980

# HW-8 offset problem solved

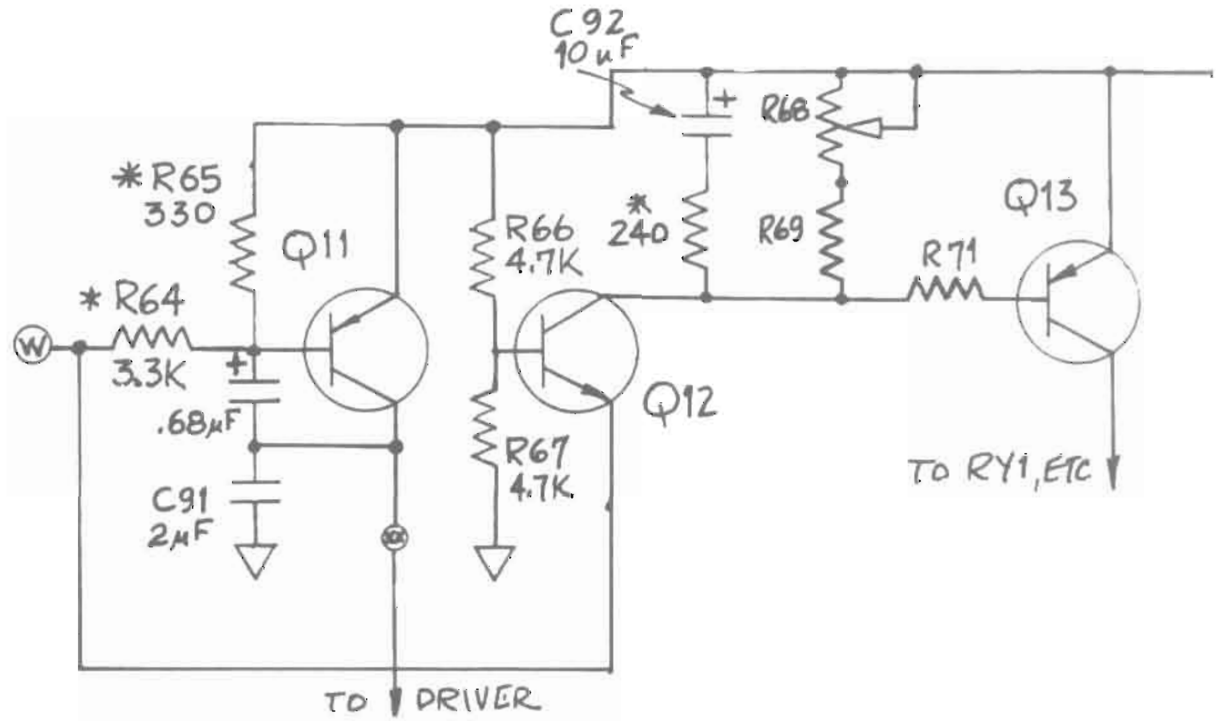
Here's a simple solution I found for an HW-8 that offsets more than or less than the 750 Hz on transmit, thereby causing off-frequency net operation or band-walking. (A phenomena that results when two transceiver operating hams keep raising or lowering their dial to compensate for poor offsets)

The problem is caused by capacitor C55 (5pF on the schematic), which is switched into the VFO on transmit to lower the frequency so that a 750 Hz beat note is heard on receive. If it's a little off, you have a problem.

Remove C55 (next to the VFO variable) and install a ceramic trimmer of the 2-8 pF range in its place. With the rig on and the covers off, short diode D11 to ground (imitating transmit mode) and zero-beat a steady carrier or long winded CW operator. Then remove the short to see how close the received beat note comes to the peak of the active filter bandpass (the loudest note). Adjust the trimmer and keep checking until you get it perfect and you will have solved your problem.

# Keying shaping mod for the HW-8

This modification eliminates the harsh keying caused by the fast raise-time of the keyed signal. A 68 uF capacitor (tantalum or other compact, low-leakage type) is connected from the base to the collector of Q11. The positive lead should be on the base. It may be mounted on the foil side of the circuit board, under Q11. It's also necessary to change the values of R64 and R65 to obtain proper shaping, since the original values give too slow decay and virtually unreadable keying. R65 is now 330 ohms, and R64 is 3.3 K ohms; the raise and fall times are now about 5 milliseconds.




# Break - in delay modification

If you use a key or keyer with delicate contacts, or ICs, you may have experienced contact burning or premature failures. This is caused by high surge currents which flow to charge C92 in the break-in circuit. To limit these surges, install a resistor in series with the capacitor. A 240 ohm resistor limits the current to less than 60 mA. This will be adequate in a majority of cases. The resistor may be installed without cutting the circuit board by connection it in series with the negative lead of C92. The other lead of C92 is extended with a lead trimmed from a resistor.
Don't try to simplify this by putting the resistor in the key line. This will only delay operation of RY1, chopping off the beginning of the first dot or dash sent. The method shown does not slow down the relay.

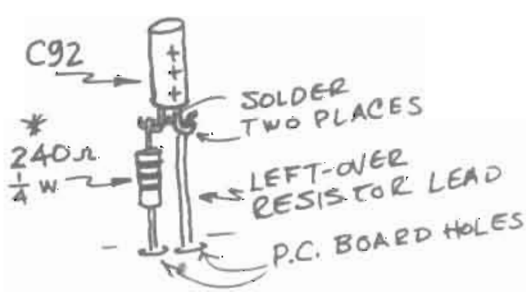
Tim Groat, KHOU, QRP Quarterly April 1984

## Heathtip

*A product called Wrights Brass Polish(similar to Brasso)sold in supermarkets does a super job of removing extremely stubborn,(baked in?) dirt deposits on Heathkit baked enamel front panels.I recently brought a couple pieces of Heath test gear back to life (esthetically)this way and the results were simply remarkable.*

*I was not able to remove the dirt with soap,detergent, alcohol,or mineral spirits paint remover,but the Wright's took care of the problem just about immediately.*

*Malcolm Leonard*



# A second RIT mod for HW-8

Here is an effective RIT circuit which uses a minimum of parts and which can be assembled on a small piece of perf board and a small terminal strip.

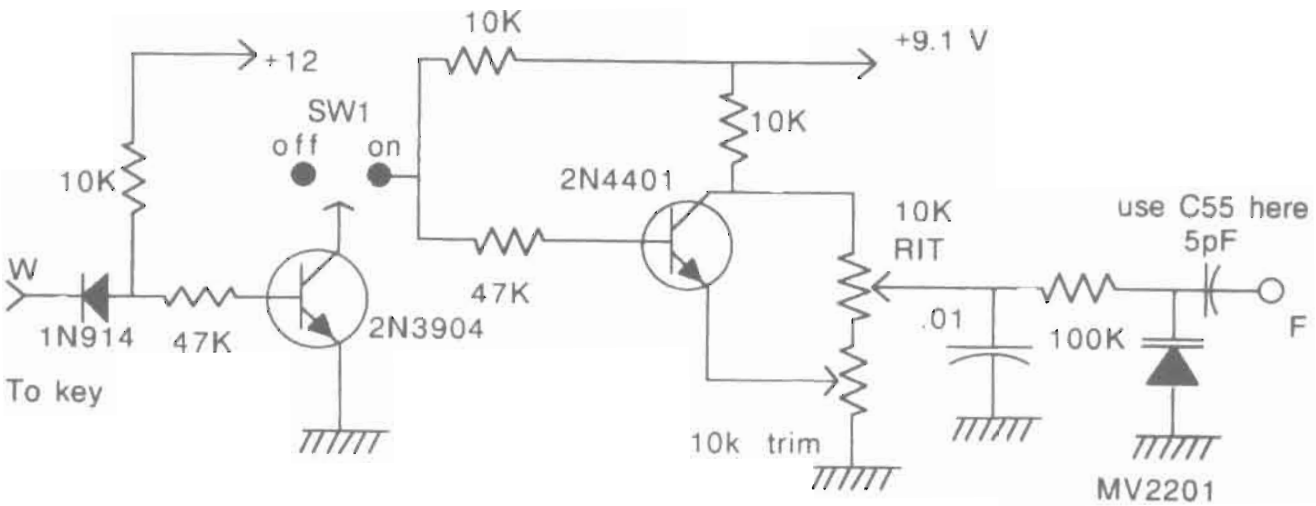
Remove SW302 (wide/narrow filtering). If it is desired to retain this function, an SPDT miniature toggle switch may be installed in the upper right of the front panel near the preselector tuning capacitor. Otherwise, the rig may be wired permanently in the narrow position by disconnection the three wire cable between SW302 and the main PC board. Jumper between points "HH" and "EE" on the board. Now mount the 10K linear taper offset tuning pot on the hole left by SW302.

Drill a hole in both front panels to left of the new RIT control for SW1. This switch is either a normally closed push-button switch or a normally closed toggle switch with a monetary contact. It disables the RIT for zero beating the incoming signal.

Remove C55 (save it for later use), D11 and R36. Assemble all of the components to the left of the dashed line in the schematic on the perf board and mount it on the inside wall near the zero beat switch, SW1. Use a small stand-off. Mount the remaining components on a small terminal strip and fasten the strip to the frame of the VFO tuning capacitor.

With the RIT offset tuning pot set at mid-range, adjust the 10K trim pot to set the desired shift on either the high or low side of zero beat. The pitch should not change with SW1 open or closed.

D.A. "Mike" Michael, W3TS




## Heathtip

*Stuck knobs?*

*Try this trick I have used in the past.. cut a 2" piece of heavy copper wire from some household wiring, strip it and wrap it around a soldering iron so that it makes a heated probe. Carefully heat the set screw and then let it cool off. Do this a few times and try turning the screw each time. Eventually the expansion/ contraction will break the corrosion bond. You can also use Liquid Wrench at the same time to help penetrate the bond.73*

*Keith Harvey, VA3KRV*

# Rigged for silent keying

Here is a modification which replaces the noisy antenna changeover relay with a silent, efficient and economical electronic transmit-receive switching device The circuit is a diode switch. During reception, diodes Dl and D2 are forward biased, and D3 is reversed biased, blocking the transmitter sinewave. D3, added insurance, becomes forward biased to pass to ground any RF that might try to sneak through. D4 and D5 are back-to-back, the third insurance factor should the other safety devices fail to protect the receiver. Transistor Q1 is a switch to ensure the proper bias voltage swing on the diodes. During reception, about 2 volts are applied to the anodes of Dl and D2 and the cathode of D3. During transmit, the anodes of Dl and D2 are at ground, while their cathodes are at 12 volts. This ensures complete reverse bias while D3 is hard on during keying. The circuit is not difficult to build, even for the inexperienced. I used Vector board and push-in terminals plus components from Radio Shack and Circuit Specialists. The RF chokes are "Micro Mite" molded coils. I used the Miller 93l0~0. This is a 15 uH choke with a Q of 65 at 2.5 Mhz. You also can make your own chokes out of ferrite beads, but make sure the Q is sufficiently high so that output absorption does not occur.

Installation requires the drilling of a single hole in the HW-8. I mounted the T/R switch in the same manner as the audio amplifier circuit board, using a one-inch metal stand-off. Refer to the HW-8 Manual for directions on removing the top and bottom chassis plates, which exposes the PC board and component sides of the board. I recommend you buy a roll of de-soldering braid. This makes work a lot easier when it comes time to remove the antenna relay and change other components.

Remove RY1. Then on the foil side of the board, install a 270 ohm resistor from point J to ground. This makes the collector Q13 "see" a load that once was the relay coil. Mount the T/R switch in the selected spot, as discussed above.

It's time to refer to the HW-8 manual, Page 79, the X-Ray view of the main circuit board, and the schematic for the following:

Locate the now unoccupied solder land that was once the normally closed contact of RY1 to the receive side of the T/R switch (D4, D5 back-to-back diodes). Take the antenna wire from J302 and twist another wire around it. Pass them through the solder land hole that once was normally open contact of RYl. (Hint: trace "L" to that point)

Solder the other end of that twisted wire to the transmit side of the T/R switch. Connect the 12 volt line from the T/R switch to the "ON" side of SW3O1, the on-off switch. C305 is mounted there (.47 uF capacitor).

To install the keying line, solder a wire from point "J" to the keying line of the T/R switch (the anode side of D6). One more thing to remember: you must ground the T/R circuit either though the metal stand-off or by attaching a wire to the ground foil of the transceiver. This completes the T/R switch installation. Check your wiring again, and get ready to try it out.

Connect power, key. Turn on the rig and listen to all those signals barreling in! Connect a clip lead from the antenna jack to the receive terminal of the T/R switch. By shorting and unshorting the T/R switch, you should not hear an degradation of the incoming signals.

Enjoy the HW-8 for a while. Enjoy the silence of relay-less keying, until it becomes apparent that the audio recovery is too slow. Not quite QSK! Fast audio recovery is the second phase of this project. To accomplish this, we must look at the break-in delay and mute circuits to understand and correct the problem.

On page 76 of the HW-8 manual, a discussion of the break-in circuit is given. Because there is no more relay, we can decrease the delay that originally was built into the circuit to accommodate the relay.

I changed the value of C92 (10 mF) to 1 mF. To soften the keying, I placed a 0.47 mF disc capacitor from the base to the collector of Q1 1, the keying transistor. Place this capacitor on the foil side of the PC board.

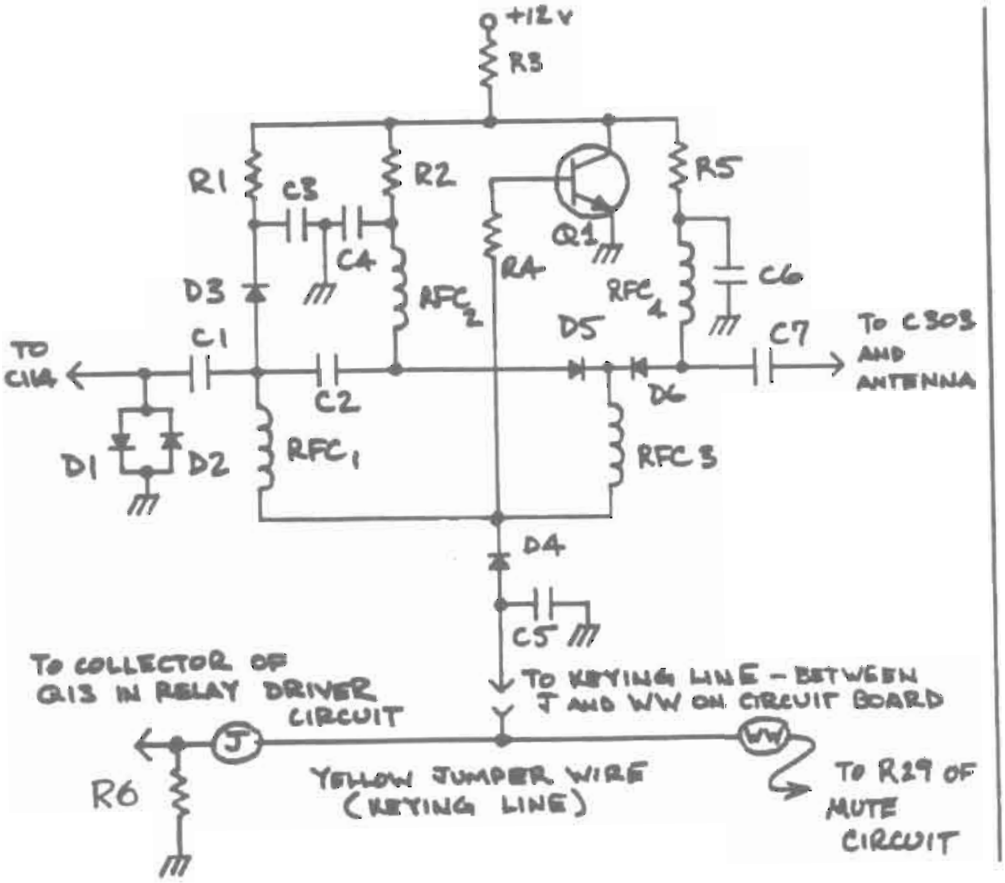
The audio recovery rate is determined by the RC time constant associated with IC2C the audio amplifier, and C38 C39 and R27. With these values, the recovery rate is 2.7 seconds.

Because R27 is frequency independent, I elected to reduce its value to 500K ohms instead of reducing C38, as suggested in Sprat. With this change, the recovery rate will be about 1.1 seconds.

With these component changes, you will notice some popping. This is a race condition between the receiver recovery and the sidetone oscillator. Adjusting the relay control, R68 probably will eliminate this. It if remains objectionable, you can increase the value of C92 to 4.7 mF or play with the value of R27.

This T/R switch has been in operation for more than six months without any ill effects.

