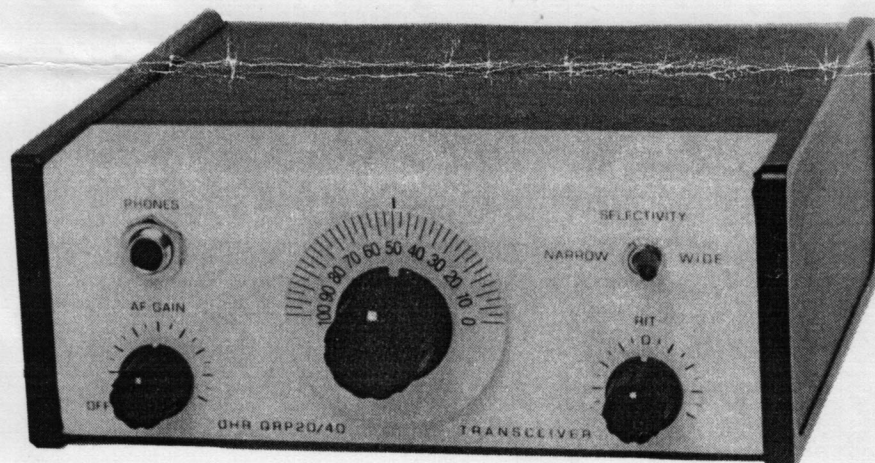


INSTRUCTION MANUAL

QRP CW TRANSCEIVER KIT

OHR QRP 20



OAK HILLS RESEARCH

20879 MADISON STREET

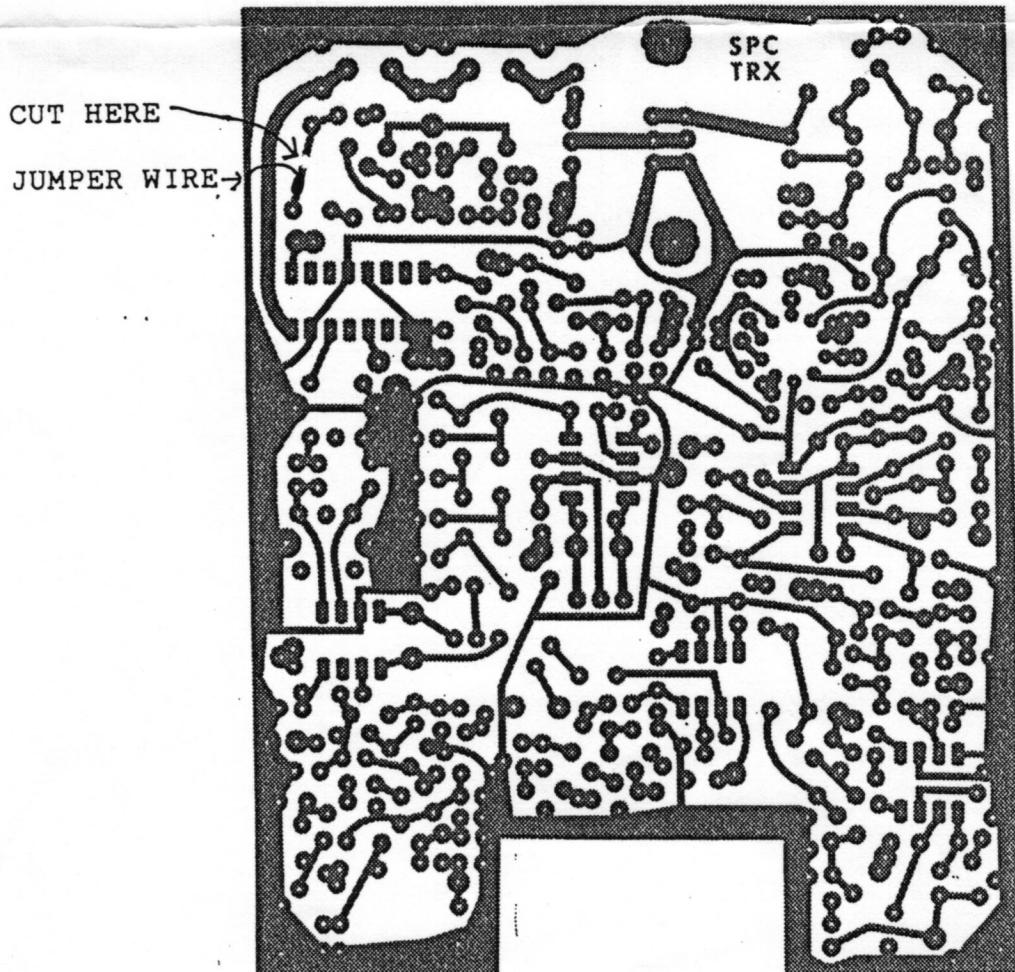
BIG RAPIDS, MI 49307

(616) 796-0920

CIRCUIT CHANGE

Please make the following change on the PC board before starting construction of the kit.

- 1) Lay the PC board in front of you with FOIL side up as shown below.
- 2) Using a sharp hobby knife, carefully cut thru the PC run at the place shown on the PC diagram. You can make two cuts parallel to each other, and then remove the small piece of copper. Just make sure the trace between the two donut pads is an open circuit.
- 3) Now take a small piece of hook-up wire or a lead cut-off from a component and tack solder one end to the trace as shown below. Solder the other end to the ground foil as shown below. Just make the jumper wire long enough so it does not touch any other trace.
- 4) This change will greatly improve the control you have over the Sidetone Level.



Open the parts packages and compare the parts with the parts list. If any parts are missing, contact us for a replacement. The IF filter crystals are packaged separately, do not mix them with the other crystals as they are a matched set of four.

A large PC parts overlay, schematic diagram, and a pictorial diagram are included with each kit. Please study them before starting construction. Keep all component leads as short as possible and be sure to observe the correct polarities of the electrolytic capacitors and diodes. The cathode (black band) of each diode is indicated by the letter "K" on the parts overlay. Many components mount in the vertical position on the board. This is shown on the parts overlay as a circle with a line running thru it. The circle indicates the body and the line indicates the top lead. All coils (core and necessary wire) are packaged separately. Do not open these packages until you are ready to wind that coil. Also, see top of parts overlay to see how the coils look after winding. Remember when winding the various coils, turns are counted on the inside of the core.

