EXP1750a

A "GROOVY" SSB/CW TRANSCEIVER FOR THE 1750 METER LONGWAVE BAND; 160 KHz-190 KHz.

Today's new technology provides use with the means of exploring our radio hobby with far more ease and success. Implementing this technology allows us to overcome many of the limitations which had previously discouraged potential LOWFERS (Low Frequency radio enthusiasts) from achieving successful results. I won't fool you. 1750 meters is not for the faint hearted! This band can be very noisy, filled with static, man made interference, and carriers. Add to this the FCC (part 15) regulations that limit our transmitter DC INPUT power to 1 Watt and the transmitting antenna length, including feed line, to 50 feet. What to do? Why go to the trouble? Newer, better technology overcomes many of these roadblocks and will provide you with the pearl in the oyster; a truly great band, well worth your effort.
1750 Meters is fun. It has amazing ground wave propagation that allows even low power levels such as these to travel surprisingly far (several hundred miles).
When the band is quiet, its REAL quiet (you can hear a pin drop). All of this, and license free too. If you enjoy building electronic kits, and "getting on the air", then this may suit your taste. In my opinion; this is *true* Amateur Radio!

WHO CAN YOU TALK TO?

Currently there is quiet a few beacon stations across the country that send repetitive messages and/or call signs. Call signs are usually created from the last three letters of a Ham call sign, or your initials. Beacons are very helpful in determining band conditions and propagation. SSB communication on the other hand has not been as quick to catch on, which leaves a gapping hole in terms of practical communication. Single sideband is the best mode for voice communication, and works quiet well on 1750 Meters. An example of this is the 9AM Saturday morning contact I enjoy with my buddy, Randy Seden (call sign ELU) on 183.5 KHz, for the past 14 years. Talk about regular contact! Recently, a growing number of new stations have joined our local "net", including DJL in Thousand Oaks (40 miles), and SB in Santa Barbara (90 miles). It helps to have "radio" friends who live a reasonable distance from you to become involved in this project, thus insuring successful two-way communication. Distances in the 100 mile range are not uncommon for voice (SSB) communication, with CW (Morse code) easily doubling the distances of SSB, which is limited primarily by local noise, transmitting power, and more importantly; *Your Antenna System!* A key factor in successful operation is the use of a resonant antenna. You must use a resonant VERTICAL antenna for transmission or your signal will go NOWHERE!

The antenna and ground system should be considered an important part of your LF station. To aid in this endeavor, a considerable amount of antenna information is included in this manual to assist in your antenna design. The authors who have written these articles have extensive experience with 1750 Meters and have spent hundreds of hours experimenting with practical "LowFER" antennas.

TRANSCEIVER FEATURES

Everything you need to effectively communicate has been included. The front panel controls are:

FRONT PANEL:

ON/OFF:	Turns the power on and off.
LED:	Led illuminates during transmission for indication of RF clipping.
PRESELECTOR:	Peaks the receiver-input frequency. Adjustable from 160 KHz to 190 KHz.
Q MULTIPLIER:	Peaks the RF Preselector for best response of voice and CW.
MIC GAIN:	Adjustable gain control for microphone.
FREQUENCY:	Adjustable frequency control for tuning the desired frequency. Tuning range is 15 KHz.
FREQUENCY A/B:	Switch selects either the upper or lower 15 KHz slice.
VOLUME	Audio speaker/headphone volume.
IF GAIN	Adjusts the AGC level and IF sensitivity.
NOISE BLANKER:	Removes impulse noise. Continuously adjustable.
CW FILTER.	CW/SSB audio filter with adjustable bandwidth (accessory).
NOTCH FILTER	Removes heterodyne or interference from carriers. Notch Frequency is adjustable (accessory).
S-METER:	Displays relative signal strength of received signal and displays output current during transmission when used in conjunction with the RF Detector accessory.

REAR PANEL:

POWER JACK:	Male receptacle accepts 13.5 to 24 Volts, filtered D.C. 4 amps minimum of current capability is recommended for output power greater than 1 Watt.
GROUND JACK:	Banana receptacle for station ground.
R.F. JACK:	BNC style for receive and transmit.
SPEAKER JACK:	3.5mm mini phone audio output to 8-Ohm speaker or headphones. up to 3 watts of audio power.
CW JACK:	3.5mm mini phone jack used for your code key. The tip is normally high, and should be grounded to send CW. Transceiver automatically goes from receive to transmit operation upon activation.
MIC JACK:	A Mic jack is not included due to the enormous variety of microphones (see text).

CW DELAY: A control trimmer used to adjust the delay from transmit to receive while sending CW.

DRIVE LEVEL: Sets the transmitting output level.

OTHER CONTROLS:

PA BIAS: Controls the bias level to the transmitting transistors for class B operation.

SIDETONE: Adjusts the frequency of the sidetone oscillator (usually 1 KHz).

CW FILTER: Adjusts the frequency of the CW filter (accessory).

ACCESSORIES:

CW/NOTCH FILTER: This feature is not included in the kit. It is not required for normal operation of the transceiver. It does, however, add considerably more control in removing or filtering out unwanted signals. The components used for this circuitry have their reference designators as 200, example R200 or C204.

R.F. CURRENT: The RF current detector measures current going to the antenna during transmission. This is very useful in determining proper antenna operation and resonance at the desired frequency. When the antenna is tuned correctly the current meter will tell you how much current is driving the antenna. This is not included with the transceiver kit.

JUMPERS:

JP1: (See schematic) JP1 is a jumper wire that is installed when using the same antenna for transmit and receive operation. If you plan on using another type of antenna for receive, such as a loop or active whip, then JP1 should not be installed except temporarily for testing purposes. JP1 can connect to a switch for selecting a variety of receive antenna's, thus enabling you to optimize your receiving capability. This does not affect the transmitting antenna.

JP2: (See schematic) JP2 is a bypass jumper if the RF Current Detector is not used.

JP3:	(See schematic) JP3 is installed if Notch/CW filter is not used.
JP4:	(See schematic) Preselector jumper is used for 1750-Meter operation.

COMPONENT PLACEMENT AND TESTING

There are two ways to build this kit. If you are an experienced kit builder you may want to bypass the modular building/testing section below and install parts in any order you wish, and use the testing procedure in each section once completed. A few things must be done if you skip our elaborate step-by-step process.

1. Transformers T1-T6 must have the piston capacitor inside the bottom removed. Crushing it with a small screwdriver does this.
2. Many parts are installed into the solder side of the circuit board. These parts are; J3, L3, R21, R24, R41, R83, S1, and S2. Install these parts first!

For less experienced builders, or if you desire to check each section as it is built to ensure a working finished product, we will install components one section at a time. Doing it step-by-step will save time later as the radio will already be fully tested and aligned. This is considerably helpful in becoming more familiar with your transceiver.