John McNeil, QRP Quarterly




PARTS LIST

C1-7 .01 mf disc ceramic

D 1-6 1N914 or 1N4446

R1,2,5 1K ¼w

R3 330 ohm ¼w

R4 3.3K ¼w

R6 270 ohm ¼w

RFC 1-4 see text

Q1 2N222 or 2N3904

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By John McNeil, WA2KSM
From QRP ARCI Quarterly

## Heathtip

*Something that I have found handy on smooth enameled equipment, such as most of the Heath light and dark gray series of test equipment, and certain ham gear, such as Benton Harbor lunch boxes, is the Megueir(sp?) series of auto finish products. They have a set numbered 1, 2, 3 that is a mild abrasive, clearner and polish that leaves enameled front panels looking almost new. Available in almost all auto parts stores around Chicago.*

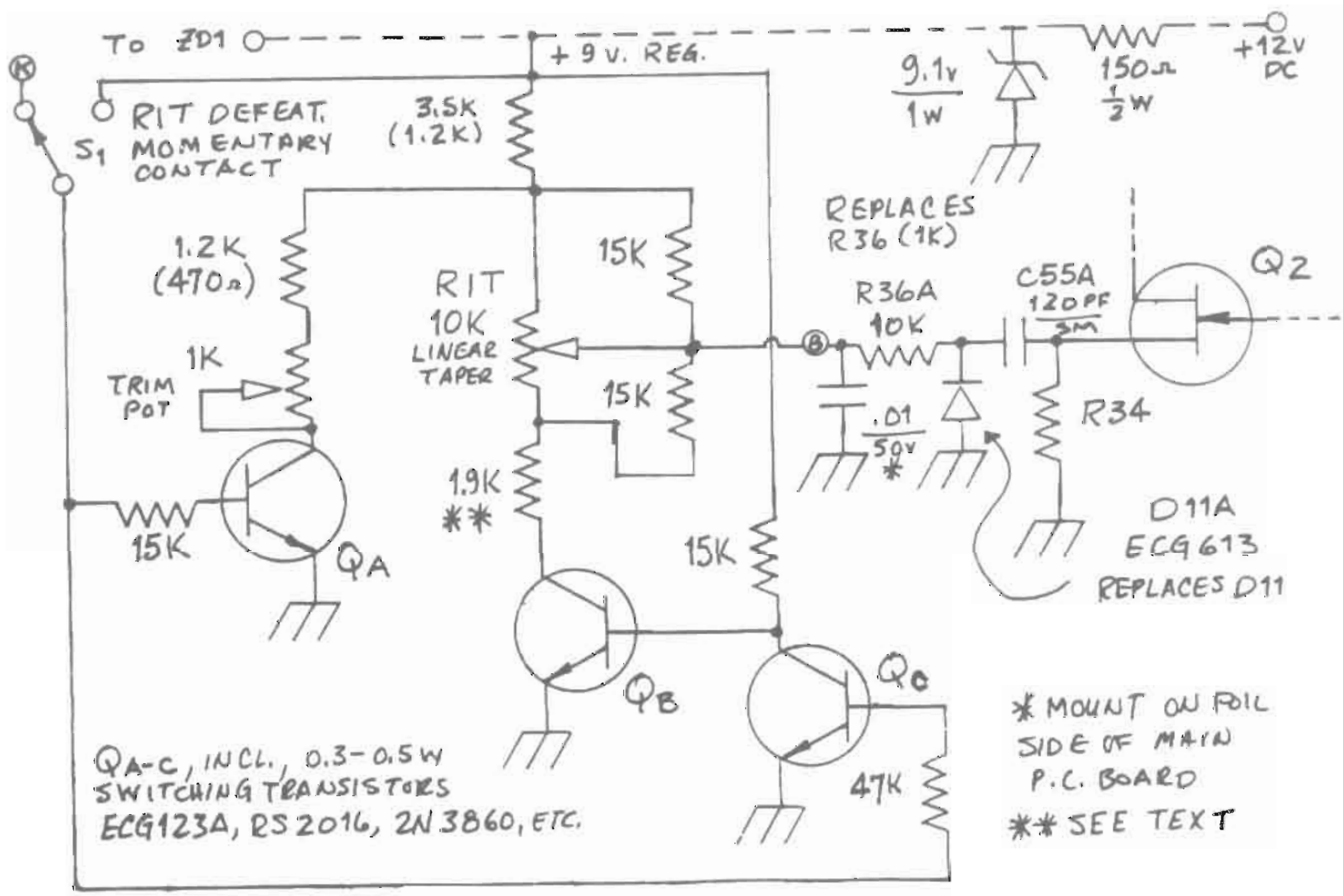
*Another handy automotive product for older gear available at parts stores is chrome restorer, sold in several brands. It will completely eleminate rust that has penetrated through pin holes in chrome fixtures and mushroomed across the surface. Sometimes chrome parts that look like they need replating will look good as new, and there seems to be little recidivism of the cleaned parts. Various soap solutions sold in car parts stores for "deep cleaning" car finishes work well on painted equipment, especially if applied with a tooth brush. Tobacco and crud come off without much argument.*

*Bob Bruner*
*WB4TAJ*

# Receiver incremental tuning (RIT)

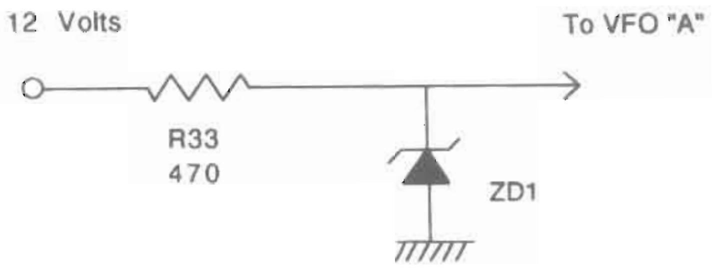
Here is my version of the K6TG RIT modification (QST July 1977), which I used for more than two years with no problems. It does not require drilling holes or cutting the foil on the main circuit board. The circuit is built on a Radio Shack board (RS-276-024). Values shown in parentheses are the minimum for proper operation and component values may be juggled to tailor the range of the RIT. The 1.9K ohm resistor (**) may be varied or eliminated to adjust the range. The dashed lines at the top show an optional power control circuit. R36A and C55A replace R36 and C55 on the main board. D11A replaces D11, and the .01 mF capacitor (*) is mounted on the foil side of the board. The RIT control (10K linear taper pot) may be mounted between the load control and the HF output meter, if a miniature pot can be found. S1 can be mounted at the left of the preselector control in the spot indicated by CO magazine (October 1977). Power can be taken from ZD1 or ZD101.

John Lock, KFOM



# Curing Zener diode noise

One of the chief sources of internal noise in the HW-8 is ZD1, a 9.1 volt Zener diode in the VFO. Remove ZD1 and R33 (470 ohms).Mount a two-point terminal strip on the chassis wall near the audio amplifier; one pin should be a ground lug.Wire the circuit as shown below. Pick up 12 volts for R33 from a nearby point, such as the on-off switch. Run a wire to point "A" in the VFO circuit. To test for a possibly noisy ZD1, connect a 50 ohm load to the antenna jack; switch to 21 MHz; open the audio gain all the way and listen with ZD1 in and out of the circuit.




Leo Delaney KC5EV

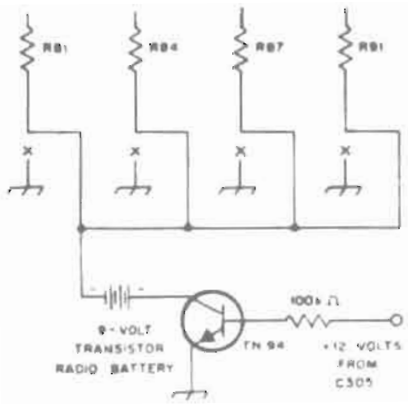
# Parasitic oscillations

Here's a method of eliminating parasitic oscillations in the HW-8. Although Doug DeMaw implied that the spurious radiation for this source is weak enough to satisfy the FCC rules ( April 1979 QST page 18), I still consider it ethically and aesthetically unsatisfactory to operate the transmitter without silencing this unnecessary noise.

The direct current bus lines to the band-switching diodes for the three bands which are not selected support the relaxation oscillations in the audio-frequency range when the key is down and the transmitter is on the air. The amplitude of these oscillations depends upon the position of the receiver preselector and RF gain controls and may become large enough to be heard in the headset, in spite of the muting circuit and the sidetone. They are probably the cause of the spurious radiations referred to above.

I have eliminated these oscillations in my HW-8 by providing back bias to turn off the bandswitch diodes which are supposed to be off. I did it by lifting the grounded ends of resistors R81, 84, 87 and 91 from the circuit board. These are connected to a "C" battery as shown below. A transistor disconnects the battery when not in use. The drain is about .2 Ma so that I expect log life for this bias supply. My HW-8 is now clean and quiet and otherwise operates exactly as before.

James E. Gray W0GNV




## *HeathTip*

*I have found a penetrating oil that frees up parts. The manufacture claims penetration to one millionth of an inch. I tried it on a variable resistor shaft that wouldn't move with pliers and after about one hour it turned and now works fine. It is made by Kano Laboratories in Nashville Tennessee. They have a web page www.kanolabs.com I'm sending this along for all those who restore old stuff, I originally bought it for work on nuts and bolts, although I'm a firm believer in the torch, 'cause if its cherry red it turns like its greased. A little hard to due on radios HI HI.*

*Peter Johnson*

# Smoother tuning for the HW-8

This is my favorite modification for the HW-8: Adding a second Jackson Brothers 6:1 vernier drive to the front panel. This reduces frequency change per knob of revolution from the original 90 KHZ to a mere 15 KHz. After operating with this modification, I could never go back to the old 15 KHz-at-a-twitch routine.

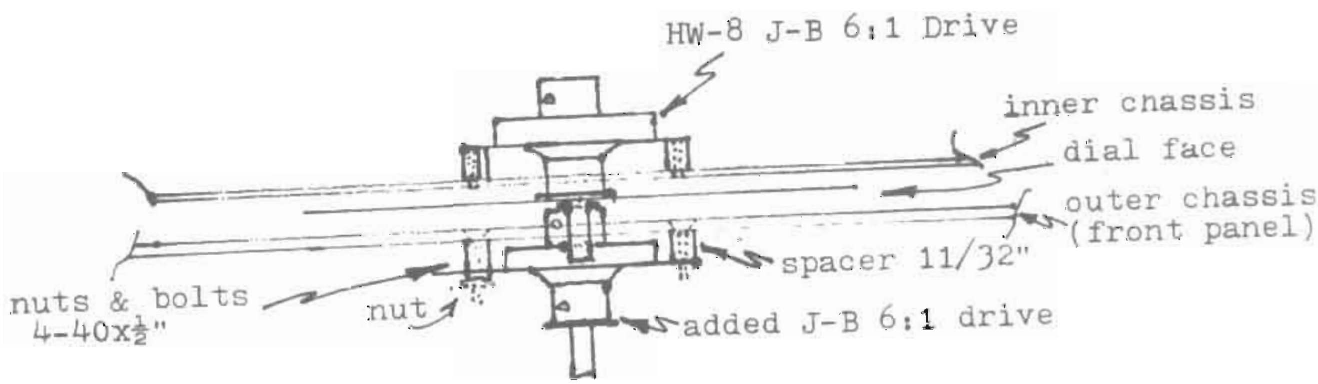
The only drawback is that the new drive is somewhat unsightly on the front panel. I overcame that problem with a 2-inch-in~diameter knob from the junk box. The larger knob also helps the HW-8 feel more like a real radio.

The extra drive was purchased from Heathkit for $7 bucks a few years ago. (Editors note: The drives can be purchased from RadioKit and other supplier of parts.)

First, trim all but 5/16th of an inch from the original shaft so the new one can fit as close as possible to the panel. using the new drive as a template, mark, drill and countersink (from the back) two holes in the front panel for mounting the new drive. Mount the new drive using 4 - 40 X 1/2 inch flat head bolts and nuts and the 11/32 inch spacers. If all is right, the new drive will slide right onto the shaft of the original one when the front panel is reinstalled.

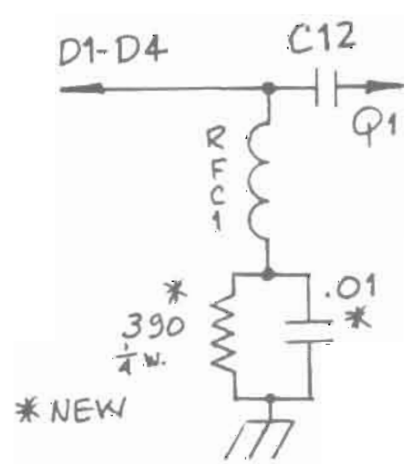
Tighten the set screws, install the knob and you're ready to enjoy extra-slow tuning rates. The only major problem is this mode is possibly mis-aligning the two drives. I suggest marking the front panel for drilling while it is still fastened to the HW-8. That way, the two drives will be coupled when the drilling marks are made.

John T. Collins, KN1H




# Anti-motorboating for the HW-8

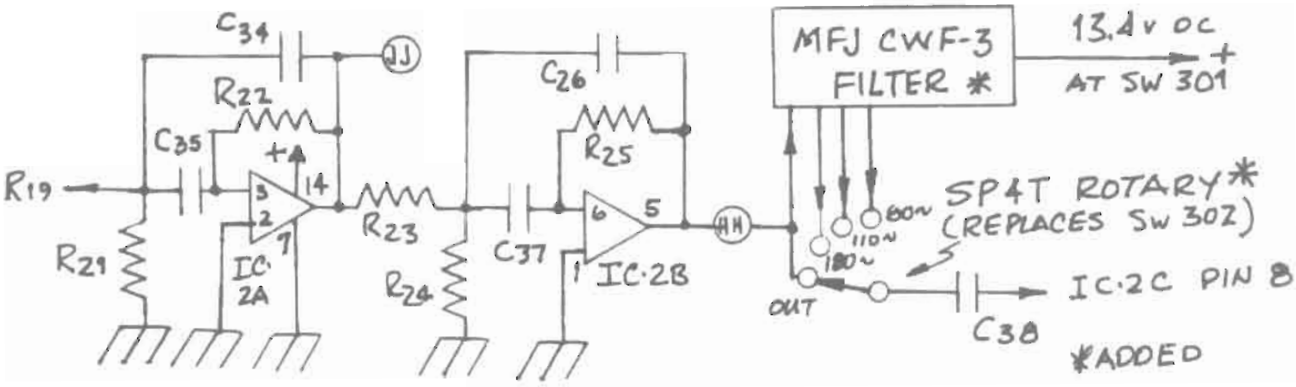
Jim Gray, WOGNV, described a cure for the poor bandswitch isolation that leads to motorboating during transmit. This simpler method accomplishes the same thing but without the bias battery and switching transistor Jim used. The required reverse-bias voltage for D1-D4 is generated by allowing bandswitching current to flow through a 390 ohm resistor. Diodes not selected see 3.6 volts, enough for good isolation. C12 blocks this voltage from Q1.



# An inboard active audio filter for the HW-8

Here is an easy way to add an active audio filter to the HW-8 inside the chassis. You'll need a single pole, four throw, non - shorting rotary switch and an MFJ Model CWF -3 audio filter out of its box. Mount the filter on the rear wall of the HW-8 on 1/4 inch standoffs. Remove SW 302 (the wide/narrow switch from the front panel) and replace it with the rotary switch. Disconnect the three wire cable running from the audio filter on the board to SW 302, and scrap it along with SW302. The output for the new MFJ filter is picked up at the "narrow" point (HH). The old "wide" point (JJ) is no longer is used, and the HW-8 stays wired for "narrow" filtering at all times. Connect the rotary switch to the MFJ filter as shown, with the steps reading out, 180,110, and 80 going clockwise. This provides great selectivity and does not result in boring any more holes in the HW-8 case or panel

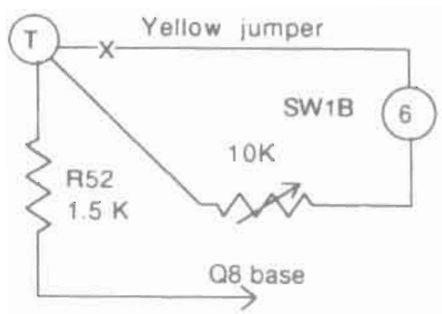
Rich Arland, G5CSU/K7YHA




# A variable drive control

This device allows the HW-8 transmitter output to be varied from zero to full power, without affecting either receiver mixer injection or output loading. It is done by varying the bias on the driver transistor Q8.

First, replace R52 (22K) with a 1.5K resistor. This was determined to be the maximum amount of resistance for minimum output. Remove the yellow jumper wire from point "T" on the circuit board to pin 6 on the 15 meter bandswitch. A front panel-mounted, 10K pot is wired in its place (see diagram). This pot can have a 518th-inch maximum diameter and mounts below the meter and above the switch gang. A larger value pot could be used, but it was found that 10K gave the best resolution. That is, anymore than 10K will not result in greater output.