CONSTRUCTION:

- 1) Install, solder, and trim the low profile components first; Dip sockets, PC pots, and monolithic capacitors, followed by the larger components; Resistors, crystals, chokes, and coils. Install the IC's into the sockets last. DO NOT INSTALL Q13 AT THIS TIME.
- 2) Coil L1 (T44-6 yellow core) is wound with 26 turns of RED #28 wire. Install the coil but DO NOT Q-DOPE IT AT THIS TIME.
- 3) Before winding the Bifilar and Trifilar coils, twist the wires together a few turns per inch. The wire colors for the Bifilar coils are red & green. The colors for the Trifilar coils are red, green, and gold.
- 4) Coil L4 (T44-2 red core) is bifilar wound with 16 turns of #28 wire. The secondary winding has 5 turns of red #28 wire over the center of the primary winding. Use two 14" and one 7" lengths of wire. Install the coil observing the proper phasing of the wires.

5) Coil L5 (T44-2 red core) is bifilar wound with 16 turns #28 wire. The secondary winding has 9 turns of red #28 wire over the center of the primary winding. Use two 14" and one 9" lengths of wire. Install the coil observing the proper phasing of the wires.

6) Coil L6 (T44-2 red core) is trifilar wound with 11 turns of #28 wire.

7) Coil L7 (T44-2 red core) is wound with 22 turns of #28 wire.

8) Coils T1 and T2 are bifilar wound with 10 turns of #26 wire. Use two 10" lengths of wire for each transformer. Observe the proper phasing when installing.

9) Coils L8 and L9 (T44-2 red core) are wound with 10 turns of #24 wire. Use 10" lengths of wire for each coil.

10) Solder the pins of the heat sink securely to the PC pads.

11) The PC parts overlay shows 26 jumpers that are installed on the component side of the board. These are shown as a "J" number with an arrow pointing to the PC pad where one end of the wire is to be soldered in place. There are 26 pairs of "J" numbers; J1 thru J26. Install each jumper one at a time. All jumpers are made using the solid hook-up wire provided except J25, which is a short length of RG174/U coax. Keep the jumpers as short as possible, a nice curved shape will give excellent results.

12) Install the relay. Use caution when installing, as it's pins are fragile. The two isolated end pins plug into the DIP socket next to D10.

13) Cut the following lengths of wire using the #24 Blk or Red hook-up wire. Remove 1/4" of insulation from each end. As you install each wire, place a marker (tape, etc.) on the free end and write in the single letter shown to the right of each wire length. This will help prevent getting the wires mixed up. See pictorial diagram. Cut the following wires:

- | | |
|--------------------------|---|
| 3) 2" wires - H, I, J | These points are shown on the parts overlay as → "B" for example. |
| 3) 3" wires - B, C, M | |
| 1) 3 1/2" wire - A | |
| 1) 5 1/2" wire - K | |
| 4) 6" wires - D, E, F, G | |
| 1) 8" wire - L | |

13) Cont. Install a short jumper wire on S1 as shown on the pictorial diagram. Cut a 4" piece of RG174/U coax cable. Remove 1" of the outer jacket. Separate the braid from the inner conductor. Twist the braid to form a lead wire. Now remove 1/4" of inner conductor insulation. Do this procedure at both ends of the cable. The inner conductor at one end goes to point "O" on the PC board and the braid goes to point "P". See parts overlay. Cut a 1" piece of #20 hook-up wire. Remove 1/4" of insulation from both ends. Connect one end to the PC pad marked "TO C5". This pad is located near L1. See parts overlay. The free end will be connected shortly. Refer to the pictorial diagram, and install the free ends of the previously installed wires. These are the ones with the tape markers on the free end. Install the leads going to S1, R32, J1, and R46. Do not connect the leads to J2, J3, and J4 on the rear panel at this time. Connect the free end of the 1" wire marked "TO C5" to the stator terminal on C5. The stator terminal is on the side of C5. TEMPORARLY connect a short length of hook-up wire from the ground foil of the PC board to the rotor (frame) of C5. Once you are satisfied with the construction up to this point, it's time to check it out and do the alignment. One note of caution, if Q13 has been installed, remove it.

RECEIVER CHECKOUT AND ALIGNMENT: (20M)

- 1) AGC - Apply +12 Vdc to the free end of the 8" wire marked with an "L". Now connect a voltmeter between the collector of Q6 and ground. Adjust trimmer pot R36 for a reading of 4.5 Vdc. This sets the AGC idling voltage and must be set with the antenna disconnected.
- 2) VFO - Connect a frequency counter to the emitter of Q3 and ground. You should be able to get 5 MHz with the plates of C5 fully meshed (closed) and about 5.10 MHz with the plates of C5 fully unmeshed (open). Either compress or expand the windings of L1 to get the desired frequency readings. Do not Q-DOPE the coil at this time. When adjusting the RIT pot, the frequency should change approximately 2.8 to 3 KHz from one end to the other. Next, adjust the RIT pot to it's center detent position and record the frequency reading. Short the wire going to J3 (KEY JACK) to ground and check the frequency. They should be the same or very close to being the same. The relay should energize when the key jack is grounded. You may have to fine tune these adjustments once the board is mounted in the cabinet. If you can't get the VFO to the desired frequency by expanding or compressing the windings, then you will have to either remove or add a turn to the coil. If the frequency is too low (below 5 MHz), then remove a turn. If the frequency is too high, then add a turn. If the frequency is not even close, then one or more of the VFO capacitors are installed wrong.

3) BFO - To set BFO, connect your frequency counter to pin 7 of U3. Now adjust C31 for a frequency of 8.999 MHz. Your counter will most likely load down the BFO, thus causing an error in the frequency. So consider this as an approximate setting of C31. You will have to fine tune the BFO while listening to an on air signal. The BFO should be set for LSB. This can be done by listening for low frequency tones when adjusting C31. You can also listen to a SSB signal, and adjust C31 until the voice is on the wrong side of zero beat. 20 Meters uses USB for normal SSB reception. When the BFO is properly adjusted, the received CW note should be clean and crisp sounding, and should be greatly attenuated when you move thru zero beat to the other side.