ASSEMBLING A LONGWAVE STATION

The following is a short list of items, which will help to make your 1750-Meter experience as hassle free as possible. Consider ordering these items if they are not already in your arsenal.

1. RF Ammeter; 0-1 Amp scale with thermocouple. These aren't cheap, but worth their weight in gold. A good meter for this purpose is available from Surplus Sales of Nebraska, model (MTR)152-352, which costs $55.00. Avoid meters rated higher than 1 or 1.5 Amps, unless you're operating high power. See Fig. 8 for Pix of a garden-variety current meter.
2. BNC fitted cables to connect the transceiver to a dummy load and RF current meter, (buy two).
3. 50 Ohm "dummy" load.
4. Power supply. Regulated, filtered, DC supply capable of 22 Volts at 4 Amps.
5. Speaker. Good fidelity speaker, 8 Ohms. 1/8" connector required.

6. Microphone. High-Z style, such as the Astatic "D-104", with push-to-talk switch
7. Code key. If you plan on sending code you will need a code key. 1/8" connector is required to mate to the transceiver jack.
8. Antenna cable. RG-58 coax cable is satisfactory. The end, which is connected to the transceiver, will need a BNC female connector or BNC adapter if using a PL259 connector.
9. Vertical antenna (see antenna information section).
10. Loading coil. You will need to wind a loading coil to match your antenna to the transceiver (see antenna information section).

NECESSARY TOOLS

Soldering iron with a good miniature tip and a rating of 30 to 50 Watts is recommended. Good quality solder, preferably the miniature type, with the "new" organic core is recommended. Kester# 24-6337-6401 is a very good solder, and available from Mouser Electronics (phone 800.346-6873). Needle nose pliers and small size wire cutters will be needed, as well as a small screwdriver or "Tweeker" for adjusting RF transformer/Inductor slugs.

TEST EQUIPMENT

50 MHz (minimum) oscilloscope with a 1 megohm input, scope probe should have 1:1 and 10:1 range @ 10pF input capacitance (or as small as possible). RF signal generator. Frequency counter, and a DMM.

COMMENTS The silk-screened circuit board is used as a guide for component placement. Part outlines are used to indicate which type of part to use. *Circles* are generally used to indicate capacitors, while *rectangles* usually indicate resistors and inductors. In locations where parts are very close together, the part number may be INSIDE the part outline to save space. Tantalum and electrolytic capacitors must match the polarity shown on the outline.

INSTALL# 1; POWER CIRCUIT:

Reminder: All components are installed on the silk screened side of the circuit board unless noted. Some capacitors are designated without full lettering, IE: C21="21".

1. D18. D18 is an LED, installed on the solder side of the circuit board. Note where the long lead is installed. Bend the leads at a right angle ¼ inch from the bottom of the led. Solder the leads so that the LED is positioned ¼ Inch from the circuit board, facing forward.
2. SPDT switch S1 on the component side, directly above D18. Make sure to solder the small two front tabs.
3. 3.5mm power jack (J1).
4. Voltage regulator U7, "7812". Note the polarity.
5. 470 uF electrolytic capacitors C84, C85, C86. Note polarity.

6. Capacitors (C69, C70, C71, C72) .1uF disc with "104" indicated on component.
7. Diode D15 (optional, see bellow).

SUPPLY TEST

Diode D15 is optional. If reversing the power supply is a possibility, a 2-amp diode may be installed at D15 to protect the transceiver.

1. Insert the power plug into J1. Your supply must provide a minimum of 13.5 Volts DC, with a current capability of 3 Amps.
2. Switch S1 to the ON position (up). With a Voltmeter, measure the Voltage at location marked "M+" (next to R96). This should equal your input Voltage. Use J3 as a ground point for your meter.
3. Next measure your regulator output Voltage at U11, pin 8. This should measure 12 Volts. If no Voltage is measured or if the regulator is hot, disconnect and check the polarity of the electrolytic capacitors or the circuit board traces for any shorts. Also check for the possibility of an open trace with an Ohmmeter.
4. Turn switch S1 off; disconnect power plug at J1.

INSTALL#2; PRESELECTOR (Please see Fig. 1 in "Design Photographs)

1. BNC jack J4, located at the back of the board.
2. Jumper JP2a, b. Use a leftover component lead. If you plan to use the current meter do not install JP2, and follow the instructions listed on the *RF current Meter accessory* instruction sheet.
3. DPDT relay K3, (G5V-2).
4. Install jumper JP1. Use a piece of component lead. See *modifications* section regarding the use of JP1.
5. Variable Inductors L1, L2; 1.5mH. Marked "T1096."
6. C2; 7.5pF ceramic disc marked "7.5."
7. C3, C6, C27; "yellow" capacitors with "331" indicated.
8. C7, C91-93; .018uF green capacitors with "2A183J" indicated.
9. C16; .0033uF. Small yellow capacitor with "332" indicated.
10. C4, C5, C15; .22uF. Small yellow capacitors with "224" indicated.
11. Jumper JP4 (located behind inductor L1).
12. D1, D8, D14; MVAM109 varactor diodes, shaped like "  ". Note polarity.
13. D13, D17; 1N914 diode. Note polarity.
14. C8, C9, C11, C13, C41, C95; .1uF disc capacitors marked "104".
15. C33;180pF. small yellow capacitor marked "181".
16. C10; 220pF small yellow capacitor marked "221".
17. T1; transformer marked "154AC470072. Break internal piston capacitor before installing.
18. R4, R51; 33 Ohm resistor. R51 mounts vertically.
19. R64; 180 Ohm resistor, mounted vertically.

20. R3, R26, R49; 470 Ohm resistor. R3 mounts vertically.
R1, R2, R15, R22, R30, R62; 4.7K Ohm resistor. R2, R30, R47 mount vertically.
21. R91; 10K Ohm resistor. Mounts vertically.
22. R5, R29; 1.2K Ohm resistor.
23. C12, C40, C48; 22uF tantalum capacitor, "22u/35V", or similar.
24. Q1; JFET, marked"J310". Note device polarity. Handle with care, this component is static sensitive.
25. U1, U4; IC, "NE602". Note the correct polarity.
26. U8; IC; "MC1350P". Note polarity.
27. R21; 50K potentiometer, green color with "B50K" inscribed. Install on *solder side*. Solder pins on component side, don't solder tabs yet.
28. R19, R31; 10K Ohm potentiometer. These potentiometers have no inscription, so you must measure them with an Ohmmeter for a value of 10K Ohm. Install on component side. Solder all pins and tabs of R19, R21, and R31.
29. R47; 4.0K Ohm, 1% metal film resistor. Mounts vertically.

PRESELECTOR ALIGNMENT

The Preselector/Q-Multiplier tuning Inductors (L1,2) must be aligned to track the desired input Frequency. A small blade screwdriver is used to adjust each Inductor. A plastic tuning wand with a small metal blade is recommended, if available. Be gentle while turning the tuning slugs.
A RF signal generator and oscilloscope will be required for this procedure.