The recommended location for the pot seems best, since it affords the shortest leads between point "T" and the bandswitch. I did not try other locations, and I suspect instability could occur with longer leads, as there is RF as well as DC in the circuit.

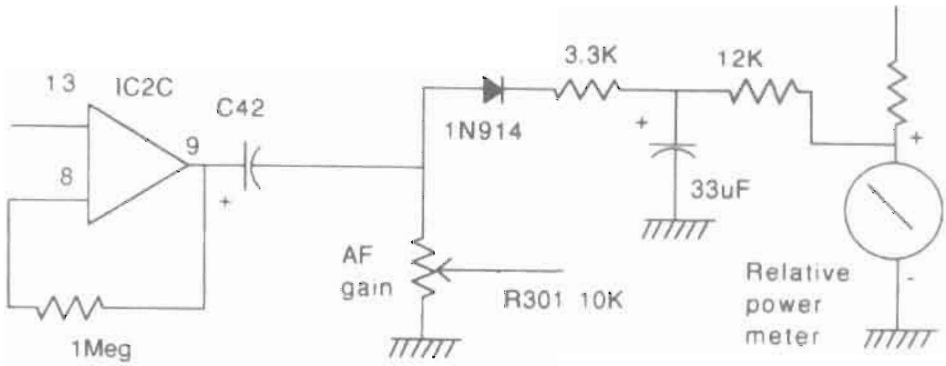
I would suggest to anyone trying this modification that component values be juggled, as I'm sure bias requirements for Q8 vary from unit to unit. Another HW-8 might require the full, original 22K of resistance.

John T. Collins, KN1H

# An "S" meter for the HW-8

This mod makes up for the lack of an "S" meter but does not affect the operation of the meter in transmit. R2 was set to bring the meter near full scale on strong signals.

Kenneth Watters, WB7OVJ




# Laundry list of mods for the HW-8

Richard Arland, G5CSU/K7YHA, and Bob Lusbay, G5EBA/K9FOH, offer the following collection of on-shot and easy modifications, which they say have been worked out over the years to make the HW-8 run smoother:

1). Replace the main turing knob with a larger, heavier knob or metal. The provides more precise tuning and gives a better "feel" to the rig. Ditto for the HW-7 preselector knob. A larger heavier pre-selector knob will allow for more accurate peaking of the receiver front end

2). Although a favorite "mod" for the HW-8 is to replace the RCA "phono" jack RF output jack connector with a SO-239, a better choice would be a BNC jack. BNC's don't have an impedance bump at RF, are smaller and more easily disconnected quickly.

3). I've always liked a ground post on my radios. this can be accomplished by adding a husky bolt with a solder lug to the inside of the back panel to act as a ground post. Scrape the paint away to expose bare metal on the back panel. Add two nuts on the outside to clamp ground wires. Solder a wire from the ground on the HW-8 circuit board to the solder lug on the ground post. Now you can clip on an external ground wire onto your HW-8

4). In order to use lightweight stereo "walkman type" headphones with the HW-8, you can addd a 1/8 inch stereo jack in parallel with the 1/4 inch phone jack. Wire the tip and ring of the stereo jack in parallel to get sound in both earpieces. If you encounter extremely low audio after peerforming this mod, place a 2K:8 ohm impedance matching trasformer between the 1/4 inch phone jack and the stereo jack.

5). Add a 12 VDC miniature light bulb in the back of the meter. Connect one side of thebulb to the nearest ground with the other side going to point "E" on the main board through a 1 00 ohm 1/4 watt resistor. The bulb and resistor are in series.

6). By monitoring either point "C" or point "H" on the circuit board with a high impedance frequency counter yields digital readout for the HW-8. If you have an old counter, what better way to put it to use. Be sure you bypass anyjacks added to the rear panel for the counter.

7). For a built-in dummy load, install a toggle switch on the real panel close to the antenna jack. Remove wire from center pin on antenna jack and solder it to center contact of SPDT switch. Route one side of the switch to the arm of the antenna-changeover relay (RYI). The other side of the switch is soldered to two 100-ohm resis tors in parallel to ground. A flip of the switch provides a 50-ohm dummy load which is handy for transmitter tune-up.

# More HW-9 notes

A friends HW-9 had barely one watt output on all bands. The problem turned out to be a faulty D407 in the electronic T/R switching. In transmit it's biased to keep the output signal out of the receiver, but this one didn't so most of the RF was sucked up by input transformer T404. No damage resulted, although an ampmeter in series with the final collector line showed that it took six watts input to produce one watt at the antenna connector---not especially good efficiency!

I noticed something interesting about the MFR237 output transistors while troubleshooting-the lead configuration is "backward." While most transistors in the TO-39 case have the familiar triangular E-B C pattern, the MRF-237 is C-B-E, as confirmed by the Motorola data book. The case is connected to the emitter rather than the collector. Keep this in mind if you ever think of replacing the finals with another transistor type-you'll have to reverse the leads.

In his HW-9 article in the FEB 1988 issue of 73 Magazine, W0WUZ complained about inadequate heat sinks on the finals, saying the MRF's run hot and "eat up your linger prints without a burp." He said he lost a pair of finals and glued additional heat sinks on the top of the old ones. After fixing the HW-9, I noticed that one of my finals was running near meltclown but the other was stone cold. I checked and found it was burned out. The rig had over half the rated output with only one good final; with two good MRFs it came up a couple watts higher, and both finals then ran at an acceptable temperature with the stock heat sink. The moral here is that if you find one of your finals exceptionally hot, don't automatically assume the heat sink is inadequate. It might just be carrying the entire load by itself.

Mike Czuhajewski WA8MCQ

# VFO dial binding fixes for the HW-9

Bending out the shield lips and experimenting with various locations for spot-soldering eliminated most of the binding. I finally removed the entire shield with no apparent spurious radiation problems Heath confirms the same experience when the shield was removed.

Random VFO drift, both quantity and direction: Leaving the rig on constantly did not help. The drift had a mind of its own. Replaced all VFO components as re-supplied by Heath. Tried my own polystyrene capacitors in the VFO circuit and purchased some new Sprague NPOd6 disc ceramic capacitors, but the problem persisted. I concluded either the coil form and/or the slug was the source of the drift. Poured wax on the slug after setting it seemed to fix the problem.

Editors' note: Check out the other VFO drift fixes in the handbook.

Dick Mcintyre, K4BNI, QRP Quarterly April 1985

## Don't forget to check out the QRP columns in the following magazines

QRP Power by Rich Arland, K7SZ in *QST* magazine
QRP by Mike Bryce, WB8VGE in *73* mazine
World of Ideas by Dave Ingram, K4TWJ, in *CQ Amateur Radio*

# Dial calibration improvements for the HW-9

Install a Johnson 1.4 to 13 pF panel-mounted air variable capacitor on the front panel between the meter and the dial face. (source was Circuit Specialist, part #1 93~04-001). Carefully remove two plates from the rotor and the stator. I used a hobby razor saw for the job. Unless you have a knob that will fit the small shaft, you'll have to build it up to accept a standard 114 inch knob. I used a Radio Shack, blue insert knob which is not only small but attractive . Connect the rotor and stator to point "E" and GND on the oscillator board and in parallel with Cl. Carefully remove the trimmer from the VFO tuning capacitor, Cl. Set your new panel variable to half scale and slightly adjust the slug in the VFO coil, Li 18, to bring WWV 10 mHz or your frequency counter setting of 5.9993 mHz to correspond with zero on the tuning dial. Your panel variable will now compensate for the exact frequency calibration up and down the band.

Dick Mcintyre, K4BNI, QRP Quarterly April 1985

# Frequency calibration for the HW-9

I brought a Ten-Tec model 226 unit which used a 3.2 mHz crystal dividing down to 25 kHz points well into the HF range. I mounted the unit on the bottom side of the right in the area just behind the CW level control. I removed the 6-32 nut adjacent to the audio output coax connector and mounted a threaded metal spacer on the screw from which the nut was removed. The spacer is one inch high and is just right for the calibration oscillator to clear other components. The oscillator PCB is drilled in three places for mounting, and I used the rear hole for the other point of attachment. There I fabricated from PCB a bracket which I glued to the side chassis of the HW-9 and soldered to the oscillator board. Part of this fabricated included two pads to accommodate a 100-ohm, 1/2 watt resistor which drops the 9 volts from the HW-9 to 7.35 volts used by the oscillator. From this resistor I ran a lead to a panel-mounted miniature toggle switch to control the on/off of the oscillator. I mounted the switch on the left side of the meter balancing the aforementioned variable. Use caution in locating the holes for these items are drill carefully to avoid scratching the panel. Since there is an inner chassis and outer panel, I mounted the variable and switch on the chassis and drilled a corresponding hole through the panel through which the switch and variable shaft protrude. From the switch I picked up 9 volts from the green wire rom P101 on the HW-9 oscillator board.

Dick Mcintyre, K4BNI, QRP Quarterly April 1985

# Alternate HW-8 power connection for the HW-9/HW-8/HW-7

What do you do if you want to operate your HW-7/8/9 portable or mobile, away from its matching power supply and plug? You could scrounge up another plug to match the power socket on the ORP rig, or cut the wires off the power supply cable and take the plug along with the rig. Dick Boykin, N3GGP, has a better idea. He mounted a pair of binding posts on the rear panel of his HW8, wired in parallel with the existing power connectors. This allows connection of any 12 volt source without requiring a matching plug for the HW-whatever. It also has the added advantage of making a convenient connection to the 12 volt source when the matching supply is used. These binding posts could also be used to power an external accessory such as a keyer or crystal calibrator.

Dick Mcintyre, K4BNI, QRP Quarterly April 1985

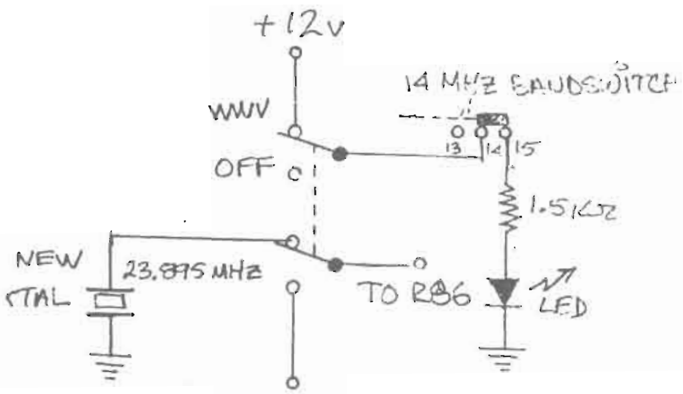
# Zero beat and WWV modifications for the HW-9

A short while after finishing my HW-8, I became disappointed with the way the HW-8 would shift frequency from one day to the next. It almost seemed like it would change about 5 kHz every time I turned it on. So I never really knew where I was at unless I had another receiver to constantly calibrate my HW-8. So I set out to remedy the problem.

First I thought it would be simple to put the 15 MHz WWV into the HW-8 since you only had to shift the 14 Mhz heterodyne oscillator by 1 mHz. Usually the bandwidth and injection level of the heterodyne oscillator have enough overkill to allow the slight retuning to accommodate the 14 and 15 mHz oscillators with no degradation of sensitivity or performance in the transmit mode.

I ordered an experimenter crystal from ICM, (catalog #031310 cut for 23.895000 mHz for about ten dollars.) A DPDT WWV switch and the new crystal soldered on a small PC board, were mounted on the back panel near the heterodyne oscillator crystals. One side of the crystal is connected to the radio ground from the ground foil on the small PC board, through a metal "L" bracket mounted on the back panel. Mare sure you scrape the paint off around the "L": bracket mounting hole, to insure a good ground connection, The foil between R86 and Y3 was cut with a small knife, see figure 2. Two holes were then drilled in these two foil halves, one near Y3 and the other near R86. A wire should be soldered from the center pole of one hall of the DPDT switch to the drilled hole near R86. The new hole near Y3 and one side of the new crystal should also be soldered to the remaining positions of this switch half. The other half of the DPDT switch is used to turn a small WWV indicator LED on. I mounted the LED near the lower right corner of the meter on the front panel. Twelve volts is routed through the DPDT switch through an unused section of the 14 mHz bandswitch, then through a 1.5 K resistor to the anode of the LED, see figure 1.

The heterodyne oscillator is the only adjustment needed to make WWV work. Set the bandswitch and the WWV switch to the 14 mHz position, then measure the RF voltage at TP-1 with an RF probe. The RF voltage on my HW-8 was about .12 volts. Now set the WWV 14 mHz switch to WWV and turn the bottom slug of Li 9121 until the RF voltage measures slightly less than that in the 14 mHz position. This was about 1 or 2 turns on my HW-8. I checked my HW-8 on a communications service monitor and found that there was no degradation of sensitivity on the 14 mHz band with this particular tuning procedure. The sensitivity of the WWV position was also the same as the sensitivity on the 14 mHz band!




The second modification took a lot of time, patience and some intricate work. This modification shouldn't be attempted unless you are patient and are very careful about your work, since tolerances and room for errors are limited. My HW-101 gave me the idea for the zero set modification for the HW-8. Basically the dial plate is changed to work on a clutch system. So when you hold the zero set button down this holds the dial plate from moving thus allowing the tuning capacitor to slip in the dial-clutch assembly as the tuning capacitor is changed.

First I found a small 1" square piece of plastic about 1/16" thick. The plastic needs to be thick enough to that it won't strip out when a small screw is tightened down. See figure 3 for the dimensions of the clutch plate. Three holes were then drilled in the clutch plate equilaterally. The holes need to be at least 5/16" from the center of the clutch plate.

The holes need to be small enough to allow a small screw to be threaded when it is screwed in the clutch plate. Two of the screws used to mount the dial plate to the Jackson drive can be used for the clutch screws. After the holes have been drilled in the clutch, the clutch can now serve as a marking guide for the new holes that will be frilled on the dial plate. The pattern that worked well for me is shown in figure 4. These holes can be slightly larger than those in the clutch plate since they don't need to be threaded. If you make these holes too large it may introduce some play in the dial-clutch assembly.

You should try to remember what position the clutch was in when the dial plate was marked, since the dial and clutch will be mounted together later on.

Next I found a small piece of plastic that I could cut and sand into the shape of a button as shown in figure 5. And old escutcheon may work.

The face plate and Jackson drive should be carefully removed from the HW-8. The dial plate mounting flange on the Jackson drive should be filed down to about 9/16" in diameter, and the hole in the chassis should be expanded to 7/8", as shown in figure 6. I then expanded the diameter of the hole in the face plate to 7/8", and drilled a hole for the zero set button as shown in figure 7. I located the button far enough away from the center of the dial so that the back of the button wouldn't rub on the dial scale and markings. This measurement came out to be almost an 1 1/2" from the center of the Jackson drive. Finally the Jackson drive can be reinstalled in the VFO assembly. Slip the clutch behind the dial mounting flange, then mount the dial plate to the clutch with three small screws. You'll want to make sure the clutch doesn't drag on the enlarged chassis hole. You should tighten up the mounting screw until the dial takes a little bit of effort to slip the dial-clutch assembly on the Jackson drive. You should also make sure the clutch screws don't drag on the dial mounting flange. You can now reinstall the faceplate with the zero set button in place. The clutch screws can be adjusted without taking off the faceplate. You should make sure the screws won't drag on the faceplate hole either. See figure 8 for the completed assembly.