4) IF - To align the IF, temporarily connect an antenna to the input of the receiver. This will be point "11" on the receiver schematic diagram. Tune in a weak signal and adjust trimmer caps C15 and C23 for maximum audio in the headphones. There should be a noticeable peak as each cap is adjusted.

5) FRONT END - While receiving a weak signal near the center of the tuning range (C5 half unmeshed), adjust coils L2 and L3 for maximum signal strength. You may have to touch up these adjustments at the low and high end of the tuning range to get a more even response across the band.

6) When the key jack is grounded, the received signal will be muted and the sidetone will be heard. Trimmer pot R42 adjust the sidetone level.

TRANSMITTER CHECKOUT AND ALIGNMENT: (20M)

1) Advance trimmer pot R63 mid-way. When the key is closed, the relay should energize and de-energize when the key is open. The delay time can be increased by increasing the value of R54 and can be decreased by decreasing the value of R54.

2) The transmitter is broadbanded and only requires three adjustments to be made. If you have an oscilloscope, connect it between R68 and ground. Key the transmitter and adjust C69 and C70 for maximum output. There should be between 5 and 8 Vpk-pk and you should notice two peaks when adjusting C69 and C70. If you don't have an oscilloscope, just go on to the next step.

3) Remove power from the radio. The MRF472 and MRF476 final transistor cases have the emitter and base reversed. Both are clearly marked on the PC parts overlay as to which one mounts on which side of the heat sink. Coat the back of the transistor with a small amount of heat sink compound and bolt it to the heat sink, using the lower hole and solder. The heat sink is isolated from the rest of the circuit so no insulator is required.

4) Attach a suitable dummy load and wattmeter (3 WATT OR MORE) to the antenna coax cable coming from the board. Apply power and key the transmitter. Adjust C69 and C70 for maximum power output. Again there should be two noticeable peaks when each of these caps are adjusted, but they may be close enough together that it looks like one long peak.

5) You will notice that when trimmer pot R63 is adjusted from one end to the other, the output power will increase to full power and decrease to no power. Adjust R63 no farther than necessary to obtain maximum power output.

6) Trimmer capacitor C89 adjust the CW carrier oscillator frequency, which offsets the transmitter signal by 700 Hz. The easiest way to adjust the offset is to listen to a signal transmitted from your present transceiver on the OHR QRP 20. Then transmit a signal from the OHR QRP 20 and adjust C89 until a 700 Hz tone is heard in your present transceiver. This way you will be assured that the offset is approximately 700 Hz. You can also make this adjustment using a frequency counter connected between the source of Q14 and ground. Key the transmitter and adjust C89 to a frequency of 8.9993 MHz.

If any signs of instability are noted during transmitter tune-up, reduce the value of R68. A 39 ohm resistor is included with the kit, so try a 33 ohm next and so on.

FINAL ASSEMBLY:

1) Remove the temporary ground wire from the frame of C5, the air variable capacitor. This wire is no longer needed. Unsolder the short wire coming from the board to the stator terminal on C5. Leave the wire soldered to the board, just unsolder at the stator terminal of C5. Now scrape and clean any paint from the inside of the cabinet at all punched hole locations. Do both front and rear panels and inside of chassis. You will need a good ground at all these locations.

2) Mount C5, the air variable capacitor, to the floor of the chassis at the two small holes near the center of the chassis. The corresponding holes in C5 are drilled & tapped for 4-40 hardware. Use the hardware packed with C5. Place a #4 lockwasher on one of the 4-40 X 5/16" screws, then put it thru one of the holes in the chassis. Place two #4 lockwashers on the screw, and a #6 nut (used as a spacer). The #6 nut will help hold the screw in place. Repeat this procedure for the other screw. Place the shaft of C5 thru the center round hole in the front panel, hold C5 in position and start the screws in the two tapped holes of C5. Now tighten these screws.

3) Install the PC board mounting hardware in the four holes on the bottom of the chassis using the following procedure: Insert a 4-40 X 3/8" screw into one of the holes from the bottom of the cabinet. Then install a #4 lockwasher, and a 4-40 nut and another #4 lockwasher. Position the nut about half way on the screw. Repeat this procedure at the other three holes.

4) Now position PC board assembly such that you can insert R32, R46, S1, and J1 into their appropriate holes. Loosely attach the mounting hardware from the front of the panel. Position the PC board on the four mounting screws and start a 4-40 nut on each. Now tighten the screws from the bottom of the cabinet drawing everything up tight. You may have to retighten the 4-40 nuts on top of the board. Be careful not to damage near-by components when tightening these nuts. Just take your time.

5) Insert the 1" wire coming from the PC board into the stator terminal of C5. Dress all wires away from this area so as not to damage any of them with the soldering iron. Now carefully solder the 1" wire to the stator terminal of C5. Redress the leads and tighten the hardware on R32, R46, S1, and J1.

6) Install J2, J3, and J4 on the rear panel using the hardware supplied with each. The flange on J2, the SO-239, goes on the outside of the panel. Also, mount a #4 solder lug on the inside of the panel at the upper left hole of J2. J4, the power connector, goes in the center hole. J3, the key jack, goes in the right hole. Solder the leads to the appropriate connector.

7) Slide the plastic dial plate onto the shaft of C5. Install knobs on control shafts. After VFO has had a final adjustment, turn the shaft of C5 so it's plates are fully meshed. Now turn dial plate to align the "0" with the vertical cursor line.

FINAL CHECKOUT AND ALIGNMENT:

1) After the transceiver is securely mounted in the cabinet and all connections to the jacks are made, apply power to the unit. Set the plates of air variable capacitor C5 fully meshed (closed). With a frequency counter connected to the emitter of Q3 and ground, set the RIT pot to it's center detent position. Now compress or expand the turns on L1 until the counter reads 5 MHz. After this adjustment is made and everything looks ok, you can seal L1 with a few drops of melted candle wax. Or if you prefer, Q-DOPE can be used instead of wax. You can also do the same for coils L4 thru L9 and transformers T1 and T2.

2) The output power you obtain will depend on the power supply voltage. This 20 Meter kit should have an output of 2W using a 12 Vdc supply and 2.5 to 3W using a 13.8 Vdc supply. DO NOT use over 14 Vdc with this transceiver.

3) You should install a fuse rated at 1 1/2A in the positive supply line.