1. Set RF generator Frequency to 183 KHz with an output level of 10 mV (-30DBm). Connect the output of the RF generator to the BNC antenna jack, (J4).
2. Connect Power supply and turn the transceiver ON.
3. Adjust Preselector potentiometer, R31, to the 12 O'clock (middle) position.
4. Set the Q-Multiplier potentiometer, R19, fully counter clockwise.
5. On the oscilloscope, set horizontal sweep time to 2uS/100mV. Connect probe to U8, pin 6. Connect probe ground clip to the voltage regulator tab of U7. Turn L1 and L2 for maximum response (usually in a clockwise direction). Reduce signal generator output as necessary.
6. Rotate Q-Multiplier potentiometer R19 fully clockwise. A slight dip in the signal may occur. Re-align L1 and L2 for a peak response. The peak will be very pronounced. Rotate R19 fully counter clockwise.
7. Measure the DC Voltage at pin 8 of U1 and U4, which should be 8 to 9 Volts.

TROUBLE: If you encounter something other than these values, check the Ohms/Volts table for troubleshooting assistance.

INSTAL# 3; BFO/LO (Local Oscillator)

Disconnect all previous test and power supply equipment.

1. C1, C14, C19, C37, C42, C51; 68pF "yellow" disc capacitor, marked "680".
2. S2. Install push-switch on solder side. Component leads are soldered from the component side. Add the knob after installation.
4. L3. Mounts on solder side, ¼ inch from board. Marked "15 uH, 2A".
5. Y1, Y10; VXO crystals. Install crystal marked "10.1819" into Y1. Y10 is the accessory crystal, marked "". Place a small dab of solder from the case of Y1/Y10 to the solder pads located directly next to each case.
6. C18; Variable capacitor. Locate the side with 5 leads and install into the circuit board. Make sure the tuning shaft is facing toward the front. Pull the leads firmly and solder. Clip away excess leads. Solder a bare wire from the lead on the right side of C18 into the small hole directly underneath. Locate the black, ½" fiber shaft and metric screw. Install into the front of C18. Do not over-tighten, a dial will be added later.
7. T2, T5; Transformers marked "154PC470033N". Remove internal capacitor by breaking it with a small blade before installation.
8. C17, C64, C66, C94; 470pF "yellow" capacitor. Marked "471".
9. Y9, BFO crystal marked "9.996400". Place a small dab of solder from the case of Y9 to the solder pad under the case of Y9.
10. C100; 25pF trim capacitor.
11. C44; 27pF disc capacitor, marked "27".

BFO/LO OSCILLATOR TEST

1. Apply power and connect scope probe to pin 7 of U1. Set scope freq./div to .05uS. Rotate the Frequency control (C18) while monitoring the scope A P/P Voltage reading of 1 to 2 Volts should be measured, depending on the position of C18, and the capacitance of your scope probe. The waveform should be nearly sinusoidal throughout the tuning range.
2. Using your scope probe check the BFO (Beat Frequency Oscillator) waveform at pin 6 and 7 of U4. A similar waveform should be noted. Rotate trimmer capacitor C99 to the middle position. Disconnect transceiver.

INSTALL #4: AUDIO AMPLIFIER

This time were starting from the back of the circuit to eliminate any audio problems later. Nothing fancy here, just good'ol board stuffin.

1. J2, J6; mini phone plug.

2. U6; LM380N IC. Note polarity.
3. C52, C24, C46, C35; .01uF disc capacitor, marked "103".
4. C54, C102; 4.7uF electrolytic capacitor. Note polarity.
5. R32; 3 Ohm resistor. Mounts vertically.
6. C55, C96, C98, C101, C103; .1uF disc capacitor, marked "104".
7. R10, R13; 1K Ohm resistor.
8. C90; .22uF "yellow" disc capacitor, marked "224".
9. JP3; Audio filter bypass jumper. Install a bare wire into JP3 IF filter is not used.
10. R24; 10K PC mount potentiometer. These potentiometers are unmarked, so you will need to measure the pot to determine which one is 10K. Install on the solder side. Solder leads from the component side.
11 U5 IC, CD4053 Note polarity
12. T6; IF transformer marked "154AC470072". Remove piston capacitor inside transformer before installing.
13. R6, R36, R42, R69; 33K Ohm resistor. R36, R42 mount vertically.
14. R39, R70; 2.7M Ohm resistor. R39 mounts vertically.

AUDIO AMPLIFIER TESTING

Before applying power, check to be sure that the polarity of C84 is correct.

1 Plug in the power cable and speaker. Turn the transceiver ON. You should hear a mild "thump" when turned on.
2. Rotate volume control (R42) fully clockwise.
3. Holding a small screwdriver or piece of bare wire, touch pin 2 of U6 for an indication. Likewise touch pin 14 of U5 for a similar indication.
4. Rotate R31 counter clockwise and disconnect power.

Please see Fig. 2 in the design photograph section to confirm which components are mounted on the solder side.

INSTALL# 6: IF AMPLIFIER/XTAL FILTER

1. K1, K2. Relays marked "G5V-1".
2. U2, U3, "MC1350P". Note polarity.
3. C32; 47pF disc cap, marked "470".
4. C21,C22, C34, C36, C39; .1uF capacitor, "104M".
5. T3, T4, "42IF129".VERY IMPORTANT; You must remove the small internal capacitor under the transformer before installing.
6. R7; 82K Ohms resistor.
7. R8, R27; 47 Ohm resistor.
8. R11, R23, R84; 10K Ohm resistor. R84 mounts vertically.
9. L4, L5; 27uH inductor, "Red, Violet, Black, Gold", or "LQ275".
10. D2-D6 (5 pieces); diode marked "1N914". Note polarity.
11. Y2-Y8, Y11; filter crystals marked "10.00".

12. C29, C99, C30, C43, C45, C47, C49, C50, C31, C38 (10 pieces); 120pF "yellow" capacitor, marked "121".
13. C28; 33pF "yellow" capacitor, marked "330".
14. R85; 25K Ohm PC trimpot, marked "25K" near the top of the component. Set wiper of R85 to the middle position.
15. R9, R76; 22K Ohm resistor. R76 mounts vertically.
16. C20, C67, C89; .0047uF polystyrene capacitor, marked "4700J".
17. R41; 10K potentiometer. Measure potentiometers to find a 10K part. Install on the *solder side*. Do not solder the left hand mounting tab until the noise blanker potentiometer, R35, has been installed.
18. R93; 500K Ohm "green" PC Potentiometer, marked "B500K" on the back of the pot. Install on the *solder side* of the circuit board.
19. U13 IC; CD4011. Note polarity.