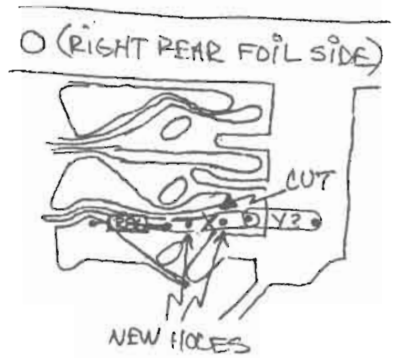
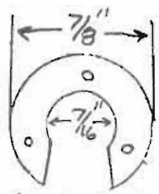
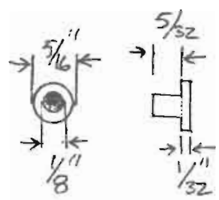


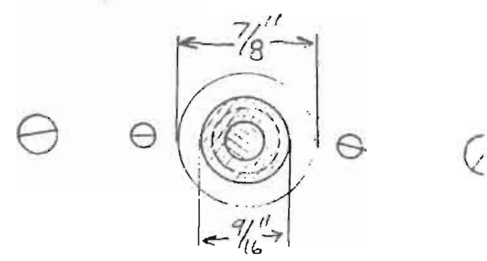
Fig. 2



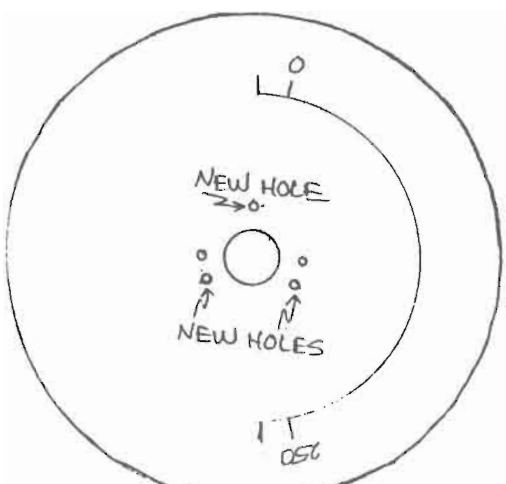
CLUTCH
Fig. 3



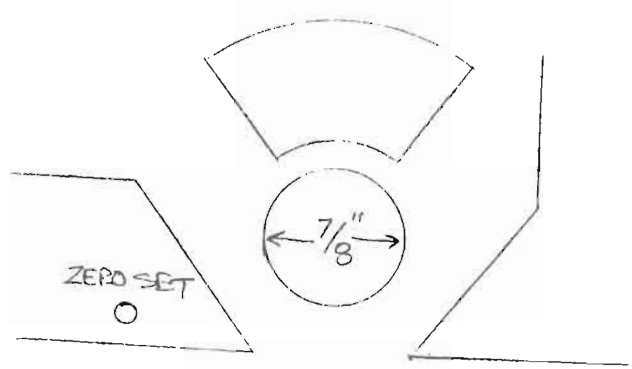
BUTTON
Fig 5.



CHASSIS
Fig. 6



DIAL PLATE
Fig 4.



FACE PLATE
Fig. 7

# Two simple mods for the optimum Performance of the HW-9

**Active AF filter**

The schematic for the HW-9 active filter is not correct in the Heath manual. Both sections of the filter use 1.5 Meg resistors (R354 and R359) and 1000 pF capacitors (C339, C341 C344 and C345) in all versions of the HW-9 that I'm aware of, regardless of the values shown in the schematic.

The resistors appear to be 5% precision units, on the basis of my measurements in the three HW-9's, and are acceptable for use in the filter. The capacitors, on the other hand, appear to be standard disc ceramic units with a plus or minus 20% tolerance. This huge tolerance is not acceptable for use in the filter.

I have found variations of 10% or more in the nominal 1000 pF values for some of these capacitors, as measured with a calibrated General Radio RLC bridge. This much variation in the values of these four capacitors broadens the normally narrow pass band and reduces the gain of the filter. I recommend removal of these four capacitors and replacement with four matched capacitors as close ly as possible to the design value of 1000 pF.

The critical element is matching the four capacitors; they can have values from 950 to 1050 pF, but all should be the same. The center frequency is influenced by the absolute value of the capacitors and the resistors; the sharpness and gain of the filter is a function of the matching of the capacitors and resistors.

You can also check the values of the two resistors. All have been 1.5 Meg within the limits of measurement of my VTVM. Replacement of the capacitors in my HW-9's with units matched to 2% resulted in an increase in sharpness of the filter, and an increase in the filter gain.

# BFO injection voltage to U-303

Low BFO invection voltage to mixer U-303 can produce low audio otuput in the HW-9. After checking several HW-9s, one unit had only 20 uV (RMS) of RF voltage as measure at Test Point 104 (TP-104) This unit also had low audio output. Comparing this unit with another HW-9, one that had normal audio, I measured 650 uV (RMS) on TP-104. If you are experiencing problems with low audio output, I recommend that you check the RF voltage on TP-104 and, if it is under 400 uV, replace Q-114. IF this voltage is still low, then replace Q112. By insuring at least 400 uV, is present on TP-104 is good conversion gain is realized in mixer U-303

Herb Ley, N3CDH

# Better HW-9 heatsinks

When I was clearing out the parasitics in the final circuitry I noted that the finals, Q405 and Q406, ran a bit hot and I started looking for some way to cool them. The results was removal of the two-fin sinks supplied with the kit and installation of larger three-fin heatsinks. One of the original sinks was moved to Q404.

All the heatsinks are coated with heat sink compound. I figure about a 25X improvement in heat dissipation. Since I did no tests or measurements, this figure is estimated from the thermal resistance shown in the catalog, which came from, the Phillips Semiconductor Replacement Master Guide ECG21 2P.

Some mechanical work is required to make these ECG4O1 heatsinks fit the space. I filed down the edges of both sinks to clear coil T403. For sufficient shaft clearance, I also filed a bit off the bottom of one sink and checked rotational clearance before applying heat sink compound, a small tube of which is available under catalog number EC303. Radio shack also sells something close for a couple of bucks.

Jack Cleary, WN2Q QRP Quarterly October 1990

# Does HW-8 - 20 meters +$10 = 30 meters? You bet!

How about a conversion for your HW-8 that will get it on 30 meters for $10 (more or less) at the sacrifice of only 20 meters? Such a deal!

This is a very simple modification that requires only a new crystal, a handful capacitors and less than one hour's time to get your HW-8 on the new 30 meter band.

The first thing you need is an 18.895 mHz crystal (.005% tolerance, HC6/U holder, 30 p loading). You'll also need some small capacitors. Since they are in RF circuits, use silver micas, polystyrene or NPO ceramics.

My reason for dumping 20 meters in favor of 30 meters are two fold: First, the heterodyne oscillator and other circuits which have to be repeaked can be easily changed by simply adding capacitance in parallel on the foil side of the PC board. Second, the final amplifier -low pass filter, as designed by Heath for 20 meters falls, within the range for harmonic reduction for 10 mHz.

1). Wire a 47 pF capacitor in parallel with C121 on the foil side of the board.

2). Replace crystal Y3 with your new 18.895 mHz rock.

3). Peak L19 as instructed in the HW-8 manual.

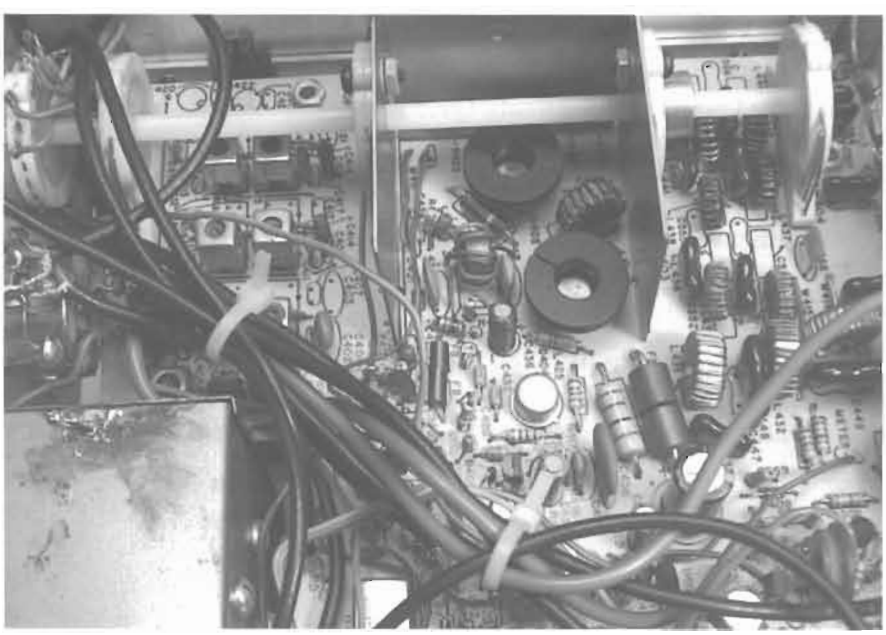
4). Add a 100 pF in parallel with C68 in the mixer amplifier.

5). Peak Li 5.

6). In the RF amplifier, parallel C22 with a 37 pF capacitor. Parallel C7 with 68 pF When you adjust C7, a definite signal peak will be heard. However, if this occur with C7 fully meshed, more capacitance will have to be added until you have a nice tuning adjustment.

7). C104 in the final amplifier must be paralleled with an additional 10 pF. Adjust C1( for maximum output.

Southwest QRPer, March -April1983



Inside the HW-9. Here's the two final transistor hiding between the wafer switches. The output filter cores are located just to the right of the two transistors.

# Fixing a dead HW-8

I picked up an HW-8 at a very good price because it was inoperative on all bands. The problem was that the heterodyne crystals were mis-tuned and thus dead. Everything worked fine after aligning them, but a tew difficulties cropped up along the way.

The 4 crystals are tuned by coils L17, 18,19 and 21, which are located in aluminum shields, two coils per can. The design is such that the business end of the tuning tool must be passed through the top slug to tune the bottom one. Since I didn't have the proper tool, with a cut-away shaft, I had to remove the top slugs to tune the bottom ones, then reinstall and tune them as well. Although the coils don't have to be tuned very often, it's a real pooper as WB8VGE would say, to have to tune two when only one really needs it. Also, the stress of removing and replacing the tops slugs increases the chance of them breaking. To get around the problem, I drilled holes in the circuit board underneath the coil cans, so the bottom slugs can be reached directly from the underside without removing the top one.

First, remove both coil cans from the circuit board to prevent damage when the holes are drilled. To position the drill accurately, I drew lines between the existing holes in a " * " pattern to hit dead center. I used a a 1/8 drill bit, although any similar size is OK as long as it allows the tuning tool to pass. Unfortunately, there are a total of three circuit traces which run through the center of the coil footprints, carrying voltages for some of the bandswitching diodes. They will be severed when the holes are drilled. Continuity is then restored with pieces of wire soldered onto them, routed to avoid the holes.

Although the alignment instructions for the HW-8 say to insure the bottom cover is in place before doing any adjustments,it didn't seem to have any significant effect on the heterodyne oscillators. I adjusted all four tuned circuits with the cover off, to allow access to the bottom holes, and noted the power output. I replaced the cover and still had full power. However, if you prefer, you can drill holes in the bottom cover as well to allow adjustment with it in place. (To align the holes, place the cover on the HW-8 before putting the coils back on the circuit board, and stick a pen or scribe through the center holes to mark the locations on the cover before drilling.)

The cores in these coil forms are smaller than the others in the HW-8 and more fragile, especially with old age. A problem that occurred during tuning up the rig was the core for the 15 meter coil cracking after I turned it a bit and it could not be moved any more. The basic inviolable law of universe that says any failure will be at the worst possible time and/or in the most inconvenient possible manner has a corollary stating that when a coil slug freezes in place for the rest of eternity it will be nowhere near resonance. I tried various methods of removing the fractured core from the form, but none worked. I considered throwing away the entire form, replacing it with one scrounged from my considerable supply of old TV circuit boards and winding the appropriate number of turns on it for both coils. I would probably have been able to find cores with the proper permeability in the TVs too, but I eventually discarded this idea. Next I considered using toroids (T-6 material) and trimmer capacitor mounted on a vertical scrap of circuit board material to get rid of the coil form entirely. It would not have been necessary to trim and fit it inside the aluminum can, since toroids are self-shielding, but mounting the board could be a problem.

Although either of these two methods would have solved the problem, what I finally did was to remove the 24 pF mica capacitor across the coil, Cl 23, and replace it with a small 6-35 pF ceramic grimmer. It tuned nicely in the middle of its range with the core stuck where was. Depending on the location of the core, and thus the inductance of the coil, it might had been necessary to add a small fixed capacitor in parallel with it. A larger trimmer could also be use, but physical size would be a limiting factor. The same technique of adding trimmers can be used with the coils for the other bands as well, although the mica capacitors are large so a fixed capacitor of some value would have to be used along with the trimmer to tune them. The exact value would have to be determined experimentally, since the inductance the coil could vary widely depending on where the core froze in place.

To make room for my particular trimmer to fit flush against the board, I found it necessary to remove the lOOK resistor located right next to Cl 23. I relocated it to the foil side of the board, and clearance between it and the cover was more than adequate. Another thing, keep in mind is that both sides of the trimmer are above ground, so you must be careful not allow it to touch anything.

Michael Czuhajewski, WA8MCQ

# HW-9 frequency stability

Denton Bramwell, K7OWJ, gave me a tip about the HW-9 frequency stability that my be helpful in some cases. He said that at one time, unknown to Heath, the manufacturer of the VFO coil suddenly started coating the winding with epoxy. This can contribute to frequency drift since stress is placed on the wire by the curing epoxy.

One of the standard tips for improving stability is to relieve stress on the wire in the VFO coils by boiling them or baking the entire assembly briefly in an oven at low heat.

Denton's method for relieving the stress, which is much more practical for a complete unit, is to get the coil good and hot with a hair blow dryer, let it cool, and then repeat two or three times. This might help reduce the drift in those units which had the epoxied coils and may help other HW-9's Denton reports the manufacture later stopped using epoxy.

Mike Czuhajewski, WA8MCQ,

# Another HW-9 drift fix

Diode junction capacitance varies with ambient temperature levels and I wondered if this characteristic could be used to compensate for the HW-9 VFO drift. Mine has a positive drift of about 3 kHz over an eight hour period. Not critical, but bothersome.

To experiment, I connected two 1 N914s back to back and soldered them across variable capacitor Cl (point "E" and GND.) I then zero beat the receiver on WWV 10 MHz. After eight hours, the drift was barely discernible and occurred mainly in the half hour warm-up period. This procedure will shift dial calibration which can be reset by adjusting VFO coil, Li 18. I did not check other diodes and different pairs may have to be tried to match my results.

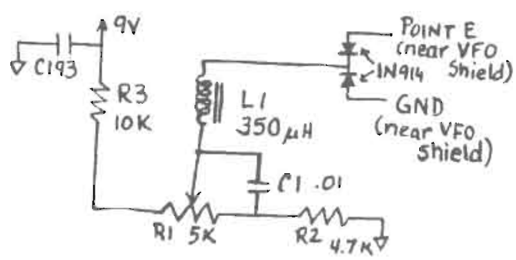
Dick Mcintyre, K4BNI QRP Quarterly January 1989

# A tailored dial for the Heath HW-9

While operating my HW-9, I noticed that, at some dial settings, the rig was not tuned to the frequency indicated by the dial. Realignment of the VFO, carefully following Heath's instructions didn't help. For example, it was difficult locating WSN (7040 at 1700 Z Saturdays) for check-in. My HW-9's VFO error was mostly due to a difference between the "tuning curve" defined by the dial markings, and the actual tuning curve of the VFO. I recommend that you install a 100 kHz calibrator. (see Larry East's modification, Editor)

See figure 1. First, I installed a dial zero set control, R1. The back-to-back diodes were recommended by K4BNI. The balance of components functions as follows: R1, the dial zero set control, is a Radio Shack 5 K pot which I mounted through the front panel to the left of the meter. R2 keeps R1 from loading down the VFO, preventing oscillations. R3 limits current drain on the 9 volt supply. L1 (Radio Shack # 273-1601) keeps the VFO signal out of the regulated 9 volt supply. Cl is also from Radio Shack, # 272-1065.

The source of the 9 volt supply is the right lead of C193; I hooked one lead of R3 to it, and soldered it around the capacitor lead. Install Li on a short terminal strip, to the right of the VFO shield. Install C1 at the rear of R1.




Adjustment of R1 from the front panel permits swinging the VFO frequency several kHz, permitting adjustment of zero-beat to coincide with the dial markings. After installation of the dial zero set control, readjust the VFO alignment to put the zero point back to its proper position (adjust L118).

One unexpected result of installing the dial zero set circuit was the virtual elimination of VFO warm-up frequency drift. CI was left in the circuit after the installation of R2. Drift will occur, however, if the ambient temperature changes, as in outdoor operation during variable cloudy conditions.

To make a dial with markings which correspond to the actual tuning curve of the VFO make sure the dial zero set control is set to mid-range, and remove the front panels knobs Carefully draw a index mark on the front inner panel, directly behind the red index line used to read the dial. Remove the outer front panel. Make certain the dial is set to zero, and note how the mounting screws holes are positioned with respect to the inner panel.

Remove the tuning dial, and drill two mounting screws holes in it, at 90 degrees from the original pair. Using 400 grit sandpaper, lightly sand the white surface on the dial back. Next use a compass and #2 pencil to draw two circles concentric with the dial center, with a radii of 1-13/32 and 1-7/32.

Reinstall the dial, white side forward, positioning it as before with respect to the limit stop cut and the limit stop screw.

Using a frequency counter or a crystal calibrator, slowly turn the tuning shaft clockwise and make a tick marks every 5 kHz around the outer edge. Remove the dial, and mark with pencil lines 5 kHz intervals, placing longer lines at 10 kHz, and the longest lines at 50 kH; points. Remount this "tailored dial" and reinstall the outer front panel and knobs.

You are now the proud owner of a tuning dial with marking which conform to the actual tuning curve of your VFO. If you need to adjust the dial calibrations points to re-zero the dial, set the dial to a calibration point and adjust the dial zero set.