4) To obtain best receiver audio, 8 ohm headphones should be used.

Thank you for purchasing this transceiver kit. We hope it provides you with many thousands of QRP QSO's. Remember, we are always available to answer any questions or problems that you have with any of our kits. Best of Home-Brewing and QRPing.

OAK HILLS RESEARCH

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20M QRP CW TRANSCEIVER KIT

SPECIFICATIONS:

FREQUENCY RANGE: 14000 TO 14100 KHz

TRANSMIT OFFSET: 700Hz

MODE: CW

POWER REQUIREMENT: 13.6VDC (NEG. GROUND)

POWER CONSUMPTION: 850mA TX (2.5W); 60mA RECEIVE (NO SIG)

ANTENNA IMPEDANCE: 50 OHMS

T/R SWITCHING: SEMI-BREAK IN

SIDETONE FREQUENCY: 700Hz

SEMICONDUCTORS: 7 IC'S; 14 TRANSISTORS; 13 DIODES

TRANSMITTER:

FINAL POWER OUTPUT: 2-3 WATTS

FINAL OUTPUT STAGE: MRF472 OR 2SC2092

RECEIVER:

CIRCUITRY: SINGLE-CONVERSION SUPERHET
IF: 9MHz

SENSITIVITY: .25uV

SELECTIVITY: 1KHz @ (-6db) 4 POLE CRYSTAL LADDER FILTER
AUDIO FILTER: 1KHz; WITH CENTER FREQ. OF 700Hz

RIT: ± 1.5 KHz

AUDIO OUTPUT: 500Mw

OHR QRP 20 PARTS LIST:

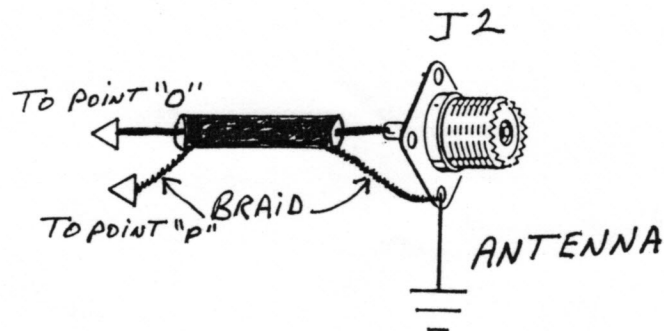
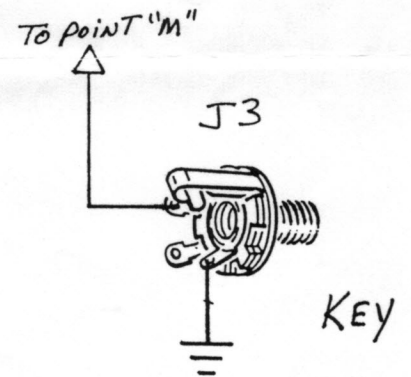
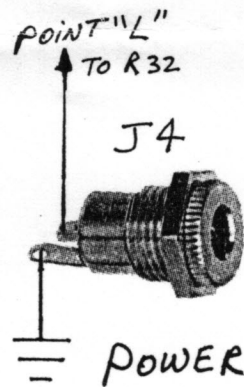
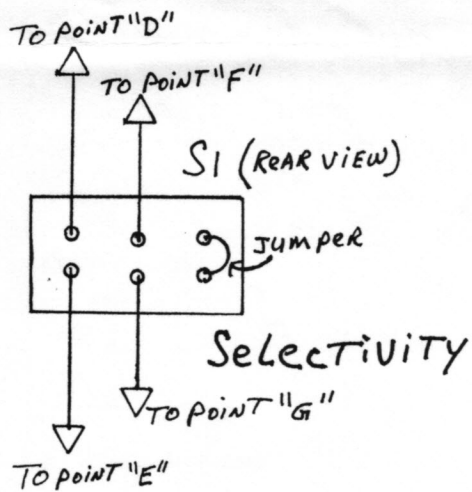
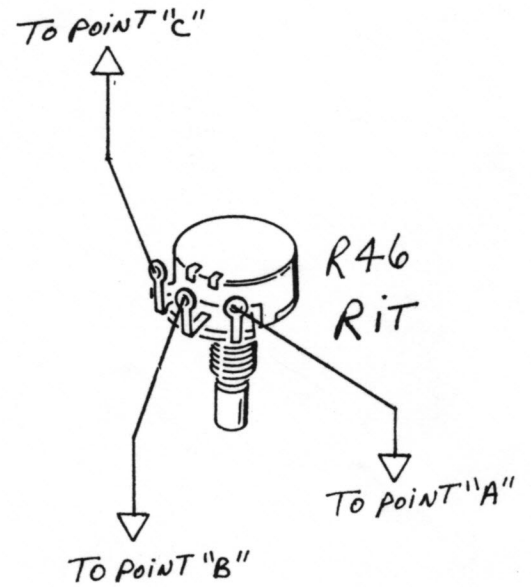
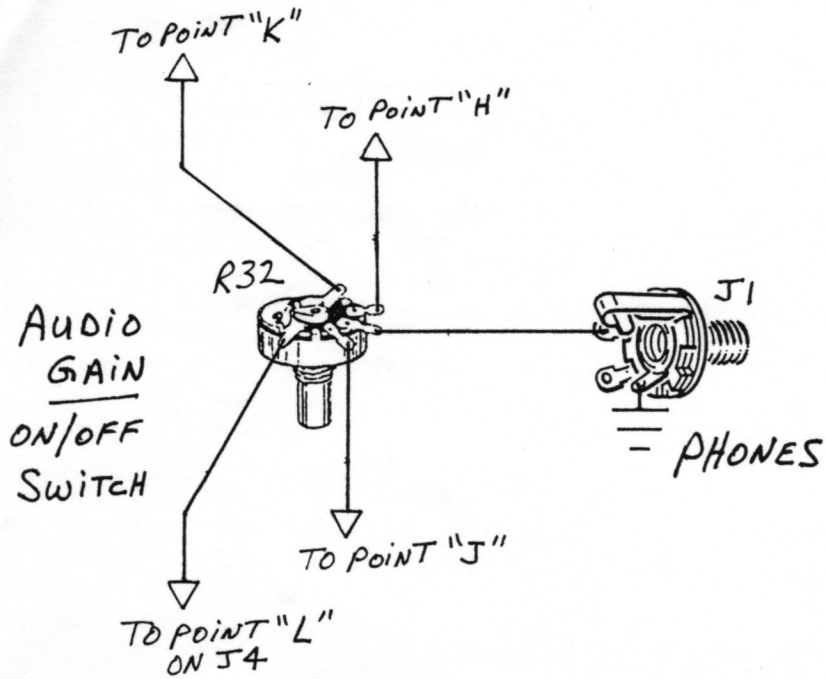
C1,C2 - 680pf (681) NP0 MONO CAPS
C3,C6 - 220pf (221) NP0 MONO CAPS
C4 - 150pf (151) NP0 MONO CAP
C5 - 17pf AIR VARIABLE CAP W/HDWE
C7,C8,C14,C26,C28,C32,C36,C42,C48,C49,C57,C58,C59,C60,C62,C66,
C67,C73,C74,C76,C78,C79,C81,C86 - .1uF (104) MONO CAPS
C9,C16,C22,C24,C25,C41,C44,C45,C53,C54,C55 - .01uF (103)
MONO CAPS
C10,C29,C77,C87 - 33pf (330) NP0 MONO CAPS