I.F. ALIGNMENT/RECEIVER TEST

The basic receiver is now finished and ready for testing. Only the Noise Blanker, AGC, and audio filter accessory have been temporarily omitted.

1. Connect power, RF Signal generator, and speaker (do not turn ON yet).
2. Set RF generator to 175 KHz, at 1mV output (-80 dBm).
3. Adjust frequency control (C18) and Volume control (R24) to the 12 O'clock position.
4. Adjust Preselector (R31) to the 11 O'clock position, and the IF Gain control (R41) to the 10 O'clock position.
5. Adjust the Q-Multiplier control (R19) fully counter-clockwise.
6. Turn power switch to the ON position.
7. Adjust signal generator frequency if necessary for an audio tone.
8. Adjust preselector control for a peak response, and the IF Gain control for a good volume level.
9. Using a small blade screwdriver or tuning wand adjust IF transformers T2, T3, T4, and T5 for an audible peak response, reducing the signal generator output as necessary.

This concludes the preliminary alignment of the receiver.
Please see fig. 3 and 4 for reference purposes.

INSTALL# 7; "S" METER (See Fig. 3 and 4 in "Design Photographs")

If you are using the Audio Filter Accessory you must install this before the "S" meter installation. This is because some of the filter parts are located underneath the "S" meter. See the installation information for the audio filter, then continue to the "S" meter installation.
The audio filter accessory can be installed later, but it will then be necessary to remove the "S" meter temporarily.

1. R46; R60, R66; 33 Ohm resistor. R46 mounts vertically.
2. R44, R75, R86; 10K Ohm PC trim potentiometer, marked "10K".
3. C104; 4.7uF electrolytic capacitor. Note polarity.
4. S Meter. Prepare S-Meter by soldering a bare wire, 4 total, to each solder lug. This wire can be a lead from an installed resistor or part. Locate the utility wire (Grey), and the ¼" standoff's. The standoffs are used to support the meter above the circuit board, while the wire holds the meter in place. Wrap the wire over the top and sides of the meter, and allow 1 inch of excess length. Remove the remaining insulation. Place a standoff over each wire, then insert the wires into the large holes of M1. Firmly pull the wires on the other side of the board, then solder. Clip away excess leads. Insert the rear wires of the meter onto the holes Marked "M- and M+". A bare wire should be soldered at holes marked "LP1" and the meter light. Keep standoff's away from other component leads.

"S" METER TEST

Apply power to transceiver. S meter light should illuminate.
Rotate IF gain control (R12), while watching the meter. The meter should from the far left to the far right position as the IF control is turned clockwise. The trimmer resistor to right of the meter, R44, sets the scale sensitivity. If necessary, turn the trimmer just to the point where the meter reads "0" when the IF control, R12, is fully counter-clockwise. Remove power and disconnect transceiver.

INSTAL#8; AGC CIRCUIT

1. U11 IC; TL072 dual opamp, marked "TL072". Note polarity.
2. R12; 82K Ohm, mounts vertically.
3. R16; 100K Ohm, installs vertically
4. C65, C78; 4.7uF electrolytic capacitor, marked "4.7uf/35V". Note polarity.
5. R20; 1K Ohm. Install vertically.
6. R19; 28K Ohm. Install vertically.
7. R17, R18, 10K Ohm resistor. R17 mounts vertically.
8. D7, D9, D10; diodes: "1N914". Note polarity.
9. R14; 5.6M Ohm resistor. Mounts vertically.
10. C68; .1uF disc capacitor, marked "104M".
11. U9 IC; Dual opamp, marked "BA15532". Note polarity.

AGC/IF GAIN VOLTAGE CHECK.

1. Rotate IF Gain control (R41) fully clockwise.
2. Measure the DC Voltage at U11b, pin 5. It should be approximately 6.5 Volts. Check U9a, pin 1. This should be approx. 7 Volts. If this is correct, remove power and install D7; 1N914 diode. Note polarity.
3. Connect power, speaker, and turn transceiver on.
4. Set signal generator output to -60 dBm (224uV). Do not connect to transceiver yet.
5. On the transceiver, adjust PC trim potentiometer R44 (behind meter) so the meter is at zero. Very slightly, adjust R44 so meter reading just begins to move forward. Stop at this point.
6. Connect signal generator and adjust the frequency so an audible tone is heard. Adjust preselector (R31) to peak the signal, while monitoring the "S" meter for maximum strength. Select an audible tone that is not to high or low, but in the middle of the audio range.
7. Locate PC trim potentiometer R85, which is the IF gain control, and adjust for a meter reading of S9+10dB on the blue scale of the meter.
8. Decrease signal generator output to -100 dDm (2.24uV).
9. Using a tuning wand (or similar), peak the IF coils; T2, T3, T4, and T5. Use the meter as the indicator for a peak response. Adjust R44 again for a meter reading of S3.
10. Return the signal generator level to -60 dBm, and re-adjust trimpot R85 to indicate S9+10 on the meter.
11. Reduce signal generator again to –100 dBm and re-adjust R44 for a meter reading of S3, if necessary

The receiver IF and AGC is now aligned. Remove power and continue. Consult the resistance/voltage chart if problems occurred.

INSTAL# 9; NOISE BLANKER

1. L7; 5.6mH Inductor, "LH256"
2. L6; 1mH Inductor, "Brown Black Red Silver"
3. C57, C59, C63, .1uF disc caps, "104M"
4. R33, R37; 10K Ohm resistor.
5. R34; 82K Ohm. Mounts vertically.
6. R38; 1K Ohm resistor.
7. R35; 50K Ohm potentiometer, no marking. Measure with Ohmmeter to determine correct value. Install on component side.
8. Q6; NPN Darlington transistor, marked "MPSA13".
9. C61; .001uF "yellow" disc capacitor, marked "102J".
10. D11, D12; diodes, "1N914". Note polarity.
11. C60; 120pF "yellow" disc capacitor, marked "121".
12. Install C62; 22uF tantalum capacitor. Note polarity.
13. Install C58; 4.7uF electrolytic capacitor, marked "4.7uF/35V". Note polarity.

NOISE BLANKER TEST

Clean the solder side of the circuit board where the noise blanker circuitry was installed using alcohol and a Q-tip (or similar) for proper operation. This is due to the high impedance of the circuit, where solder flux residue can cause electrical leakage and create faults.

1. Connect the transceiver to the power supply (only) and turn on.
2. Rotate front panel noise blanker control (R35) fully counter-clockwise.
3. Using high impedance DMM, measure the Voltage at U9b, pin 5. The value should be approx. 50 mV. Rotate the noise blanker control fully clockwise and check Voltage again at U9b, pin 5. The value should be approx. 150 mV.

If a value of 400 mV or higher is present, re-clean with alcohol the solder side, particularly the area of Q6, U9, C60, and D11. Re-check the Voltage at U9b, pin 5. When finished, turn transceiver off and disconnect power supply.