Frank Allard, WB7O QRP Quarterly July 1990

# HW-9 audio notes

I've been cursed with a number of problems with my HW-9 and haven't solved them all yet.

I installed the QST article mods (April 1988) directly on the existing PC board by scraping the resist off the copper in the area I was working, cutting extra pads with a scalpel and a pad cutting bit. I drilled holes with a hand held pin vise. Soldering components flush against the back side of the board or instant glue standoff insulators on the top took care the rest.

The thump suppressor works great, especially if you hand select a gate bias resistor, as suggested in the article. The filter works well too. The trick here is to use well matched components and 1% resistors, if you can find them. I also replaced the headphone jack with a 1/8" stereo jack, so I can use walkman style headphones. Most of these headphones aren't 8 ohms, but are close to 40 or 50 ohms. So, if you put a resistor in series with the amplifier output to each of the channels, when you plug in mono headphones you will load the output with a resistor instead of shorting it. Any value between 39 and 75 ohms should work well. The trade off being the audio output varies when using mono headphones.

My first problem was spurious receiver responses on 40 and 80 meters. Backing off the HFO level (R173) helped quiet the reverse tuning shortwave broadcast birdies on 40 meters, but not the AM broadcast birdies, which were worse on 80 meters and downright disastrous when using an end fed wire. Being about five miles from three 50 kW AM stations doesn't help!

I tried cutting D406 out of the circuit, but that didn't help. Then I figured it was most likely D403, D404 and D407, which are all small signal silicon diodes being used in the T/R switching duty. Not having any PIN diodes available at the time, I tried the old standby of using high voltage rectifiers as sloppy bulk effect. I used 1N4937s and this helped some. I would suggest that you try the following first, since I think they make much more of a difference, unless you have some PIN diodes. Don't try putting a high pass filter in the antenna line, though; I did and it does a great job of sucking out virtually all of the transmitter output.

There is no need to improve the nose figure of the rig at low frequencies, so try replacing C443 with a 1000 pF. This will attenuate BC signals a lot. If this does not help you, you need to increase the standing current through the diode's "on" time. This will cost you a few extra mils of current during receive, but this is probably not critical.

Replace R423 with a 1000 ohms and, to keep the bias points about the same, also change R401 to 2200 ohms; If you still have some problems you can further increase current by not sharing the path with D407. Remove W417 and replace it with a 1 K resistor series with a small RF choke. I used a 68 uH unit I had. (W417 feeds the junction of C442 a D407 from the junction of R423 and L427) Put heat shrink tubing over the pair and solder them on the bottom side ot the board to get around the shield walls. It you still have a problem, use a balanced antenna.

Another problem has been high band transmitter instability, which is still there, even after trying a lot of published and homebrew fixes. However, some of the following have helped some and might fix your problem.

Try damping the Q of T403 by bridging it with 220 ohms. Then parallel L426 with 100 ohms or less. Since T402 provides a DC return for the base, once you get down to about 51ohms you can just take out out L426 and use the resistor alone. By the time you get down to about 39 ohms, you may not have enough drive left. At this point, rewind T402 for a higher turns ratio-(8:3 seems to work well) until you get below 20 ohms, although you can still make 2 watts output with even 15 ohms.

Marc Ressler, K3NCO, QRP Quarterly, July 1990

## Dial lights for the HW-9

After staring into its cold, dark front panel for months, I finally added dial lamps to HW-9. While lighting the meter is a simple matter of gluing and taping a bulb to its back, (Editor's note. Unless John's meter is of a different lot than other meters for the HW-9, then are painted and you can't get a light to shine though) light the calibrated dial requires careful work. Here is how I did it.

After removing the top, bottom, front panels, and the dial, I applied masking tape to back of the inside front panel. I turned the chassis upside down on the work bench drilled a small center hole at slow speed with a hand drill. This hole was enlarged to 3/8" and then to 13/16" with a chassis punch.

Two 6 volts, 2 mA bulbs, (Radio Shack #272-1140) were then connected in series and I centered one within the punched hole. The dial lamp is held in place with tape; a bit of fast drying glue applied to the insulation secured the meter bulb in place. To reflect light forward, the back of each bulb was painted white. Two pieces of white graphic tape cut 3/4" X 2" were then taped to each bulb to add support and reflectivity. Lining the tape with aluminum foil enhanced the front lighting. The results are dramatic and well worth the work. It's just like old time radio! And thank goodness, no more squinting into a dark front panel while chasing elusive DX on a cold winter nights.

John F Cleary, WN2Q, QRP Quarterly July 1990

# Super RIT for the HW-8

A number of years ago I added Receiver Incremental Tuning (RIT) to my Heathkit HW-8 under the direction of a magazine article.

Having a minimum understanding of direct conversion receivers, I operated my HW-8 for several years without any transmitter offset. I thought the RIT modification I installed worked just like the RIT controls on superhet rigs. The operator normally used the RIT control only when he needed to track the transmitting station. Little did I know I always needed the RIT to provide a transmit offset. After learning about direct conversion receivers, transmitter offset, and proper tuning procedures, I improved my RIT circuit so it provided an offset when set to zero position.

My super RIT goes one step beyond ordinary RIT controls, as it allows sideband switching without retuning. This greatly reduces QRM in direct conversion receivers, as an interfering signal may not be present in the opposite sideband. This modification requires a frequency counter to accurately adjust all the offset frequencies.

Understanding the HW-8's original offset circuitry helps one comprehend the Super RIT design. Originally the transmit offset is produced when D11 is forwarded biased via R36, adding C55 to the oscillator circuit.

In the Super RIT circuit, a varactor diode replaces D11 and C55 is increased to provide sufficient oscillator swing for lower and upper sideband operation. Different voltages are placed on D1 depending on which sideband is used, the position of the RIT control, and whether or not the HW-8 is in transmit mode. Furthermore, R36 is increased to provide more isolation between the RIT circuit and the VFO.

During transmit, Q1 saturates, thus impressing emitter voltage on D11 via R36. R3 and VR2 form a simple voltage divider for this voltage. During receive the voltage on D11 is obtained from another voltage divider (R2, R4/RVR1, and the R5+VR3/VR4 network). This voltage depends on the RIT control (VR1) and the sideband switch. The sideband switch selects a different voltage leg in the divider (R5 and VR3 or VR4). R4 limits the voltage across the VR1, determining the RIT frequency range. R7 provides isolation between the RIT and the transmit voltages. R1 and D1 regulate supply voltage to 9.1 volts, improving oscillator stability.

### Construction

Replace D11, C55 and R36 with the values given in the parts list. Locate the wire connected to R36, labeled point "B" on the HW-8 circuit board and schematic. Remove the end of the wire connected to point "K" on the circuit board. Solder a .01 mF capacitor from point "B" to ground on the underside of the main circuit board. The RIT control can be mounted in place of the selectivity switch on the front panel. The sideband switch may also be located on the front panel; I placed mine to the upper right of the loading control.

Place the remaining parts on a small circuit board. Note that the three trimmer potentiometers (VR2, VR3 and VR4) should be ten turn potentiometers to minimize resistance changes, and to insure accurate calibration. Mount the RIT circuit board close to the RIT control and VFO circuitry. Connect 12 volts, ground, RIT control, sideband switch and the wires from "K" and "W' (CW key, grounded on key down) on the main circuit board to their proper places on the RIT circuit board. The Super RIT mod in now completed!

### Adjustment

For linear operation, Super RIT must operate in the linear region of the graph, between +3 and +5 volts. While transmitting, adjust VR2 for 4 volts on the collector of Q1. Measure the local oscillator output by attaching a high impedance frequency counter to TP-2 (Q5 emitter) on the main circuit board. Adjust the VFO while transmitting to 7.040000 MHz on the counter. Set the sideband switch to USB and the RIT to the center, or zero position. Adjust VR4 for a reading of 7.040800 MHz. Key the transmitter and verify that the counter reads 7.040000 MHz. Set the sideband switch to LSB. Adjust VR3 for a reading of 7.039200 MHz. Key the transmitter again and verify a reading of 7.040000 MHz. Repeat these adjustments until all three readings have been verified. Now the RIT control should be rotated to its stops in both directions to verify that a linear variation of the RIT control causes a linear change in oscillator frequency.

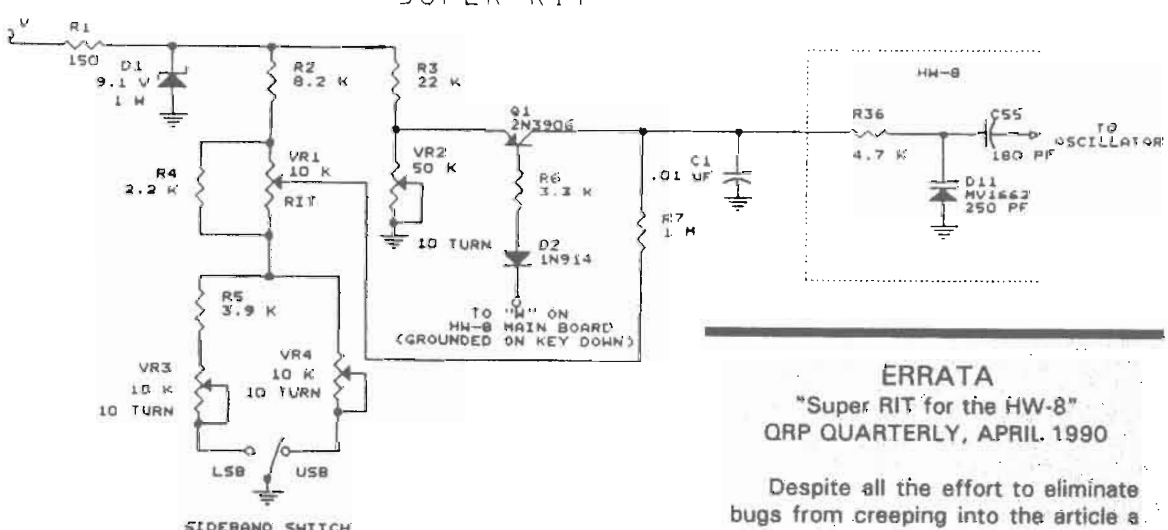
### Operation

Adjust the RIT control to zero position. Zero beat the transmitting station by tuning the VFO until an 800 Hz tone is heard. Tune to the sideband at which the sideband switch is set, or proper zero beat will not occur. If increasing the VFO frequency increased the pitch, the operator is tuned to USB. If decreasing the VFO frequency increases the pitch, the operator in on LSB. Once "netted" or zero beat with the transmitting station, the operator can instantly copy the other sideband with a flop of the sideband switch to avoid QRM. The RIT control can be adjusted to track the transmitting station.

The R2 and R4 voltage divider sets the range of the RIT control. (with the specified value of R4, the RIT range is ~800 Hz.) This range can be increased by increasing the resistance of R4. R2 should be decreased by the same amount that R4 was increased in order to maintain the 10K total resistance of the two resistors.

Rulon VanDyke KA 7BCD

SUPER RIT




**ERRATA**

**"Super RIT for the HW-8"**
**QRP QUARTERLY, APRIL 1990**

Despite all the effort to eliminate bugs from creeping into the article a vicious bug wedged its way into the schematic and parts list. The transistor bias resistor R6 should be a 330 Kilohm instead of the 3.3 Kilohm indicated in the schematic and parts list. Proper transmit bias voltages cannot be achieved at the collector of Q1 with the original value of base resistance. This low resistance changes the R3/VR2 voltage divider ratio by effectively adding a low resistance in parallel with VR2.

I deeply regret and apologize for any inconvenience and frustration created by this bug.

- Rulon VanDyke, KA7BCD

# 160 meters for the HW-8

One of my favorite bands has always been 160M. It is a good band when the static and noise are at a minimum, during the winter months. To convert the HW-8 for 160M follow these simple directions:

1. Replace Y1 with a crystal cut for 10.695 MHz. This puts the band edge at " 10" on the dial.
2. Replace C116 with a 150 pF capacitor.
3. C64; Add a 400 pF in parallel on the foil side of the PCB.
4. Replace Cl with a 560 pF capacitor.
5. Replace C15 with a 330 pF capacitor.
6. C78; Add a 330 pF in parallel on the foil side of the PCB.
7. L22; Remove all turns on the toroid and rewind with 34 turns of #32 wire and add a 230 pF in parallel with L22 on the foil side of the PCB.
8. Replace C94 with a 470 pF capacitor.
9. C96; Add 470 pF in parallel on the foil side of PCB.
10. C97; Add 680 pF in parallel on foil side of PCB.
11. C303; Add 220 Pf in parallel, which is switched in when 160M bandswitch position is depressed. A. Connect one end of the 220 pF cap to C3031R304 junction. B. Connect the other end to pin 14 of the bandswitch. C Jumper a short lead between pins 11 and 15 of the bandswitch.

For maximum performance in the CW segment of the band, set the tuning dial to 40 (1.840 MHz) and allow the set to warm up for 30 minutes. Realign the 160M circuits following the 3.5 MHz instructions in the Heath manual. Transmitter power is 2 watts out.

By doing this mod, you'll lose the 80 meter band.

Bob Fowler, G3IQF, Sprat

# Filter mods for the HW-9

The HW-9 has proven to be a very able and welcome successor to the HW-8. I had identified a few areas in which the HW-9 could use some improvement. Apparently I'm not alone, for there have already been a number ot modifications articles published for this rig.

My first area of concern was the IF crystal filter. This is a CW only rig, so I expected a good bit of selectivity in the IF. I was disappointed to discover that the filter had a very broad passband. Broad enough in fact that SSB signals were easily copied. Even with the narrow audio filter turned on, a strong CW signal outside of the audio passband , but inside the IF passband, would pump the AGC and make it difficult to copy the desired signal.

A call to Heath brought a new filter, but no change in performance. I peeled open the original filter and found it contained two three terminal devices that were later identified as monolithic resonators. Referring to Hayward's article in QST, I reworked the capacitances around the resonators and was able to narrow the bandwidth of the device, but dure to the characteristics of the resonators, I always came up with a passband that had two distinct peaks, separated by about one kHz.

Feeling that I had reached the limit of my knowledge, I decided enlist Wes' help. He very graciously agreed to look into the situation. I sent him the old filter plus a schematic, and the results were just short of dramatic.

The filter, as it turns out, is fairly broad and not very well terminated. Wes' measurements showed that it has a bandwidth of about 3kHz with no way of making it into a cw filter. To quote his letter to me, "It is, however a reasonable filter to use in a simple SSB receiver or transmitter... Don't throw the filter away, but don't use in in the HW-9".

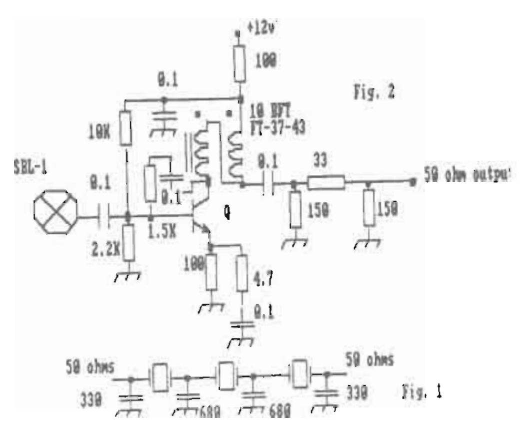
Wes then obtained three 8.83 MHz crystals, and with the help of his computer model, transformed them into a real cw filter, seen in Fig. 1. Very conveniently, the filter uses standard values of caps, and has 50 ohm end terminations. The 3 dB bandwidth is about 450 Hz, with good steep skirts, making it a real fine CW filter.

Another problem area in the rig is the IF amp which follows the diode ring mixer and precedes the crystal filter. This amp must provide a proper termination for the mixer, and the JFET chosen for the job won't do this. A better choice is a bipolar transistor with high standing current and heavy negative feedback, such as the one it Fig. 2. Wes has used this circuit successfully in other applications, such as the Progressive receiver, November 1981 QST. A 2N3866 will do well in this circuit, but needs a heat sink because of the fairly high standing current (50 mA or so). I had to reduce the value of the 100 ohm resistor in the schematic to 47 ohms to get the 50 mA standing current.

I etched a small circuit board to hold both the amp and the filter. After removing all the unneeded parts from the main transceiver, RX-TX circuit board between the SBL-1 and the IF chip, I mounted the new filter board just above the main circuit board, suspending it on its power and signal leads. Power is provide by picking off the +R voltage at the point where L304 use to be. It was necessary to do a little experimentation with the value of the capacitors in the BFO to get the passband of the filter back to where it should have been. W7ZOI suggests building a separate oscillator so that one can be used for the BFO and the other for the offset oscillator for the transmitter. I chose rather to stick with the Heath method of using one oscillator to do two jobs by pulling off frequency when the rig is keyed. It may be easier to build the separate oscillator to more easily obtain the correct offset for transmit.