C11 - 2.7pf (279) CER DISC CAP
C12,C13 - 27pf (27) CER DISC CAPS
C15,C23,C31,C69,C70,C89 - 70pf (ORG) TRIM CAPS
C17,C21 - 330pf (331) NP0 MONO CAPS
C18,C20 - 470pf (471) NP0 MONO CAPS
C19 - 560pf (561) NP0 MONO CAP
C27,C33,C56 - .001uF (102) CER DISC CAPS
C30,C88 - 68pf (680) NP0 MONO CAPS
C34,C35,C37,C40 - .001uF (1000pf) POLY CAPS
C38,C47,C75,C80 - 10uF 25V ELECTROLYTIC CAPS
C39 - 47uF 25V ELECTROLYTIC CAP
C43,C52 - 1uF 25V ELECTROLYTIC CAPS
C46 - .047uF (473) MONO CAP
C50 - 100uF 25V ELECTROLYTIC CAP
C51,C61,C63 - 22uF 25V ELECTROLYTIC CAPS
C64,C65 - .1uF (104) CER DISC CAPS
C68,C71 - NOT USED
C72 - 5pf (479) CER DISC CAP
C82,C83,C84,C85 - 220pf CER DISC CAPS
D1,D3,D4,D5,D6,D9,D10,D11,D12 - 1N4148 DIODES
D2,D13 - 1N757 OR 1N5239B 9.1V ZENER DIODES
D7 - MV2109 VARACTOR DIODE
D8 - 1N752 OR 1N5232B 5.6V ZENER DIODE
L1 - T44-6 CORE (YEL) / #28 RED WIRE
L2,L3 - GRN CORE TRANSFORMER (421F123)
L4,L5 - T44-2 CORE (RED) / #28 RED, GRN, GOLD WIRE
L6,L7 - T44-2 CORE (RED) / #28 RED, GRN, GOLD WIRE
L8,L9 - T44-2 CORE (RED) / #24 RED WIRE
Q1,Q4,Q5,Q14 - MPF102 TRANSISTOR
Q2,Q3,Q7,Q8,Q9 - 2N3904 NPN TRANSISTOR
Q6 - 2N3906 PNP TRANSISTOR
Q10 - 2N2906A PNP TRANSISTOR
Q11,Q12 - 2N2222A NPN TRANSISTOR
Q13 - MRF472 OR 2SC2092 TRANSISTOR
RFC1 - 470uH CHOKE (YEL-VIO-BRN)
RFC2,RFC4 - 15uH CHOKE (BRN-GRN-BLK)
RFC3 - 100uH CHOKE (BRN-BLK-BRN)
R1,R8,R10,R69 - 330 OHM 1/4W RES (ORG-ORG-BRN)
R2,R43,R44,R70 - 100K OHM 1/4W RES (BRN-BLK-YEL)
R3,R67,R68 - 39 OHM 1/4W RES (ORG-WHT-BLK)
R4,R19,R35,R50,R55,R58,R60,R66 - 1K OHM 1/4W RES
(BRN-BLK-RED)
R5,R6,R12,R24,R25,R37,R39,R41,R47,R48,R52 - 10K OHM 1/4W RES
(BRN-BLK-ORG)
R7 - 33K OHM 1/4W RES (ORG-ORG-ORG)