TRANSMITTER ASSEMBLY

INSTALL# 10; AUDIO OSCILLATOR

1. Q8, Q10; 2N2222 transistor, marked "TP2222A". Note polarity.
2. R87; 1K Ohm PC trimpot. Marked "1K".
3. R80, R81, R82; 22K Ohm resistor.
4. R48; 200K Ohm resistor, mounts vertically.
5. R43, R78; 270 Ohm resistor, R43 mounts vertically.
6. R88; 1K Ohm resistor.
7. R89; 10K Ohm resistor, mounts vertically.
8. Q9; J-FET, "J310". Note polarity.
9. C25, C26; .1uF disc capacitor, marked "104M".
10. R45, R74, R90; 100K Ohm resistor. All mount vertically.
11. D16; Diode, 1N914. Note polarity.
12. R77; 3.3K Ohm resistor.
13. C97; .22uF "yellow" capacitor, marked "224".

AUDIO OSCILLATOR TEST AND ALLIGNMENT

In order to proceed with the next test, you will need to have a code key or keyer, or small screwdriver that can fit into J6 for keying the audio oscillator.

1. Connect speaker, code key to CW jack (J6), and power supply. Turn transceiver ON.
2. Connect frequency counter to speaker terminals.
3. Depress code key. An audible tone should be heard. Adjust volume so the frequency of tone can be displayed
4. Adjust trimmer potentiometer R87 for a frequency of 1KHz.
5. If no tone, or weak tone occurs, check the oscillator performance by monitoring the signal using an oscilloscope at TP2. Set scope to .5Volts/Div, at a sweep time of .2ms/Div. A 1.5 Volt P/P semi-sinusoidal waveform should be displayed.
6. Disconnect transceiver.

INSTALL# 11; MIC PREAMP AND 1ST RF AMPLIFIER.

1. C23, C88; 4.7uF electrolytic capacitor, marked 4.7uf/35V". Note polarity.
2. Q7; JFET transistor, marked "J310".
3. U10, U12; Opamp, TL071. Note polarity.
4. C73, C75, C77; .001uF "yellow" disc capacitor, marked "102".
5. R50; 33K Ohm resistor. Mounts vertically
6. R40; 200K Ohm resistor. Mounts vertically.
7. R52, 10K Ohm resistor. Mounts vertically.
8. R25, R72; 82K Ohm resistor. Mounts vertically.
9. R53, R54; 22K Ohm resistor.
10. R55, R56; 66.5K Ohm 1% resistor, "blue" color part.
11. C53, C79, C80, C81; .1uF disc capacitor, marked "104M".
12. R57; 2.2K Ohm resistor.

MIC PREAMP AND 1ST RF AMP ALLIGNMENT

1. Connect power, code key, and speaker.
2. Connect oscilloscope probe to T7a. Probe tip should fit into T7a hole. Connect probe ground to tab of voltage regulator U7. Set scope to 100mV/div, at 2us/div.
3. Turn Mic gain control (R21) fully counter-clockwise.
4. Turn transceiver on and key the transceiver using the code key or similar.

Monitor the scope and peak T1, and T6 for a peak signal response of approx. 1 Volt P/P.

INSTALL# 12; 2nd STAGE RF AMPLIFIER (PA driver)

1. R59, R79; 1K Ohm resistor. Mounts vertically.
2. T7; I.F. transformer, "RMC502182N". Do not remove internal capacitor.
3. R58; 100 Ohm resistor. Mounts vertically.
4. Q3; PNP transistor, "KN2907". Note polarity.
5. C56, C74, C76, C82, C83; 22uF tantalum capacitor. Note polarity.
6. R61; 6.8K Ohm resistor.
7. R62; 4.7K Ohm resistor
8. R71; 8.2K Ohm resistor.
9. R63; 12 Ohm resistor.
10. R65; 68 Ohm resistor. Mounts vertically.
11. Q2; NPN power transistor "TIP29". Note polarity.
12. T8, "Yellow" transformer marked "TL030". Note polarity: "P" on one side should be installed where "P" is located on circuit board.
13. R83; PC potentiometer marked "B1K". Mounts on *solder side.*
14. R67, R68; 47 Ohm resistor.

2nd STAGE DRIVER TEST

1. Rotate drive control (R83) and Mic gain (R21) fully clockwise.
2. Connect power supply, and code key to jack J6.
3. Set frequency control (VFO, C18) to 2 O'clock. Set band switch (S2) to the "out" position (175-190 KHz range)
4. Turn transceiver on and depress code key. As the code key is depressed, the red limiting light should illuminate. Reduce Mic gain so the light is barely visible. Peak T7 for maximum brilliance and reduce Mic gain as necessary to visually check tuning.
5. If no indication is found, check polarity of LED (D18). Also check collector of Q2. Signal at this point s/b: 12 P/P or greater.
6. Remove power and code key.

INSTALL# 13: PUSH-PULL P.A. FINAL (Please see Fig. 5)

Though this transceiver is capable of producing much more output power, the instructions (and components) provided here are designed for a maximum output of only 20 Watts. Power levels above this can provide dangerously high voltage levels at the antenna that could be potentially hazardous, particularly to newcomers. At this time the FCC does not allow power levels above 1 Watt

input to the final (for you Yank's, ya' savvy?). Future changes in regulations are anticipated which will allow more power to be used by Ham operators. The input power to the PA is computed by measuring the Voltage at "M-" and the current across R96 (M+ and M-), then multiplying these to find the power in Watts.

Competent experimenters or "Lowfers" will have no problem modifying this transceiver (where allowed) to higher power levels because their knowledge will allow them to instantly see where the changes will be required! Higher output devices such as the IRF640 with appropriate turns ratio of T9 does the trick.

1. J3; Banana jack. Mount on *solder side* of circuit board.
2. R73; 10K Ohm resistor.
3. C87; .001uF "yellow" disc capacitor marked "102".
4. R96; .1 Ohm, 3 watt power resistor. Resistor mounts approx. ¼" above board, on component side.
5. Q4, Q5; MOSFET power transistors, "IRF510". Note polarity, metal side should face toward the back. Make sure component is inserted as far as possible into circuit board. *Tip*: Hold part square to the board and solder only one pad. This will allow you to inspect the part and make corrections without having to unsolder all pads.
   At this time install heat sinks to the back of each device using the screws and nuts. Do not allow heat sinks to touch each other after tightening.
6. T9; P.A. output transformer. The transformer primary uses a bifiliar (zip - cord) cable, wound over the secondary. The secondary is wound first.

a. Wind 17 turns of gray wire evenly around the 1-inch ferrite toroid. Allow 1 inch of length beyond the toroid and remove it's insulation. *Tip*: Place the wire half way into the toroid and wind 10 turns in one direction, then ten in the other. Wrap the wire around the toroid for tight turns.

b. Wind 8 turns of the cable evenly over the secondary turns, in the same direction. Allow an extra length of 1 inch beyond the toroid, removing plastic insulation.

c. The gray wires should be in-between the cable pair. One lead of the cable has a white line. Make sure the cable lead with the white line is in the same place on both sides of the toroid, otherwise there is a twist in the cable. Twist the wires and tin the ends so they will not fray.

d. Hold the transformer firmly with your index and thumb fingers, pull the wires to keep the leads firm. Insert the leads through the circuit board, make sure the solid gray wire goes into center holes "c" and "d". Pull wires taught at a 45-degree angle from the solder side, then solder each wire and remove excess leads. Check for any shorts between the primary and secondary.