After installing the new filter and post-mixer amp, I noticed a very distinct improvement in the receiver. The IF now has a true CW passband, and with the audio filter switched in, the selectivity is on par with that of some much more expensive commercial gear.

In addition, the op-amp used in the audio filter is an LM-324, which used a class B output in each section. A 2.2 K resistor to ground from each output will force it into class A, thus reducing any cross-over that may occur under some circumstances.




Cam Hartford, N6GA QRP Quarterly

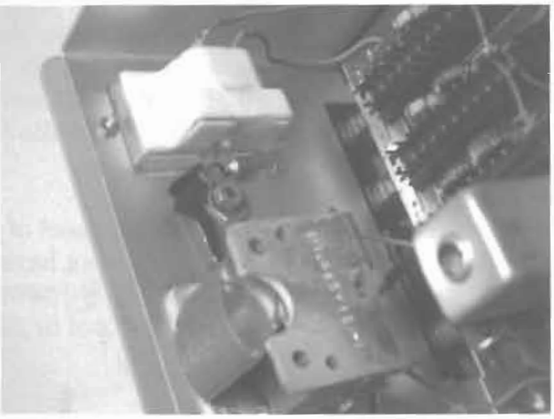
# Dial light for the HW-7

Here's a modification that's simple, yet this the first one I've ever come upon.

Here a small light bulb is inserted into a hole that is just big enough to hold a rubber grommet. When the radio is turned on,the light puts a bright "spot" right on the dial hair line and the plastic dial. Really looks nice.

Notice how the wires to and from the light are kept from the VFO's capacitor.

From an unknown ham... picked up radio at a hamfest. Mike, WB8VGE



In the same radio, another light is placed to the edge of the meter. Again, when the lights are on, the effect has a nice warm look to it.

# No holes dual RIT for the HW-8

Editor's note:

*When Tom sent these three mods to me, I had planned to redo the schematics with the CAD program. However, since they are rather complex, the thought of me adding to the errors was enough to cancel my redrawing idea. So, having said that, here are Tom's modifications for the HW-8 as he submitted them to me. Enjoy!*

On FD in June, 1977 my buddy Pete Morrison,then VE3AYL, commented while frantically twisting the RIT pot on my PM3A to the other side of zero beat, "Instead of RIT, this rig needs dual offset and a toggle switch so I could switch instantly." I said, "I will do better than that. I will give you Dual RIT." In October, 1977 I added a second RIT pot and a toggle switch. It worked so well for dodging audio image QRM for both casual operation and contesting that I have since installed Dual RIT in two Century 21 xcvrs and my HW-8. One year I worked 194 stations on FD with the PM3A modified for Dual RIT.

I call my HW-8 the HW348DR because in addition to the Dual RIT, I put in a new tuning capacitor with a 3 to 1 gear drive driven by the existing planetary drive. It now tunes 290 kHz at 33 kHz per turn of the new knob that once graced a BC348 receiver. I use concentric RIT pots. If I had done this modification when Heathkit was still in business, I probably would have ordered replacement RF and audio gain pots and knobs from Heathkit. That would have been very handsome. As it is, it looks pretty good with a new hand-calibrated dial in kHz divisions over 1.5 turns that is drawn on a stick-on label sheet applied to the reverse side of the original dial plate.

I noted that there was a very ingenious mechanical dial calibration modification in the HW-8 Handbook. However, I decided it would be easier to recalibrate electrically. So I added a second varactor diode with the dial calibration pot mounted on the back panel of the HW-8. Using a second varactor diode eliminates the interaction between the RIT pots and the Dial Reset pot that would occur if they both were in the same DC circuit.

Once I had added Dual RIT, I worked Neal, N4HAF, who said he thought at first that I was a Cuban with my QRP signal and my distinct chirp. Assuming this was not a compliment, I added 1N756 zener diodes across R81, R84, R87, and R91. Note that I did not remove those resistors as suggested in the HW-8 Handbook. I believe that having the resistors there will make the back bias on switching diodes more definite. Anyway, this modification regulated the voltage to the heterodyne oscillator and to its switching diodes, thereby removing the chirp. When I tuned up the heterodyne oscillator and the transmitter chain, I found that I was able to get the 80, 40, and 20 meter oscillator frequencies within 1 kHz of ideal. Only 15 meters was off it could be corrected with my varactor diode calibration circuit.

Again following the HW-8 Handbook, I added a 390 Ohm resistor between RFC1 and ground in the diode-switched tuning circuits for the RF amplifier. This adds a back bias to the off diodes of 3.6V so that motor-boating is avoided. Note that I did not put a capacitor across the 390 Ohm resistor because RFC1 keeps most of the RF away from it anyway.

Because I had a 2-stage 750 Hz audio filter in my junk box, I added it to the HW-8. I used three double-throw toggle switches to select 4 or 2 or 1 audio filter stages. These miniature switches were carefully (!) mounted just below the upper edge of the front panel. Do not make a mistake when drilling these holes. The toggle switches are actually mounted on the inner panel and only the toggles pass out of the front of the dress panel. Note that the RIT/ZIT switch is a DPDT. When in ZIT, one half disables the RIT circuit and the other half connects to the output of the first audio filter. This makes it easy to hear the zero beat.

Actually, I don't tweak the Dual RIT pots much during normal operation. They could really be on the back panel of the HW-8. Replacing the existing selectivity switch with a 6PDT switch (5 positions used) means that you will not have to drill any new holes in the front panel of the HW-8. The Dual RIT circuit shown titled "No Holes" Dual RIT is essentially the same as that which I use in my current TT C21 Digital. Note that one-half of the switch selects the RIT pot or ZIT and the other half chooses the number of audio filter stages.

The third Dual RIT circuit titled "NIB" HW-8 Dual RIT is the circuit which I am proposing for my friend, Tom Curtola, VA3TY. He will shortly be building a 25 year-old HW-8 kit that I bought new in 1977. Even though I never put it together, I long ago drilled the 3 holes across the upper part of the panel for miniature toggle switches. So I am recommending that he mount the toggle switches and the 6 position switch on the front panel and the RIT pots on the rear panel.

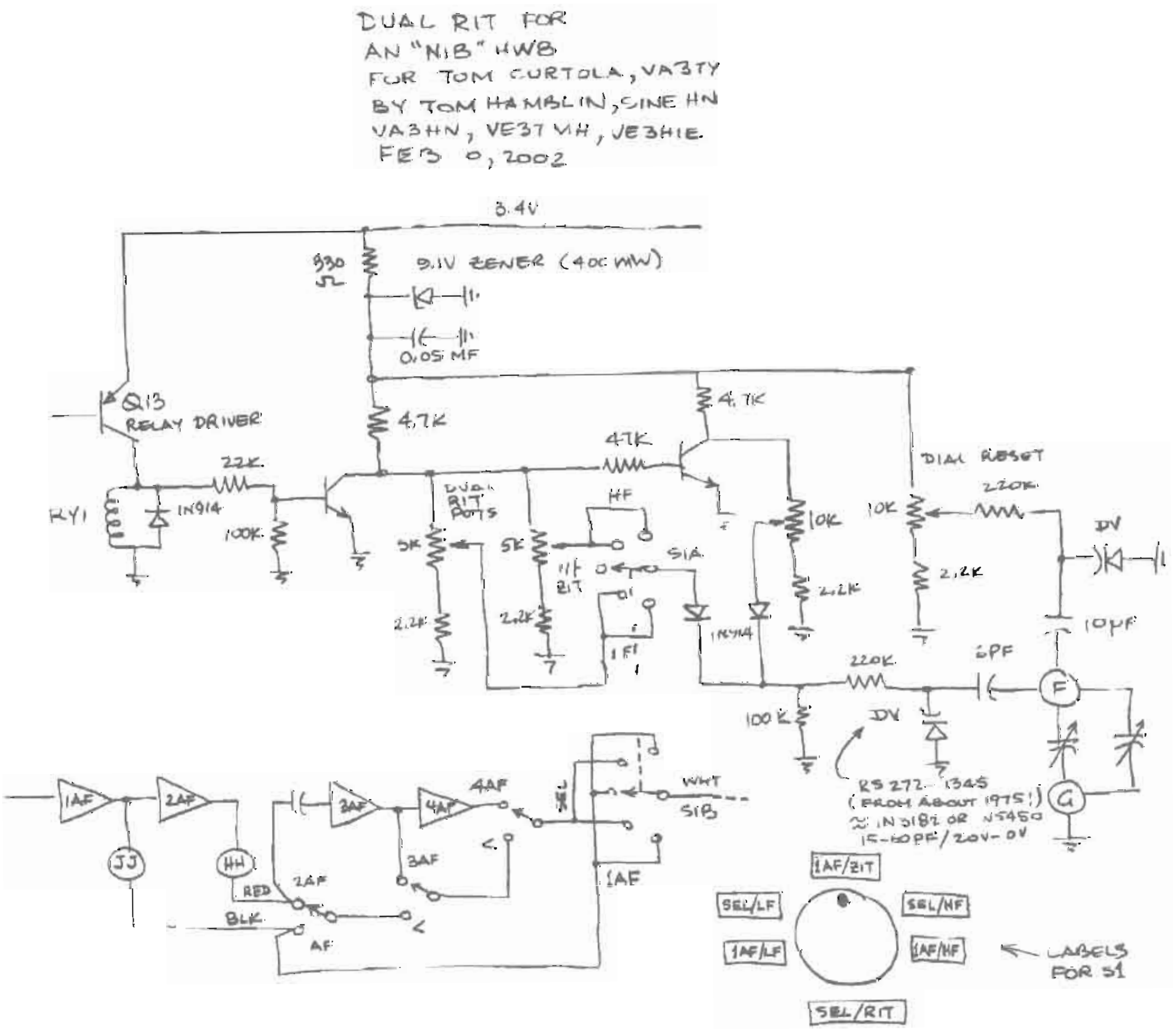
# No holes dual RIT for the HW-8

When setting the RIT pots and the 10K ZIT trimmer to match at zero beat, the easiest method is to use a high impedance digital voltmeter to measure the voltage supplied to the varactor diode. For the HW348DR circuit, measure the dc voltage at the junction of the two 220k resistors connected to the varactor. For the "No Holes" Dual RIT, measure at the junction of the 1N914 diodes and the 100k resistor. This is also applicable for the "NIB" HW-8 Dual RIT circuit. Incidentally, if you can't find 5k pots for the RIT pots, use 10k instead. And since the varactor that I used is probably long since out of stock at Radio Shack, there may be a little bit of easy cut-and-try to be done to get a reasonable tuning range from the RIT pots.

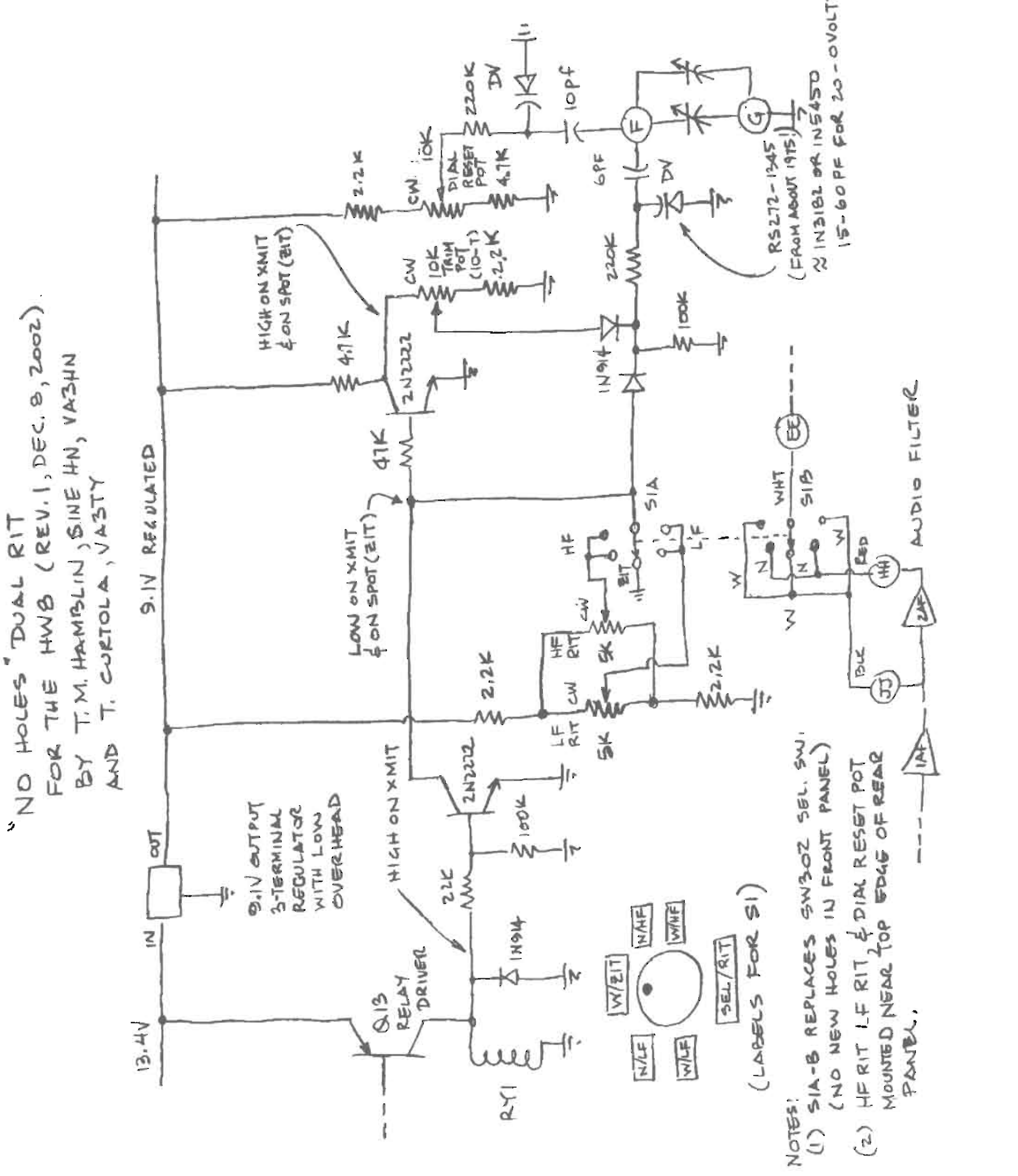
The only other modifications that I have made to date are (1) to better shape the keying by removing C91 (2mF) and adding 0.68mF from collector to base on Q11 and (2) to limit the initial Q12 collector current (and hence key current) to about 33mA by adding a 390 Ohm resistor in series with C92 (10 mF).

One of these days I will get around to doing a real QSK mod. Or maybe VA3TY will beat me to it.

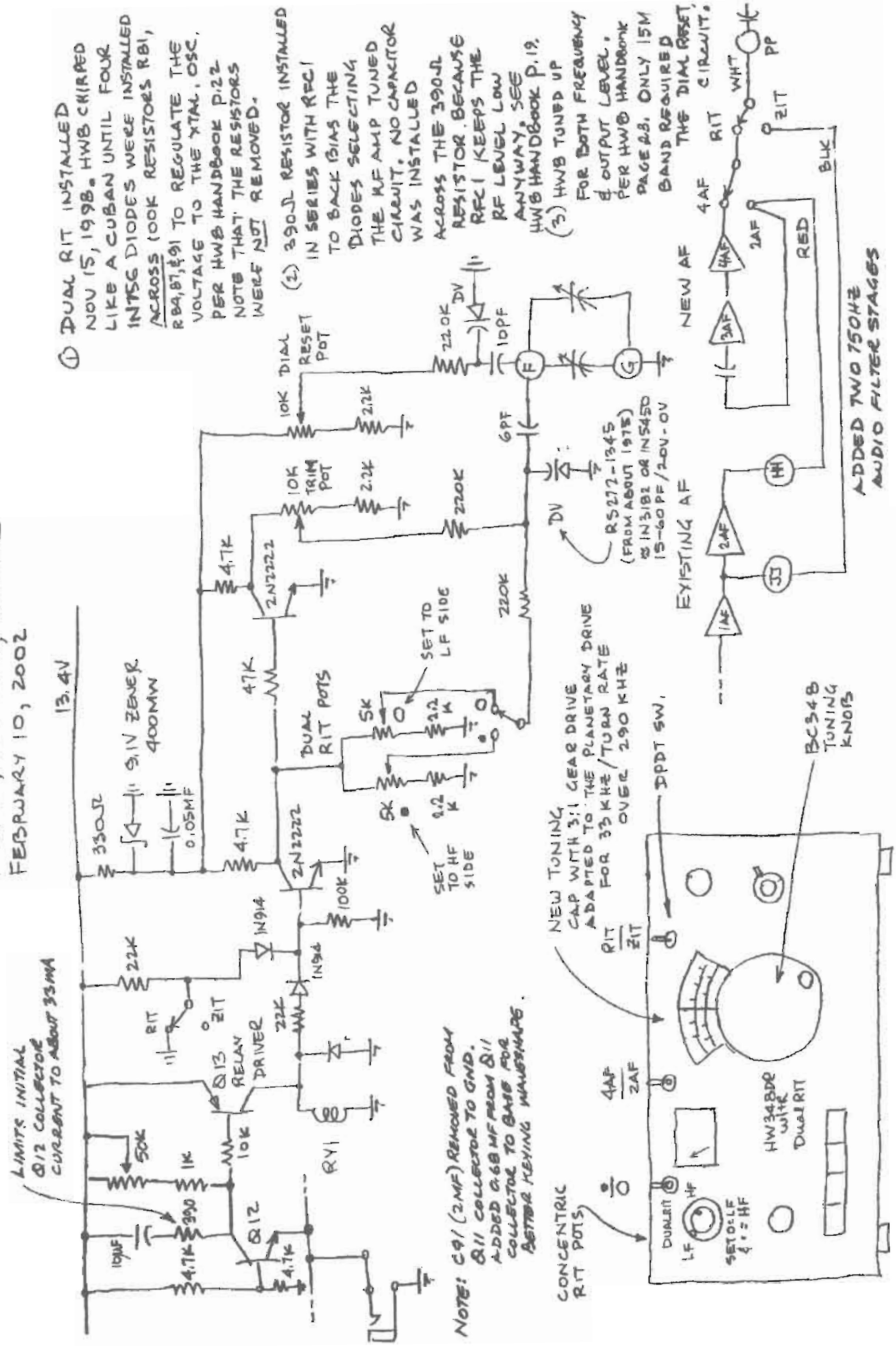
T. M. Hamblin, sine HN
VA3HN, VE3TMH, VE3HIE



# No holes dual RIT for the HW-8



# No holes dual RIT for the HW-8



# Give your Heathkit a bath!

(editor's note: Needless to say, use common sense here. If you have a basket case like Mark has, it's worth a shot!)