OHR QRP 20 PARTS LIST: CONT

R9, R13, R27, R29, R59 - 3.3K OHM 1/4W RES (ORG-ORG-RED)
 R11, R62 - 100 OHM 1/4W RES (BRN-BLK-BRN)
 R14, R15 - 1.8M OHM 1/4W RES (BRN-GRY-GRN)
 R16, R53 - 680K OHM 1/4W RES (BLU-GRY-YEL)
 R17, R20 - 24K OHM 1/4W RES (RED-YEL-ORG)
 R18, R21, R33 - 22K OHM 1/4W RES (RED-RED-ORG)
 R22, R30, R31, R64 - 15 OHM 1/4W RES (BRN-GRN-BLK)
 R26, R54 - 1M OHM 1/4W RES (BRN-BLK-GRN)
 <C> R28, R38, R40, R45, R49 - 47K OHM 1/4W RES (YEL-VIO-ORG)
 R32 - 1K OHM LINEAR TAPER POT W/SWITCH (AF GAIN)
 R34 - 2.2M OHM 1/4W RES (RED-RED-GRN)
 R36 - 10K OHM PC TRIM POT (103)
 R42 - 1M OHM PC TRIM POT (105)
 R46 - 10K OHM LINEAR TAPER POT W/CENTER DETENT (RIT)
 R51, R65 - 4.7K OHM 1/4W RES (YEL-VIO-RED)
 R56 - 820 OHM 1/4W RES (GRY-RED-BRN)
 R57, R61, R71, R72 - 470 OHM 1/4W RES (YEL-VIO-BRN)
 R63 - 500 OHM PC TRIM POT (501)
 R73 - 1.5K OHM 1/4W RES (BRN-GRN-RED)
 S1 - MINIATURE DPDT TOGGLE SWITCH
 T1, T2 - FT37-43 FERRITE CORE / #26 RED, GRN WIRE
 U1, U3 - NE602AN LINEAR IC
 U2 - MC1350P LINEAR IC
 U4 - TL072CP DUAL LOW NOISE OP AMP
 U5 - LM386N-3 LINEAR IC
 U6 - 78L09 9V 100mA POS REG
 U7 - MC1496G LINEAR IC (UA796HC)
 Y1, Y2, Y3, Y4, Y5, Y6 - 9 MHz HC-18/U CRYSTAL
 5 EA - 8 PIN DIP SOCKET
 1 EA - 16 PIN DIP SOCKET
 1 EA - DPDT 12V RELAY
 1 EA - TO-220 STYLE PC MOUNT HEATSINK
 5' - #24 RED, BLK, WHT SOLID HOOK-UP WIRE
 1' - RG174/U MINIATURE COAX CABLE
 1" - #20 RED SOLID HOOK-UP WIRE
 1 EA - COAXIAL TYPE JACK W/PLUG (POWER)
 1 EA - SO-239 FLANGE TYPE JACK W/HDWE (ANTENNA)
 2 EA - 1/4" PHONE JACK (HEADPHONES & KEY)
 1 EA - PRE-PUNCHED & LETTERED CABINET
 1 EA - KNOB SET (1 LARGE & 2 SMALL)
 1 EA - SCREENED DIAL PLATE
 1 EA - HARDWARE PAK
 1 EA - PC BOARD
 1 EA - SET OF INSTRUCTIONS