8. Microphone connection. Behind the front panel Mic Gain control is a hole next to Q7 with "Mic" written beside it. This connects to your microphone. Take a 2" piece of wire and solder it to this pad from the *solder side* of the circuit board. Next to the Mic port is an unmarked ground port. Solder a 2" wire to this port and twist this 4 to 6 times with

the Mic wire. Remove the insulation of both wires at the other end so they may be soldered later to a Mic jack. Take a 7" piece of wire and solder it from the solder side to the hole marked "PTT" (located at the back right corner). The "mic" port is for a high impedance microphone such as a D104 or similar. They can be found at most Ham radio or CB stores. The microphone switch, usually located on the Mic, which is activated when grounded, keys the "PTT" (push-to-talk) port. You must use shielded cable between the microphone and Mic plug. Shielded stereo cable is recommended, using one side for the Mic and the other for the push-to-talk line. Many microphones, including the D-104, have an adjustable switch wiring inside the Mic housing. Locate the switch wiring and wire one of the unused NC (normally closed) switch contacts to the Mic lead and the other side to ground. This will short the Mic element when it is in the standby mode (receive). The connector used to connect your transceiver to your microphone is completely up to you. There are so many styles that I was not able to choose one that would be accepted by everybody, and therefore not included . A good choice however is one that is already used in your radio gear Use the same jack and wire the Mic, ground, and PTT lines to the appropriate connector pins. The Mic will not be used for the PA testing and alignment.

ALLIGNMENT# 13 PA OUTPUT AND BIAS ADJUST

1. Rotate PC PA bias trimpot (R86), and front panel Mic gain control (R21) fully counter-clockwise, as viewed from front.
2. Rotate drive control (R83), located at the back left corner, fully counter-clockwise (as viewed from rear).
3. Connect power, code key, and dummy load with RF current meter to the RF antenna jack (J4). *Note: A dummy load is a 50-Ohm resistive termination that simulates the antenna. A power meter using a power attenuator can be used effectively, or a RF current meter in series with a 50 Ohm dummy load. A dummy load can be purchased from many vendors, or built by using four 200 Ohm 5 Watt resistors in parallel. Wirewound power resistors are OK to use at these frequencies, especially since they are in parallel. If no current meter is available, use an oscilloscope to measure the voltage across the dummy load. The RMS voltage can be determined by the peak-to-peak voltage divided by two, then multiplied by .707. Multiply this value times 50, then take the square root. This is the power output.*
4. Connect a small wire into hole near the right hand corner marked "PTT". Jumper this wire to ground jack J3.
5. Connect a voltmeter across R96, to meter test points M+ and M-. Set meter to the low voltage range.
6. Apply power. The relays should activate when turned on. Watch the meter and slowly turn PA bias trimpot clockwise. Adjust for a reading of 4mV. *Note: This reading is actually 40mV, or 40 milliamperes of current since*

R96 is only .1 Ohms. The 40 milliamperes are split between Q4 and Q5, providing a bias of 20 milliamperes each.

7. Remove the jumper to ground at "PTT".
8. Key the transmitter by depressing the code key. Rotate rear panel drive control (R83) slowly clockwise (as viewed from rear) for an output indication. A table is included to give you an idea as to what power levels you can expect at different voltage/power levels. The drive control can be adjusted for a power input level of 1 Watt RMS, as required by American (FCC) law. Maximum values are shown here, connected to a 50 Ohm load.

Pout	Pin	Eff.	Volts	Current
12.5	17	73%	13.1 (14)	1.3
21.8*	29	75%	18 (17)	1.7
30 42*	43.26	70%	20.6 (22)	2.1

"*" Requires 5 watt economy heat sink on voltage regulator U7.
"( )" Actual input voltage to transceiver.

9. Disconnect transceiver and clean the solder side of the circuit board with alcohol using a q-tip (or similar).
The transceiver is finished, hooray! If you encountered any problems or need to trouble shoot, please use the resistance/voltage chart.

INSTALL# 14: FRONT PANEL DIAL INSTALLATION (Please see Fig. 6)

1. At the end of the manual you will find several dials illustrated on a page. Cut one of the dials from the page and glue it to the round blank. Silicon rubber is an excellent choice for use as an adhesive.
2. Locate the metric screw and fiber standoff. Insert the screw into the standoff and push it through the paper dial. Make sure the dial has dried sufficiently
3. Insert the dial and screw combination into the frequency tuning control (C18), and tighten gently with your fingers.
4. With the frequency control turned fully clockwise, and the dial shaft reasonably tight, turn the dial so that it reads "190" (which resembles 190 KC) at the top, or 12 O'clock position. Tighten firmly the shaft into C18 so that the dial does not slip when rotated.

ALLIGNMENT# 14: DIAL CALIBRATION

The frequency readout on the dial is reasonably accurate; however, it must be calibrated to remove the possibility of "out-of-band" operation.
The upper frequency range of the dial is very course as compared to the lower range, and it is therefor necessary to adjust the upper limit. The highest calibrated point on the dial is 189 KC, which is used as the calibration frequency. Since there are always

variances in actual crystal frequencies, C18 trimmer is increased to limit the upper range.

1. Connect power, speaker, and signal generator. Turn ON.
2. Set signal generator output to 189 KHz, with an output between -90 and -40 DBM (low level output, but very audible).
3. Make sure frequency switch is in the upper band position.
4. Turn frequency control fully clockwise. The signal generator should be heard as you tune around the generator frequency.
5. Adjust C18 frequency trimmer capacitor, located at the rear of C18, for a zero-beat response. If a zero beat is not obtainable, lower the frequency slightly and readjust the frequency dial so it reads "189" at the top. Adjust the frequency trimmer for a zero beat. Repeat this procedure if necessary.

TROUBLESHOOTING AND VOLTAGE CHECK

Here is a list of Voltage and resistance checkpoints to aid you in determining any problems you might encounter during the construction of your transceiver. Most common mistakes can usually be found by visual inspection.
Check for reversed polarized capacitors, or incorrect resistor values. Check the polarity of IC's and diodes, as well as transistors and capacitors. Power supply is 14 Volts input for these tests. The transceiver is disconnected from the power supply during resistance testing. Results may vary due to variations in measuring equipment and device tolerances. All front panel controls are rotated fully counter-clockwise. Terms; high: high resistance, n/a: not applicable, low: low resistance value.