Last week I did the unthinkable...I put an SB-101 I have into the dishwasher. Yes, I can hear the groans all ready but in my case the rig was 50/50 on being restorable, or becoming a parts rig. It was very dirty inside and no vacuuming or hand cleaning could get it clean.

It sure came out nice when finished!!

I pulled all tubes, pulled the meter, covered all the IF transformers with plastic wrap and in she went. I ran a quick cycle, used normal dishwasher soap, did not let it go through the dry cycle. The heat from the Hot water dried a good piece of it. I then put it in the oven at LOW temp for 4 hours. I then let it sit over night, then back into the oven for 4 hours the next day. I then let it air dry outside for an afternoon. I then used a good quality contact cleaner on all the pots, switches, shafts etc. to force out any moisture and stop any corrosion.

I then let it sit for 4 days before the power test.

It powered up just fine and worked!!

In hindsight, I'd remove the front plastic dial bezel and the actual dial the next time as the soap and hot water faded them. Lucky for me I have these spare parts so I was OK.

Worked for me!! As I mentioned, my risk was low because this was 50/50 on being a parts rig. She's a keeper now!
Mark V. Johnson VE3DJU


Here's a mod you don't see to often.

The crystal socket has been replaced and in its place is a multi-turn pot.

This pot is the speed control for an internal keyer.

# Receiver sensitivity and signal/noise ratio chart

Receiver sensitivity and signal/noise ratio is both interesting and enlightening. I ran across a chart several years ago which lists the signal required (uV) and the corresponding "S" meter readings on a properly calibrated receiver. This chart lists both the classic "Ham" standard and the newer "World" standard. It goes as follows;

| "S" units | Old Ham Standard | Newer "World" standard |
|---|---|---|
| S9 | 50.00 uV | 40.00 uV |
| S8 | 25.06 uV | 20.04 uV |
| S7 | 12.56 uV | 10.04 uV |
| S6 | 6.29 uV | 5.03 uV |
| S5 | 3.15 uV | 2.52 uV |
| S4 | 1.58 uV | 1.26 uV |
| S3 | .79 uV | .63 uV |
| S2 | .39 uV | .31 uV |
| S1 | .19 uV | .15 uV |

As can be seen from the above chart, if you are peaking a receiver for operation on 80 or 40 meters, then pretty much anything below 1 uV or so in sensitivity is unuseable. This is because the noise level on these bands is typically S3 to S7 on most receivers, thus a perfect example of a poor signal/noise ratio. Of course as we move on up in frequency the band noise drops and sensitivity below 1 uV becomes more of an issue. Obviously by the time we get up to ten meters, where band noise is minimal, we would do well to strive for an optimum S/N ratio. The point to all of this is that as we strive to optimize our green jewels' receive performance, it would be better to do so on either 10 or 15 meters, then the lower bands will also be quite acceptable in performance as the main limiting factor there is the ambient band noise levels.

John W8JNC

## *HeathTip*

*When I was 14 I got my first Heathkit and first radio to match my Novice license, a Heathkit HW-7 (Lousy first radio, but my folks meant well, and I learned a LOT about construction, and especially about the uselessness of calling CQ with 3 watts into a poor antenna!)*

*While I was building it, the band switch section called for you to cut a large number of pins off one side of the switch so it would mate with the holes in the PC board while the buttons would poke through the panel.*

*I remember to this day walking into the living room, telling my brothers 'See - I can just cut the pins off this like they don't even matter!' (hey - 14 year olds are goofy). Then I went back to the bench to install the switch, only to realize I cut the pins off the wrong side of the switch and they were all the ones that were supposed to REMAIN.*

*In a panic, I saved the day by running wires from the top of the switch around to the bottom to make the connections. The switch had redundant pins on the top side, all of which went through to the bottom, so I could solder on wires and run them down. I still have that HW-7, but some day I won't and some one will look at my work and wonder who the idiot was that assembled it. (never mind that it works perfectly with full output on all bands!)*

*Dave WB7AWK*

# "Almost noiseless" T/R relay mod for the HW-8

There have been a number of suggestions for modifications of the T/R relay circuit in the HW-8. One of these involved a solid state diode switching circuit published originally in the QRP Quarterly and reprinted in the HW-8 Handbook. The original open relay in the HW-8 is definitely noise and is subject to contact corrosion, so replacement is sometimes necessary for electronic as well as esthetic reasons. It is not necessary to go to diode switching to solve these problems.

I offer a simple mod that is almost noiseless, easy to install, and permits easy replacement of the relay if it fails. It centers around the use of the Radio Shack sealed unit 5V SPDT relay, part number 275-243 for $2.39 in the catalog. The coil resistance is 70 ohms (requiring a 100 ohm series resistor in the HW-8), the contact carry a 2A rating, and the relay plugs into a standard DIP socket. When installed in the rig the relay switching is nearly inaudible.

Now for the details. I used a small piece of circuit board cut from Radio Shack 276-168A general purpose component PC board to mount a 16 pin socket. The board measures slightly more than 3/4 by 3/4 inches. The relay is mounted with pin 1 at one end of the socket so that the pin for the armature is immediately adjacent to the antenna jack. At the opposite end of the socket a 100 ohm 1/4 watt resistor is plugged into pins 8 and 9. With this resistor, the total resistance in the coil circuit and the coils current are the same as with the original relay. Jumpers are used to connect this resistor in series with the relay coil and to connect the coil and resistor to two wires extending down from the circuit board in the approximate positions for the coil connections on the HW-8 circuit board. Similarly, wires are attached to the NO and NC pins for connection to the appropriate pads at the mounting position for the old relay.

It's a good idea to check out the lead functions with an ohm meter before soldering the board into the HW-8 circuit board. It's easier to change a jumper than to find out after installation the one should have been changed.

The most difficult part of the mod is removing the original relay from the HW-8 board. Once it is removed, shape the leads from the new relay board to match the appropriate holes in the HW-8 board. Because the holes for the relay in the circuit board are larger than the wires used in this mod I like to bend the wires over to lay on the pads, ti insure good contact when soldering. Check the clearances between the board and the case before soldering.

Fire up the HW-8, sit back and enjoy the nearly silent relay operation. Don't forget to get a spare relay. Radio Shack sometimes discontinues items without notice or rationale.

Herb Ley, N3CDR The QRP Quarterly October 1994

# "Splatter Paint" for the HW-8 Case

If you have ever had to repaint a HW-7 or HW-8 case, you know how hard it is to create that splatter paint from the factory. Well it's not really that hard to do and in fact, can be quite fun! Here's how you go about "splatter painting" the case.

First you need to get the matching paint color. Heathkit made several different shades of the popular green. You can get matching paint for several sources. A lot of times, you'll find it on the Ebay auctions. You can also find it at Total Electronics [http://www.angelfire.com/nc/totalelectronics/]

Buy several cans. Now, paint the case the matching color with the paint. When you have a nice coat on, let it dry completely. Then take one of the spray nozzles and with a straight pin, push the pin into the nozzle slightly. This destroys the spray head. Now try spraying the paint. You'll find that the paint now "spits" out instead of spraying. Depending on how much you push the pin into the head will determine how much "spit" comes out. The idea is to get the nozzle to the point it splatters the paint onto the case. The effect can be changed by the distance between the case and the spitting nozzle. You don't want large drops, but lots of smaller paint drops to hit the case. It will take some practice to get the right amount of splatter from the nozzle and the correct distance. But when you get it right, you can't tell the difference between a factory "splatter" paint and the one you did the the basement.

DE Mike Bryce, WB8VGE

# Keying fix for the HW-8

I have an HW 8 that works fine except when I try to run it at speeds faster than about 16 WPM. At faster speeds the dits are run together, for example three fast dits are transmitted as one long keyed element.

First, you need to check the adjustment of the break-in delay control, trim pot R68 (50K) which, in series with R69 (1K), connects between the 13.4V bus and the collector of Q12, and, through R71 (10K), to the base of Q13: if this trim pot is not set for higher speeds, or is out of specs (or, if any associated resistors or other parts have drifted out of specs - a common enough occurrence with older Heathkits), then the break-in delay may be wrong and the dots & dashes could run together at higher speeds.

R68 is located close to the rear of the pcb near the antenna socket on the back panel, between the 4 crystals and the relay. The manual doesn't say much about setting this control, only (on p. 68, under "Operating Hints") to adjust it to obtain the desired hold-time of the T/R relay.

If that doesn't help enough, try the following fix, from a writeup in the August '82 issue of Ham Radio Magazine, p. 60, "The Ham Notebook" column, by Robert Lewis, W3HVK:

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To paraphrase W3HVK:

When keyed at and above 25 wpm, the HW-8 break-in delay circuit had a long rf output decay time, even though the sidetone sounded good. The parts involved were Q12, R66 & R67 (4700 ohms each, C92 (10 uf), and keying transistor Q11.

If you look on your schematic, after the key is released capacitor C92 discharges through Q12, causing Q11 to remain in conduction (for 100 ms in the author's case). This keeps the T/R relay in the xmit position for that long after key-up - the time required for C92 to discharge is controlled by trim pot R68.

The solution was to reconfigure Q12 to function as an ordinary diode; then when the key is released, Q12 is reversed biased, thus effectively disconnecting C92 from the keying circuit.

Modification to accomplish this:

Leaving C92 as is, remove resistors R66 & R67; then solder a jumper wire directly between the base and collector of Q12. There will no longer be a connection from the base of Q12 to ground through a bias resistor.

The author said this modification had no noticeable effect on the break-in delay circuit or the setting of the delay control.

73

John Farrington KE5ZB

# Removing stuck coils in a HW-8

You need an alignment tool that you are willing to part with so that may not be a good thing to try. Still, there may be instances where drilling out a slug may not be advisable. Put some epoxy on the end of the tool and insert it in the broken slug. Wait for the epoxy to cure and then back the slug out. Then you can look at the dimensions and get another one from another coil. I saved a bunch of old slugs so I would take one from the pile.

Gerald Lemay W1ID

# HW-8 Keying Interface

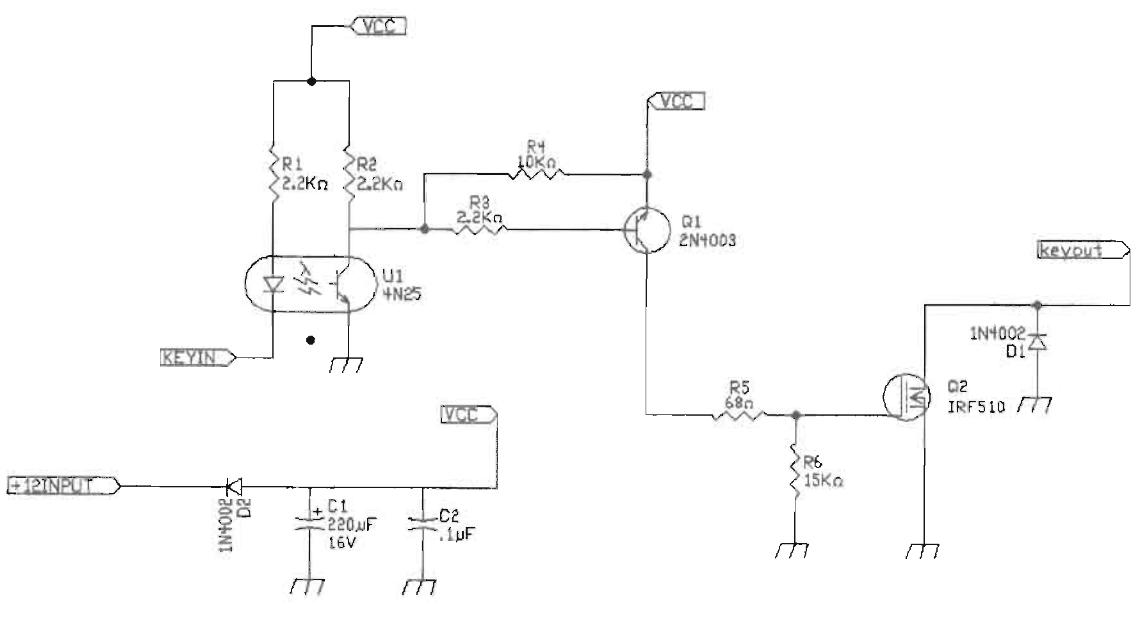
I always thought the HW-8 keying line was a bit odd. It seemed that some keyers would work with the little rig while others would not. What happened more than likely was the key line was never pulled completely to ground, making for all sorts of problems. This little circuit modifies the key line so you can use ANYTHING to key the HW-7, HW-8 or the HW-9.

The circuit is really simple. In a nut shell, the key line for the HW rig is optically coupled via the 4N25 optocoupler IC. When the keyin line is pulled to ground, the output of the 4N25 goes to ground. This turns on the PNP transistor, Q1. When Q1 is on, it supplies gate drive to the IRF510 power MOSFET. The MOSFET turns on and it's drain lead goes to ground. Since the gate lead is tied to the HW rig's key line, the radio keys. Diode D1 prevents any spikes from the T/R relay from cooking the MOSFET.

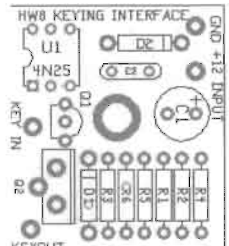
The interface steals power from the rig. Diode D2 prevents damage to the circuit in the event you hook things up backwards. Capacitors C1 and C2 provide some RF decoupling.

The entire circuit was built on a double sided PC board. The circuit board is then installed into the radio by using a threaded standoff. You remove one of the mounting screw nuts. Screw in the standoff and then mount the PC board with the same nut you just removed. It should be clear, but the standoff must have a female on one end and a male on the other end. I used a 3/4 inch standoff.

The necessary wires are connected to the PC board. The wire from the key jack is removed and attached to the PC board. From Mike Bryce, WB8VGE




Full size PC board for the HW-8 Keying Interface



# Common HW-8 Fixes

## WB6FZH HW-8 Modifications

*Double the antenna windings on the 15 meter RX antenna Coil for more sensitivity
*Change R-F output meter circuit to work with SWR/PWR bridge circuit
*Antenna connector change to SO-239 or BNC from RCA type
*Power Connector added: to AC Adaptor type jack for mulitiple power sources
*50V 1A diode added accross power input to blow fuse on polarity reversal
*Add a small 12v lamp behind tuning dial (W/switch for power savings)
*Replace cabinet feet
*Add Ground Terminal post with wing-nut & washers for counterpoise,etc
*R-F Output Transistor change from 2N4427 to ECG-488, etc.(more output)
*Audio Transformer added to headphone line to increase output to lo-z headphones
*3.5mm jack added paralell to headphone output for stereo/mono earphones
*RX R-F Amp transistor changed from MPF-105 to 2N4416 or other gain mosfet
*Drive level control added for QRPp level adjustments
*Add dummy load with switch for power, antenna and test adjustments
*Additional stage of audio amplification added to drive speaker
*Add 9v Zener Diode to Xtal Oscillator source (ac/bat freq.changes)
*Add a small speaker , muted by headphone plug-in

From WB6FZH

## COMMON MODE HUM

What is common-mode hum? That was one of the many short-comings of early DC receivers, also known as tunable hum. When operating on an AC power supply, you could tune the pre-selector to peak signals, and at the same time hum would start coming through. It is now generally accepted that the cause of this is VFO energy leaking out and getting back to the diodes in the power supply, being modulated with 60 Hz AC, reradiated and picked up by the receiver along with desired signals.Do away with the AC power supply completely, or put a choke between it and the receiver to keep the VFO energy from getting to the diodes, or bypass each diode in the rectifier with a capacitor so the signal couldn't be modulated.