PICTORIAL DIAGRAM

WIRING CONNECTIONS TO POTS, JACKS, & SWITCHES





1 YEAR LIMITED WARRANTY

OUR RESPONSIBILITY

PARTS - Replacements for defective parts will be supplied free for 1 year from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts by writing or telephoning us at (616) 796-0920. We will pay the shipping charges on these parts.

SERVICE LABOR - For a period of 1 year from the date of purchase, any malfunction caused by defective parts will be corrected at no charge to you. You must deliver the unit at your expense to Oak Hills Research.

TECHNICAL CONSULTATION - You will receive free consultation on any problem you may encounter in the assembly or use of our product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED - The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in it's entirety. This warranty does not include reimbursement for inconvenience, loss of use, or customer assembly.

This warranty covers only Oak Hills Research products and is not extended to other equipment or components that a customer uses in conjunction with our products.

OWNERS RESPONSIBILITY

EFFECTIVE WARRANTY DATE - Warranty begins on the date of first consumers purchase. You must supply a copy of your invoice when you request warranty service or parts.

SHIPPING UNITS - When shipping a unit back to us for repair, use adequate packing material. Damage due to inadequate packing cannot be repaired under warranty.

OAK HILLS RESEARCH

20879 MADISON STREET

BIG RAPIDS, MI 49307

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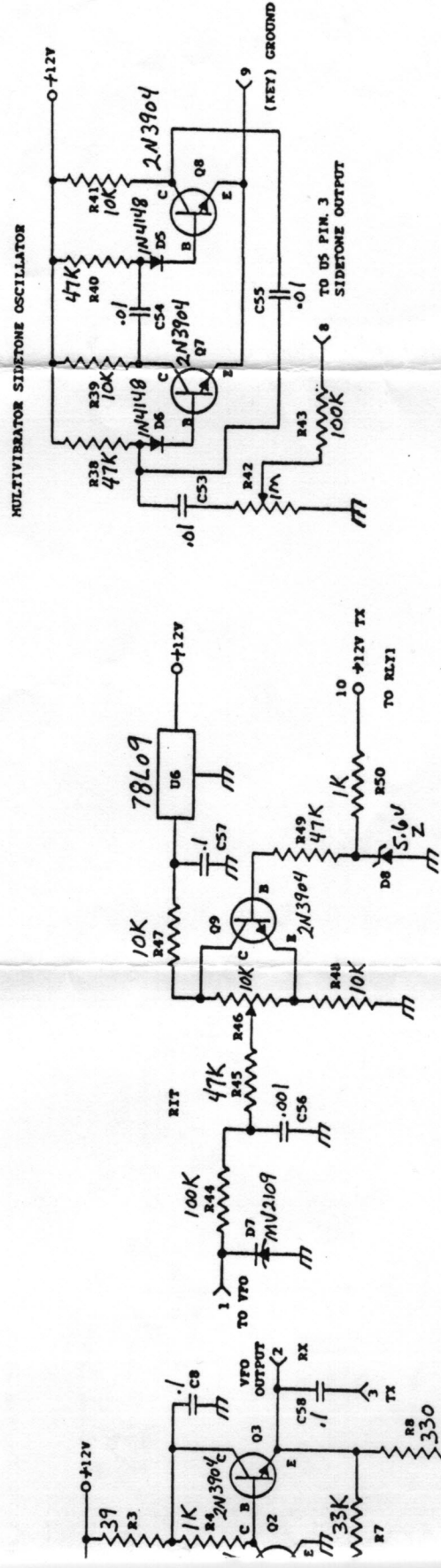
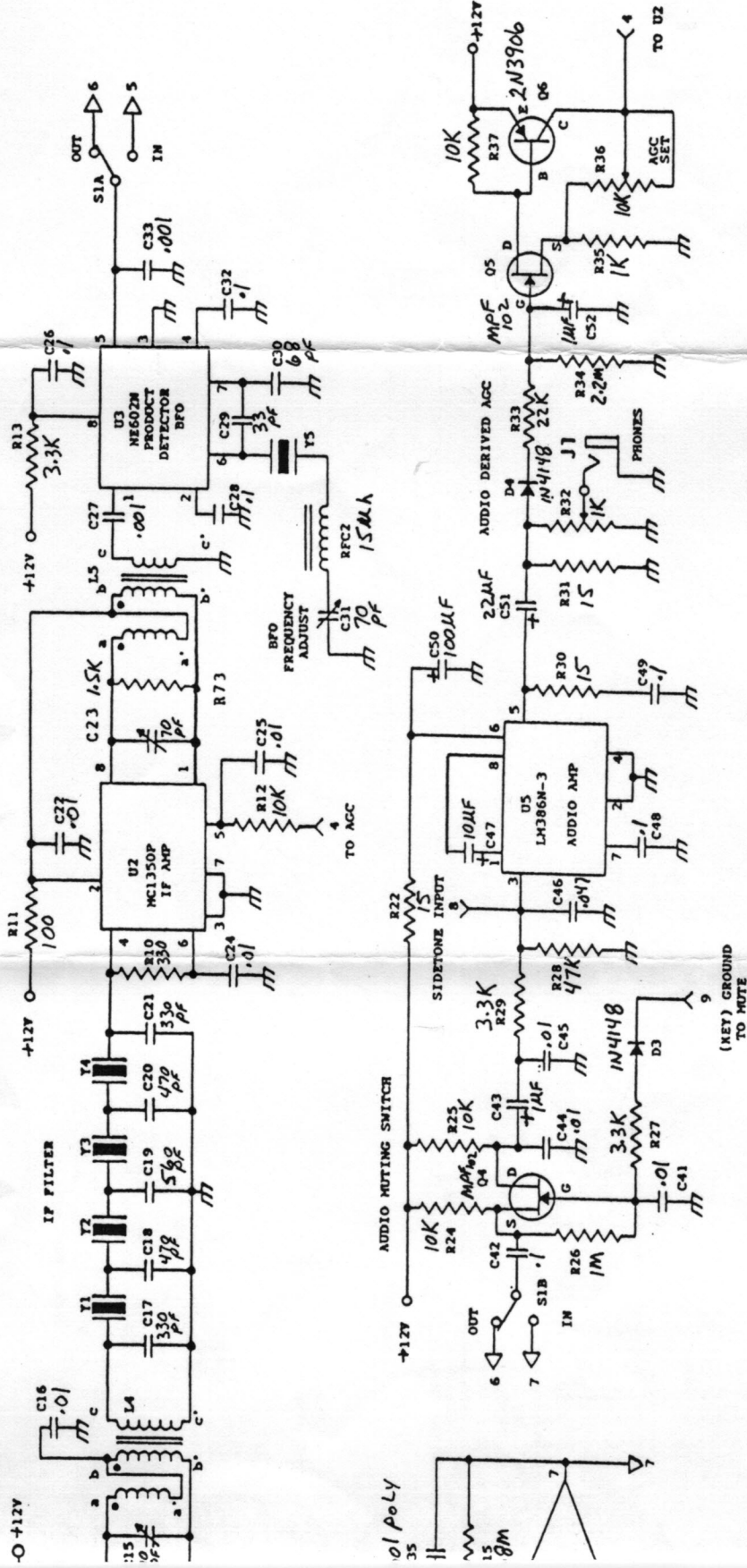
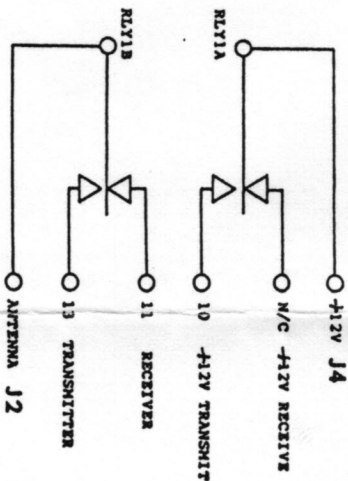
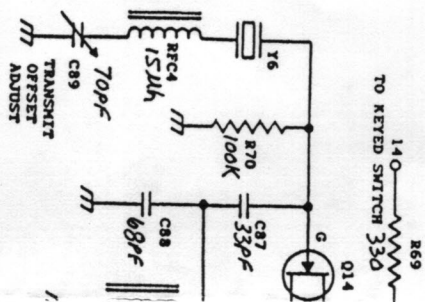