LOCATION:		VOLTAGE:	RESISTANCE:
U1			
Pin:	1	1.45	high
	2	1.45	high
	3	0	0
	4	7.5	2.8K
	5	7.5	2.8K
	6	8.7	20K
	7	8	27K
	8	8.7	1.2K
U2			
Pin:	1	12	n/a
	2	12	n/a
	3	n/a	n/a
	4	4.1	11.7K
	5	5.8	54K
	6	4.1	11.7K
	7	0	0
	8	12	n/a
U3			
Pin:	1	12	n/a

LOCATION:		VOLTAGE:	RESISTANCE:
	2	12	n/a
	3	n/a	n/a
	4	4.1	14.3K
	5	5.9	56K
	6	4.1	14.3K
	7	0	0
	8	12	n/a
U4			
Pin:	1	1.3	46K
	2	1.3	46K
	3	0	0
	4	7.6	2.6K
	5	7.6	2.6K
	6	8.6	18K
	7	8.1	24K
	8	8.7	n/a
U5			
Pin:	1	5.8	51K
	2	5.4	51K
	3	8.7	51K
	4	8.7	51K
	5	1	100K
	6	0	0
	7	0	0
	8	0	0
	9	12	51K
	10	9.5	100K
	11	9.5	100K
	12	7.6	700
	13	7.6	2.6K
	14	7.6	5.6K
	15	5.8	3.8K
	16	12	n/a
U6			
Pin:	1	7	high
	2	.3	1.9K
	3	0	0
	4	0	0
	5	0	0
	6	n/a	n/a
	7	0	0
	8	6.8	high
	9	0	high

LOCATION:		VOLTAGE:	RESISTANCE:
	10	0	0
	11	0	0
	12	0	0
	13	n/a	n/a
	14	14	n/a
U8			
Pin	1	12	n/a
	2	12	n/a
	3	n/a	n/a
	4	4	14K
	5	6.9	6.4K
	6	4	14K
	7	0	0
	8	12	n/a
U9			
Pin:	1	6.5	high
	2	6.5	high
	3	6.5	high
	4	0	0
	5	<1	100K
	6	<2	low
	7	11.3	49K
	8	12	n/a
U10			
Pin:	1	n/a	n/a
	2	8.7	50K
	3	8.7	11K
	4	n/a	n/a
	5	0	0
	6	8.7	51K
	7	12	n/a
	8	n/a	n/a
U11			
Pin:	1	6.5	105K
	2	6.5	105K
	3	6.5	78K
	4	0	0
	5	6.5	45K
	6	6.5	77K
	7	6.5	105K
	8	12	n/a
U12			
Pin:	1	n/a	n/a

LOCATION:	VOLTAGE:	RESISTANCE:
2	7.5	24K
3	7.5	24K
4	0	0
5	n/a	n/a
6	7.5	high
7	14	high
8	n/a	n/a
Q1		
Drain	8.5	low
Source	1.5	200
Gate	0	5
Q2 (Volts measured during transmit mode. Close PTT line).		
Collector	12.8	high
Base	3.2	2.8K
Emitter	2.5	80
Q3 (Volts measured during transmit mode. Close PTT line).		
Collector	0-.2	high
Base	12	600
Emitter	12	500
Q4, Q5 (Volts measured during transmit mode. Close PTT line).		
Drain	14	high
Gate	3.6	4.5K
Source	0	0
Q6		
Collector	12	23K
Base	<1	23K
Emitter	0	0

CONTROL OPERATION

The following is a straightforward look at the operation and function of each control and jack.

FRONT PANEL:

ON/OFF SWITCH

The lever-activated switch allows connection between the power supply and transceiver. There are no points of connection when this is toggled to the down position (off).

Q-MULTILIER
This control allows a desired level of feedback to regenerate within the preselector circuitry. There is no regeneration when rotated fully counter-clockwise. Too much regeneration may cause oscillation. Also watch out for noise; using the Q-Multiplier during high noise levels will defeat the noise blanker and cause excessive ringing.

PRESELECT
The preselector control works in conjunction with the Q-Multiplier. It is a tunable bandpass filter with a 3 KHz bandwidth. Rotating the preselector control (R91) will peak the desired signal, and help to remove unwanted adjacent interference. When the Q-Multiplier is advanced, the bandwidth becomes narrower and will have a very narrow response. The response can be tailored to suite the type of signal your interested in. Weak CW signals can be peak with a sharp response, while SBB (voice) intelligibility can be improved by peaking the signal overall, or boosting the bass or treble portion if it is required.

BAND SELECT SWITCH
Pushing this switch in sets the transceiver to operate on the A (lower scale): 160 175 KHz. When the switch is out it places the transceiver in the B (upper scale) position: 175-190 KHz.

FREQUENCY CONTROL
Rotating the Frequency dial control allows continuous coverage of all upper-sideband frequencies within the 1750-Meter band (160-190 KHz).

VOLUME
The volume control adjusts the volume of the speaker or headphone. It also has increases the sidetone level slightly when advanced.

S-METER
The S-Meter provides a reliable indication of the input signal level. The following is a list of signal strength values;

+25 dB over S9	1000uV or greater.
+20 dB over S9	708uV (-50 dBm)
+10 dB over S9	224uV (-60 dBm)
S9	70.8uV (-70 dBm)
S7	22.4uV (-80 dBm)
S5	7.08uV (-90 dBm)
S3	2.24V (-100 dBm)

BLANKER
During noisy conditions, the blanker control can be used effectively to remove unwanted noise such as light dimmers, car ignition, and other impulse types of noise. Static crash's can be limited somewhat, depending on the strength of the static and the signal. Use the blanker sparingly, as to much blanking will produce a hissing sound and ruin reception. The blanker is limited to it's effectiveness by the Q-Multiplier, which can stretch noise pulses into long pulses that make the blanker "think" it's a voice or CW signal, and not remove the pulse. It's a trade off: if you us e the blanker, keep the Q-Multiplier down!

I.F. GAIN
Controls the amount of gain in the I.F. amplifier. Good for reducing background noise when operating with strong local signals.

MIC GAIN
Adjusts the Mic level. Used for voice, but usually set to minimum for CW operation to reduce overload of P.A.

RF LIMITER LED
Indicates the input level to the P.A. and limits voice peaks so that the voice average can be increased, thus improving intelligibility and power.
Adjust Mic Gain control so that voice peaks keep LED on 50% of the time. This can be adjusted for best clarity and average voice power.

NOTCH
The Notch control is a part of the CW/NOTCH filter accessory, used in removing unwanted carriers or heterodyne.