-- Michael A. Czuhajewski WA8MCQ

## From the ARRL DATA BASE OF Heathkit QRP Mods

### HW-7

"Heath HW-7 CW QRP Transceiver" (Recent Equipment), QST, January 1973, pp. 48-50
"Heath HW-7 Preselector Modification" (Hints and Kinks), QST, May 1973, p. 42
"Receiver Offset Tuning for the HW-7" (Hints and Kinks), QST, June 1973, pp. 48-49
"New Front End for Heath HW-7," QST, December 1973, pp. 23-25
"HW-7 QRP Transceiver Modifications," QST, January 1974, pp. 35-39
"HW-7 QRP Transceiver Modifications" (Feedback), QST, March 1974, p. 83
"RIT for the HW-7," QST, July 1975, pp. 38-39
"Slippers for the HW-7 Transceiver," QST, December 1975, pp. 45-47
"Hum Reduction in the HW-7" (Hints and Kinks), QST, July 1976, p. 42
"Heath HW-7 Sidetone Level Control" (Hints and Kinks), QST, November 1976, p. 41
"Hints (HW-7/HW-8 interference)" (Hints and Kinks), QST, December 1978, p. 40

### HW-8

"Heath HW-8 QRP Transceiver" (Product Review), QST, April 1976, p. 31
"Full Break-in and RIT for the HW-8 QRP Transceiver," QST, July 1977, pp. 22-26
"Full Break-in and RIT for the HW-8 QRP Transceiver" (Feedback), QST, November 1977, p. 20
"About RIT for the HW-8" (Hints and Kinks), QST, January 1978, p. 40
"Full Break-In and RIT for the HW-8 QRP Transceiver" (Feedback), QST, February 1978, p. 27
"HW-8 Items" (Technical Correspondence), QST, March 1978, p. 36
"25-kHz Calibrator for the HW-8, A," QST, October 1978, pp. 20-21
"Onward with RIT for the HW-8" (Hints and Kinks), QST, December 1978, p. 38
"Hints (HW-7/HW-8 interference)" (Hints and Kinks), QST, December 1978, p. 40
"Putting the Boots to Your HW-8 QRP Transceiver," QST, April 1979, pp. 18-21
"Boots for the HW-8--Etching Pattern" (Hints and Kinks), QST, April 1979, p. 47
"Boots for the HW-8" (Feedback), QST, June 1979, p. 18
"An S Meter for the Heath HW-8" (Hints and Kinks), QST, November 1979, p. 57
"HW-8 Ideas" (Hints and Kinks), QST, January 1981, p. 45
"HW-8 And The Accu-Keyer--A Good CW Team, The" (Hints and Kinks), QST, May 1981, p. 46
"Variable-Bandwidth Control For The HW-8" (Hints and Kinks), QST, April 1982, p. 53
"30-Meter Conversion For The HW-8" (Hints and Kinks), QST, May 1984, p. 44
"Low HW-8 Power Output" (Hints and Kinks), QST, April 1993, p. 72

### HW-9

"Heath HW-9 Deluxe QRP CW Transceiver" (Product Review), QST, July 1985, pp. 37-39
"Improving the HW-9 Transceiver," QST, April 1988, pp. 26-29
"HW-9 Tips" (Technical Correspondence), October 1988, p. 43
"HW-9 Tips" (Feedback), QST, December 1988, p. 32
"AGC-Threshold Control for the Heath HW-9 Transceiver, An" (Hints and Kinks), QST, March 1990, p. 43
"Narrow IF Filter for the Heath HW-9 Transceiver, A" (Hints and Kinks), QST, June 1990, pp. 40-41
"Modifications and Improvements to the HW-9," QEX, October 1990, pp. 3-9
"HW-9 Modifications Update" (Correspondence) QEX, May 1991, pp. 16-17

# Better Ears for the HW-7

*If you see an HW-7 at a "good" price, don't pass it up because of bad things you may have heard about its receiver. It CAN be fixed!*

This is 1995, but the venerable Heathkit HW-7 transceiver is still out there, and I see ads for them from time to time. This was the first of three QRP transceivers that Heath sold, designed back in the days when direct conversion receivers had a well deserved bad reputation (much worse than they do now). In comparing the various Heath HW-rigs in 73 magazine several years ago, Mike Bryce, WB8VGE, said the receiver in the HW-7 "sucked canal water." Those who have operated HW-7s know that he was being kind.

## DC RECEIVER PROBLEMS

Many people don't like DC receivers today because you can hear signals on both sides of zero beat, but trust me, that's nothing compared to some of the other problems they used to have. Early DC receivers suffered from a number of worse maladies; these included massive hum when using AC power supplies and tuning the preselector just right ("tunable hum"), as well as AM detection of shortwave broadcast stations. The hum could be worked around by using batteries, by using a bifilar wound choke in the power lead from an AC supply, or bypassing the diodes in that AC supply with disc capacitors.

However, there was not much that could be done about the shortwave stations; that was caused by AM detection in the receiver, and no matter where you tuned in the band it was always there, across the entire dial. It was a constant background companion, Father like having a radio going on the other side of the room. The cure to these problems was pointed out by W7EL in his August 1980 QST article, "An Optimized QRP Transceiver", and also by K70WJ in his July/October 1986 QRP Quarterly article, "A High Performance Direct Conversion Receiver". (That's not a two part article; this was the year the QRP Quarterly skipped a beat for some reason and missed an issue.)

The problems didn't exist in just the HW-7, either -- the early TenTec PM- series used essentially the same design in the receiver and had the same problems, as did many homebrew rigs of the day.

The common factor was that all of these used dual gate MOSFETs as a mixer. Those provide conversion gain, but have an unfortunate side effect-they also make good square law detectors, and provide envelope detection of AM signals. Wait a minute-some older commercial receivers and transceivers used dual gate MOSFETs as first mixers and yet they don't have shortwave BC stations blanketing the dial-how do they get away with it? The key is that those units are all superhets; the MOSFET mixers are detecting the AM signals all right, but the output of the mixer goes to an IF amplifier, and an IF amp tuned to 455 KHz or somewhere in the MHz region certainly isn't going to pass an audio frequency signal. In the case of the direct conversion receiver, the mixer output goes directly to so audio amplifier chain, without passing through any tuned circuits which block out audio frequencies, so the detected AM gets passed on, along with the desired signals.

## THE CURE

The key is to get rid of the dual gate MOSFET mixer and replace it with a double balanced diode ring mixer. These have been around for years, both home brew and commercial (such as the Mini Circuits Labs SRA-1, SBL-1, TUF-1, etc). Just like Roy and Denton said, these cut out the tunable hum and shortwave BC stations. (The technical details are beyond the scope of this article, but have been well documented in the ham press.)

## A CURE IN 1987

The October 1987 issue of the QRP Quarterly had an article by John Collins, KN1H, titled "Making the HW-7 Into a Radio". Unfortunately, both the text and schematic are rather confusing and hard to follow, and John was never very happy with the translation his manuscript and drawing suffered between his hand and the pages of the Quarterly. I've sent photocopies of the article to many people over the years, along with a warning that they could get confused easily. I've been promising myself to update it for several years, and here it is at last!

## THE ORIGINAL RECEIVER

Figure 1 is the basic receiver chain of the HW-7. Parts designators are those used by Heath. The signal comes from the T/R relay through C6, to the preselector (C1 and L1). It is fed into one gate of Q1, and the other gate gets the VFO signal from 04, the doubler/tripler which follows the VFO buffer. (R1 and R2 set the bias for that gate.) Q1 mixes them and the output passes through an audio filter (L14, C5, C7 and C9) and then into a CA3035 integrated circuit audio amp.

Here are the parts values used in the original receiver.

| | |
|---|---|
| C1 393 pF | R1 100K |
| C2 .05 | R2 56K |
| C3 100 | R3 470 |
| C4 100 | R4 1500 |
| C5 .22 (.01) | R5 100 |
| C6 100 (.01) | R6 1K |
| C7 .01 | R7 180K |
| C8 none (.01) | R41 1K |
| C9 .22 (.01) | L1 1.6 uH |
| C10 .01 | L14 200 mH |
| C52 2 uf | |
| C57 15 pf | |

(Note-I have two different HW-7 schematics; in the older one, the capacitor on the left leg of L14 is a pair of .01 caps in parallel, C5 and C6, and the connection from the antenna goes directly to the tap on L1, with no capacitor. The cap on the right leg of L14 is another pair of .01's, C8 and C9.)

# Better Ears for the HW-7

## THE KN1H FIX

The KN1H modification consists of rewiring Q1 into an amplifier for the VFO signal so it can drive a DBM (the MCL SRA-1 in his case, although the SBL-I is just as good, and cheaper) as the local oscillator (LO), and feeding the signal from the preselector into the RF port of the mixer. The audio output (IF port) is then fed into a preamplifier he added, and on to the CA3035. Q1 itself was left in place on the circuit board; some of the surrounding-components were changed in value, some new ones added, some traces cut, etc, to turn it into an amplifier.

All of that made things a bit hard to follow, but it did work. It would be much easier if all of the circuitry was built up on a single board from scratch, rather than modifying the HW-7 board. While I haven't actually done that part myself, the diagrams here should make the process much easier and clearer.

#### PART OF THE ORIGINAL KN1H ARTICLE

"My HW-7 was found at a hamfest several years ago. It was terribly dirty but carried a $15 price tag. So, with a warning from its owner that it didn't receive "too well", I carried it home and plugged it in. Well, the original owner was at least partly right&emdash;it didn't receive at all, or transmit either!

"I pulled out the PNP transistor that was in the oscillator section and replaced it with the FET which belonged there, and in a few days had a working HW-7. The transmitter worked pretty well and on receive I could listen to the VOA, the BBC and our local AM station all at once on 40 meters. I could also listen to 20 meter CW stations on 15 meters. That is, if they were stronger than the ever-present common-mode hum. "This HW-7 was looking less like a bargain all the time, but by now, with $15 and several days invested, I was determined to make a radio out of this thing.

## GET A NEW MIXER

"First, the 40673 product detector had to go. The square law characteristics of the dual gate MOSFET make it a wonderful detector of any AM signal that appears at its input. The passive double balanced mixer I put in its place has no such tendencies (due to its balance); it does suffer from conversion loss, the requirement for a high level of local oscillator (LO) injection, and a low impedance output.

"The LO requirement was met by simply reconfiguring the 40673 as a broadband amplifier to boost the LO level going into the DBM. T1 is a broadband transformer with 35 turns on the primary and 5 turns on the secondary, wound on an FT37-43 toroid. This delivers about +5 dBm into the 50 ohm impedance of the DBM-a little less than the optimum +7 dBm, but it works quite well. "The conversion loss and low output impedance problems are both handled by a neat trick first published by PA0SE, Dick Rollema, "Second Thoughts on the Direct Conversion Receiver", Ham Radio, November 1977, pages 44-55. (This article is highly recommended to anyone interested in DC receivers.) The audio output of the DBM is fed directly into a miniature audio transformer with a high turns ratio, which feeds a FET amplifier. The transformer performs several functions all at once. First, it provides a low impedance for the DBM to see, and then it steps the audio voltage up to a high level which improves the FET noise characteristics. The transformer I used is an 8 ohm to 15K ohm unit found in the junk box. It has a 44:1 turns ratio (the square of the turns ratio = impedance ratio), and works well; but an even higher ratio might work better.

## A FREE FILTER

"Capacitor CT across the secondary was chosen to resonate the winding at 750 Hz. This cleans up the waveform and gives a 3 dB bandwidth of about 1KHz. A free audio filter! The value of C will have to be determined experimentally as the secondary inductance of your transformer will undoubtedly be different from mine. My C turned out to be 0.015 uF. [And beware of using a disc ceramic capacitor here&emdash;I did, and it turned out to be an excellent source of microphonics! Many ceramic capacitors exhibit the piezoelectric effect and can generate small voltages when tapped&emdash;and this capacitor is followed by a high gain audio amp. -WA8MCQ]

"Almost any FET will yield good results in this circuit, but some will be better than others of the same type number. One particular 5308 I had gave about 10 dB more gain than its nearest competitor, so it was used here.

"These modifications completely cured the AM breakthrough and common-mode hum problems [see sidebar], even when using an AC power supply. The problem with 20 meter stations breaking through on 15M was helped (but not totally eliminated) by feeding RF to the DBM from the tap on the preselector coil (L1) rather than the top of L1 [as done in the original HW-7 circuit]. With this arrangement, preselector tuning is much sharper and there is probably a closer match to the input impedance of the DBM. Also, C6, originally 100 pF, was changed to 0.001 uF which resulted in a 6 dB signal increase on 40M, but no change on 20 and 15.

"The added portions of this modification were assembled, ugly fashion, on a piece of double-sided PCB which was then bolted to the side wall of the HW-7 chassis. RF and LO interconnections were made with RG-174 mini coax, and +12V is supplied from the ON-OFF switch.

[Description of reworking the original 40673 circuit by changing and removing parts and cutting traces is deleted. While it can be done, it's a bit confusing and hard to follow, and it's probably better to simply build up the circuitry on a separate board. --WA8MCQ]

"I have found this modification to be extremely worthwhile; the HW-7 is now a thoroughly usable QRP rig with a pleasant sounding receiver. Not bad for a $15 radio! With the hamfest season approaching, let me suggest you keep an eye out for an HW-7. When you have made the modifications described, it may become your favorite rig.

--Michael A. Czuhajewski WA8MCQ

# Replacement HW-8 VFO capacitor

The HW-8 main tuning capacitor (Heathkit part number 26-152 OEM ASP*7703) rotor plates can become detached from the tuning shaft with regular usage. The ASP number is the OEM manufacturer code for the Heathkit part. ASP is now known as Oren Elliot Products. They are located in Edgerton, Ohio, and they are the largest domestic manufacturer of air-dielectric variable capacitors - since 1925.

Mr. Steven Elliot at Oren Elliot Products, has provided the following information concerning Heathkit 26-152:

The VFO tuning capacitor in the Heathkit HW-8 is the Oren Elliot Products model NS-51, with direct drive, and two rotor and two stator blades with a 0.032" air gap. It has CCW rotation, mounting holes tapped for 6-32 threads, with a trimmer and copper stator blades. This capacitor has a range of 5.2 pF to 15.1 pF. The trimmer can add 2-15 pF to both the minimum and maximum.

This capacitor was manufactured for the Heathkit Company could be easily damaged, since the vernier drive on the HW-8 is a reduction drive (planetary) with an output torque of about 100 inch ounces. The 26-152 can only stand about 20 inch ounces of pressure (at the end of the stop) before succumbing to damage. A user would only have to exert an input torque force of about 3 inch ounces on the VFO knob, with the capacitor at the end of its rotation, before possible failure.

Oren Elliott Products can supply a current capacitor model, identical to the original 26-152. Contact Mr. Steven Elliot at OEP and request a direct drive, 26-152 replacement.

Oren Elliott Products
128 W. Vine St.
PO Box 638
Edgerton, OH 43517
USA
telephone: (419) 298-2306
fax: (419) 298-3545
e-mail: oep@bright.net
http://www.orenelliottproducts.com.

Current pricing for this capacitor:
1 capacitor: $14.00
2 capacitors: $11.50 ea.
5 capacitors: $9.50 ea.

Larry Baker - WB5OFD

# Interesting stuff and other goodies

*QRP Amateur Radio Club International*, an organization begun in the early 60s has grown to over 10,000 members. The club is international in nature with members all over the world. Club members like to build and/or operate small, low powered rigs. Most of our members are not against high power and as a group we have never advocated the elimination of amplifiers or high powered contacts. We simply enjoy operating at low power levels - lower than we were used to operating. Why? Because it's FUN!
We have found that there is a real thrill associated with low power contacts. Because low power rigs are relatively easy to build, we have also found that an even greater thrill results from operating a rig that we have built ourselves. Accordingly, there are a lot of technical folks in the club who enjoy talking about new ways to build small transceivers/receivers/transmitters. Finding parts and sharing sources with others is a way of enjoying QRP as well. In fact, most all of our members get very excited about helping others who may be new to building or operating QRP.

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If questions, Mark may be reached by email at KQ0I@ARRL.NET

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