DIAGRAM OHR QRP 20 TRANSCEIVER



SCHEMATIC DIAGRAM OFR QRP 20 TRANSCIEIVER
TRANSMITTER SECTION



OAK HILLS RESEARCH

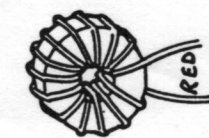
20879 MADISON STREET

BIG RAPIDS, MI 49307

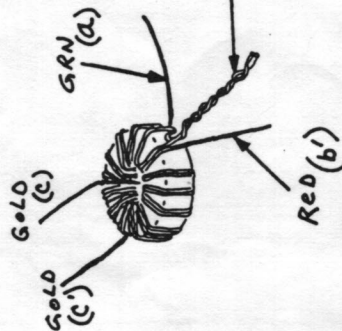
(616) 796-0920

PARTS OVERLAY

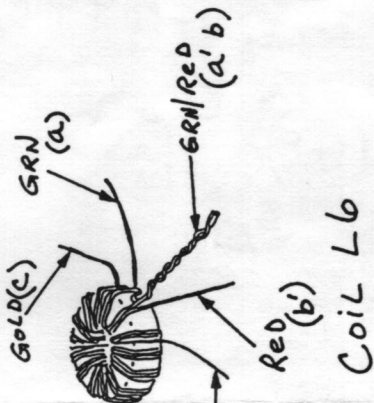
VIEWED FROM COMPONENT SIDE OF BOARD



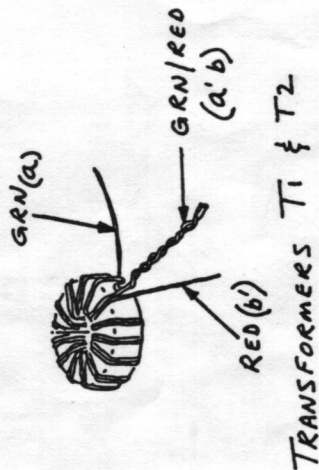
COILS L1, L7, L8, & L9



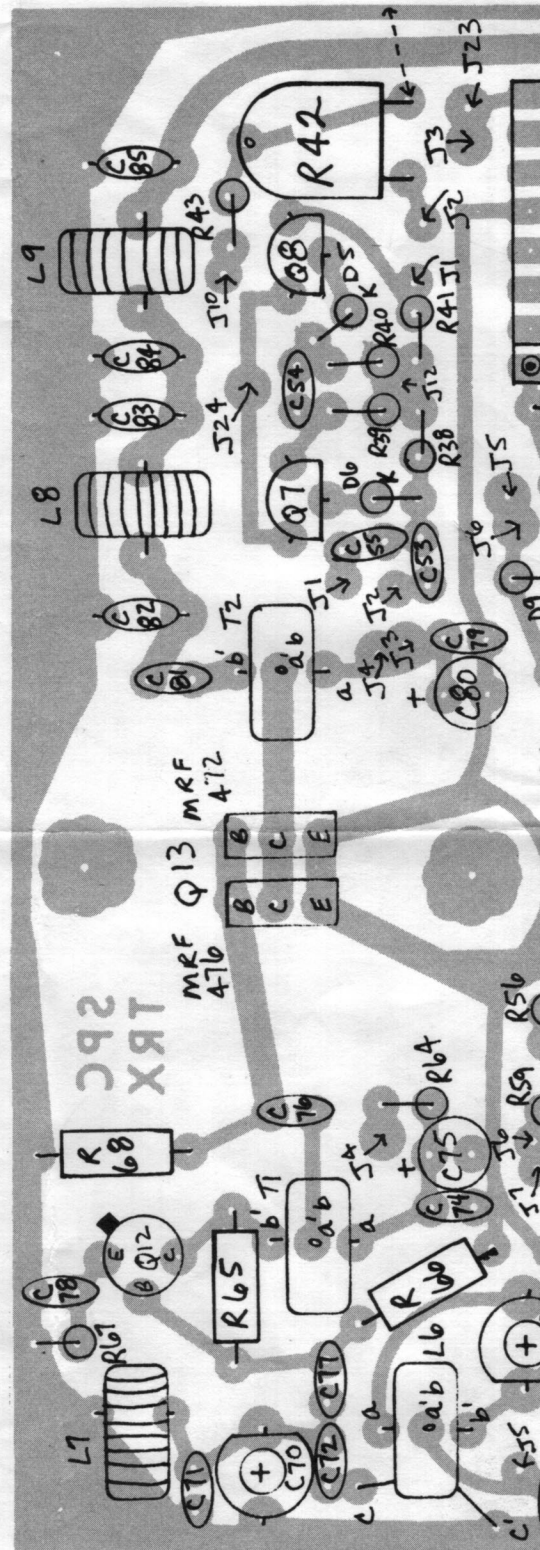
COILS L4 & L5

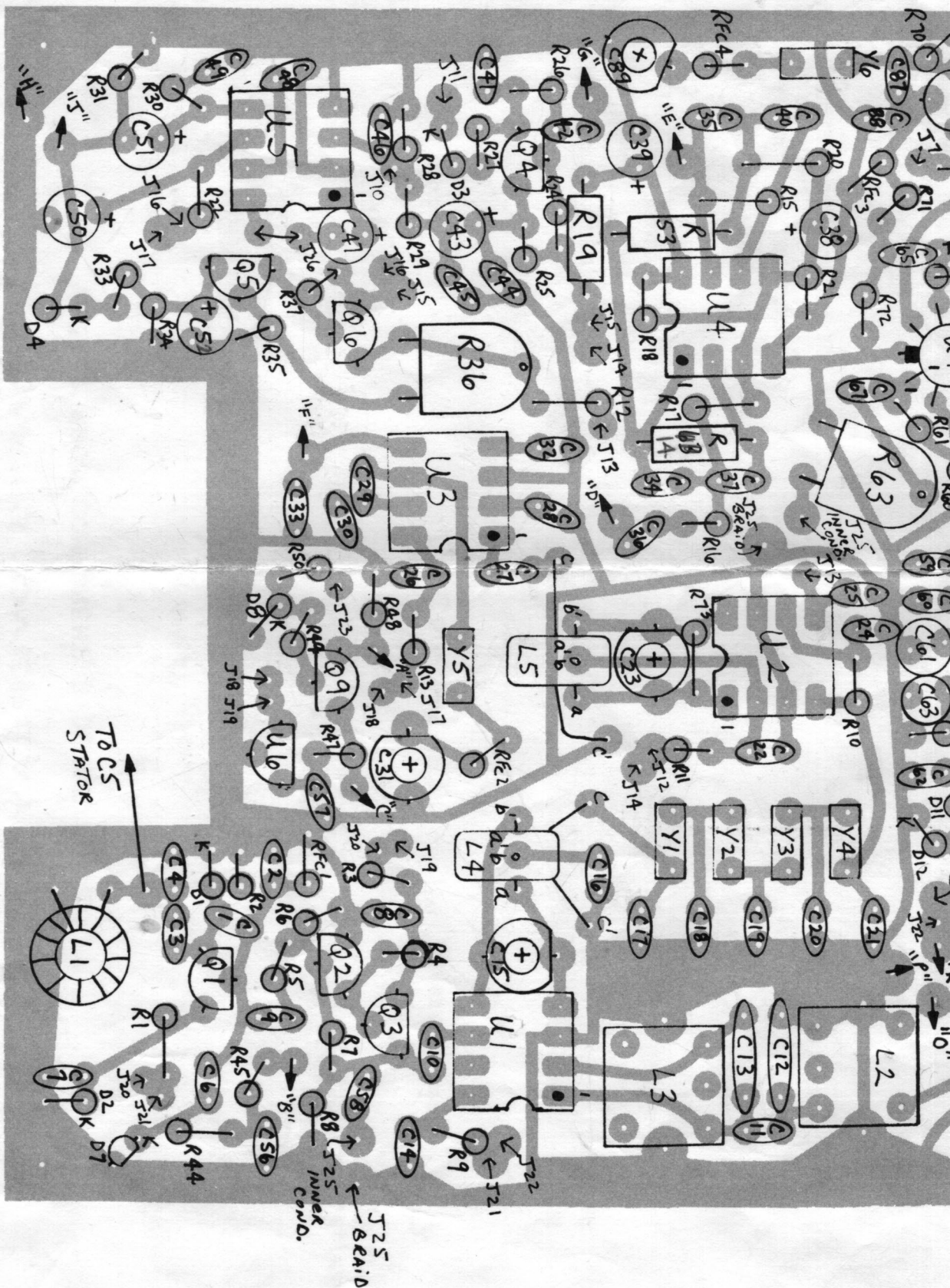


COIL L6



TRANSFORMERS T1 & T2





2415