WIDTH
The Width control is also part of the CW/NOTCH filter accessory, and used to control the bandwidth response.

REAR PANEL

CODE KEY JACK
1/8" jack for code key. Grounding center pin activates audio oscillator and keys transmitter.

CW DELAY
Adjustable delay allows operator to send code without receiver interruption.

SPEAKER JACK
1/8" jack for 8-Ohm speaker or headphones.

POWER JACK
Power input receptacle. Mating plug should be 5.5mm outer diameter, tip positive. Center pin of jack measures 2mm x 8mm.

GROUND JACK
Female banana jack allows easy connection to ground system. Avoid connection to house wiring ground (due to noise pickup). Instead, connect directly to ground rod, or antenna ground system.

ANTENNA JACK
BNC jack for transmit/receive operation.

DRIVE LEVEL
Controls output power during transmission. Used in conjunction with Mic gain control for optimum speech power and desired output.

CONTROLS LOCATED ON TOP OF THE CIRCUIT BOARD

C100: BFO trimmer. Adjust for best voice tonal balance, and rejection of opposite sideband.

L1, L2: Preselector inductors.

R85: IF gain adjust. This potentiometer adjusts the amount of gain in the 2nd I.F. amplifier. Differences in components and parts tolerances can be equalized so the "S" meter will be accurate.

R75: Carrier null. Minimizes carrier unbalance when U4 is used as a balanced modulator.

R86: P.A. Bias. Adjusts the bias of output transistors Q4 and Q5. Sets idle current to approx. 40 mA total.

R44: Meter zero. Equalizes the voltage across the "S" meter to read zero, or no reading, when no signal is present.

R87: Sidetone oscillator frequency adjustment.

R400, R401: RF Current Detector Accessory meter calibration.

R218: CW/NOTCH Accessory. Adjustment for alignment of CW filter.

T1: Transmitter mixer driver.

T2-T5: Receive I.F. transformers.

T6: Balanced modulator transformer.

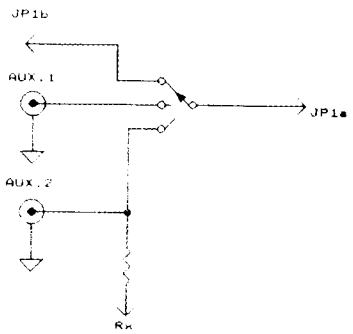
T7: Transmit limiting transformer.

MODIFICATIONS

There are several desirable features that will allow greater flexibility to your transceiver.

AUXILLARY RECEIVE ANTENNA

Jumper wire JP1 may be removed to include a switch to select different receive antenna's, such as an active whip, or loops. As you can see in the schematic, one of the antenna lines is phantom powered.



PHANTOM POWER (RECEIVE ONLY)
12 Volts of power is available during receive operation, courtesy of a hole next to the dpdt relay marked Rx. A resistor may be installed if necessary to allow phantom power for active antennas. Usually the resistance value is in the range of 200 to 470 Ohms. This port can also be used to activate relays or other hardware. Current over 500mA is not recommended.

DIAL LIGHT
Components R92 and D19 (as shown in the schematic) form a simple light circuit for illuminating the dial, if desired. D19 can be virtually any LED diode, with R92 acting as a current limiting resistor. Typical value for R92 is 2K Ohm. These components are not provided with the kit.

REVERSE POLARITY PROTECTION
If transceiver is used where the power supply polarity might be reversed, diode D15 may be used to short the supply during a period of reverse polarity. This will save the transceiver from certain damage. Diode may be a 1N4001 variety.

EXTRA SPEAKER
If you plan on using a cabinet, or need an extra speaker line, the holes behind the speaker jack can be used to connect an auxiliary speaker. They are indicated in the schematic as "EXT SPKR".

BOTTOM COUPLED PRESELECTOR

This option is included if the transceiver has been modified for use on higher frequencies. If the transceiver is going to be operated near the broadcast band, for example, remove C2, JP4, and replace JP4 with a parallel resistor/capacitor combination. The value for this replacement is determined by the filter design frequency.

RESOURCES

RF Meters, parts:	Surplus Sales of Nebraska 800.244-4567 www.surplusales.com 1502 Jones Street Omaha, Nebraska 68102
Surplus and Military;	Fair Radio Sales Co. 419.223-2196 PO Box 1105, 1016 E. Eureka St. Lima, Ohio 45802
Electronics Parts;	Mouse Electronics 800.346-6873 www.mouser.com 958 N. Main Street Mansfield, TX 76063-4827
Amateur Radio;	Ham Radio Outlet 800.854-6046 www.hamradio.com 933 N. Euclid St. Anaheim, CA 92801
Longwave publication;	Longwave Club of America (LWCA) 45 Wildflower Road Levittown, PA 19057-3209 USA; $18, Canada; $20, Overseas; $26 Annually
Quality used test equipment;	Tucker Electronics 800.527-4642 www.planetTest.com PO Box 551419 Dallas, TX 75355-1419

CLOSING THOUGHTS

If there are any mistakes, suggestions, or improvements to the performance of this transceiver, *please* do not hesitate in sending me your comments. Mail inquiries to; David Curry, PO Box 1884, Burbank, CA. 91507 I will post circuit improvements over the Internet on; www.longwave.net to share with others who would like to continue these refinements. Your input is helpful and appreciated.

EXP1750a
PARTS LIST

PART#	DISCRIPTION	QUAN
	INSTRUCTIONS	1
	MAIL	1
C1,14,19,37,42,51	68pF MONO CAP.	6
C10	220pF DISC CAP.	1
C100	25pF TRIM CAP.	1
C12,40,48,56,62,74,76,82,83	22uF TANT CAP.	9
C16	.0033uF MONO CAP.	1
C17,64,66,94	470pF MONO CAP.	4
C18	220pF VAR. CAP	1
C2	7.5pF DISC CAP.	1
C20,67,89	.0047uF POLY CAP.	3
C23,54,58,65,78,88,102,104	4.7uF ELEC CAP.	8
C24,46,35,52	.01uF DISC CAP.	4
C28	33pF MONO CAP.	1
C29,30,31,38,43,45,47,49,50,60,99	120pF MONO CAP.	11
C3,6,27	330pF MONO CAP.	3
C32	47pF MONO CAP.	1
C33	180pF MONO CAP.	1
C4,5,15,90,97	.22uF MONO CAP.	5
C44	27pF DISC CAP.	1
C61,73,75,77,87	.001uF MONO CAP.	5
C7,91,92,93	.018uF MYLAR CAP.	4
C8,9,11,13,21,22,25,26,34,36,39,41,53,55, 57,59,63,68-72,79,80,81,95,96,98,101,103	.1uF DISC CAP.	30
C84,85,86	470uF ELEC CAP.	3
D1,8,14	MVAM109 DIODE	3
D18	LED DIODE	1

D19: LED for optional dial light.

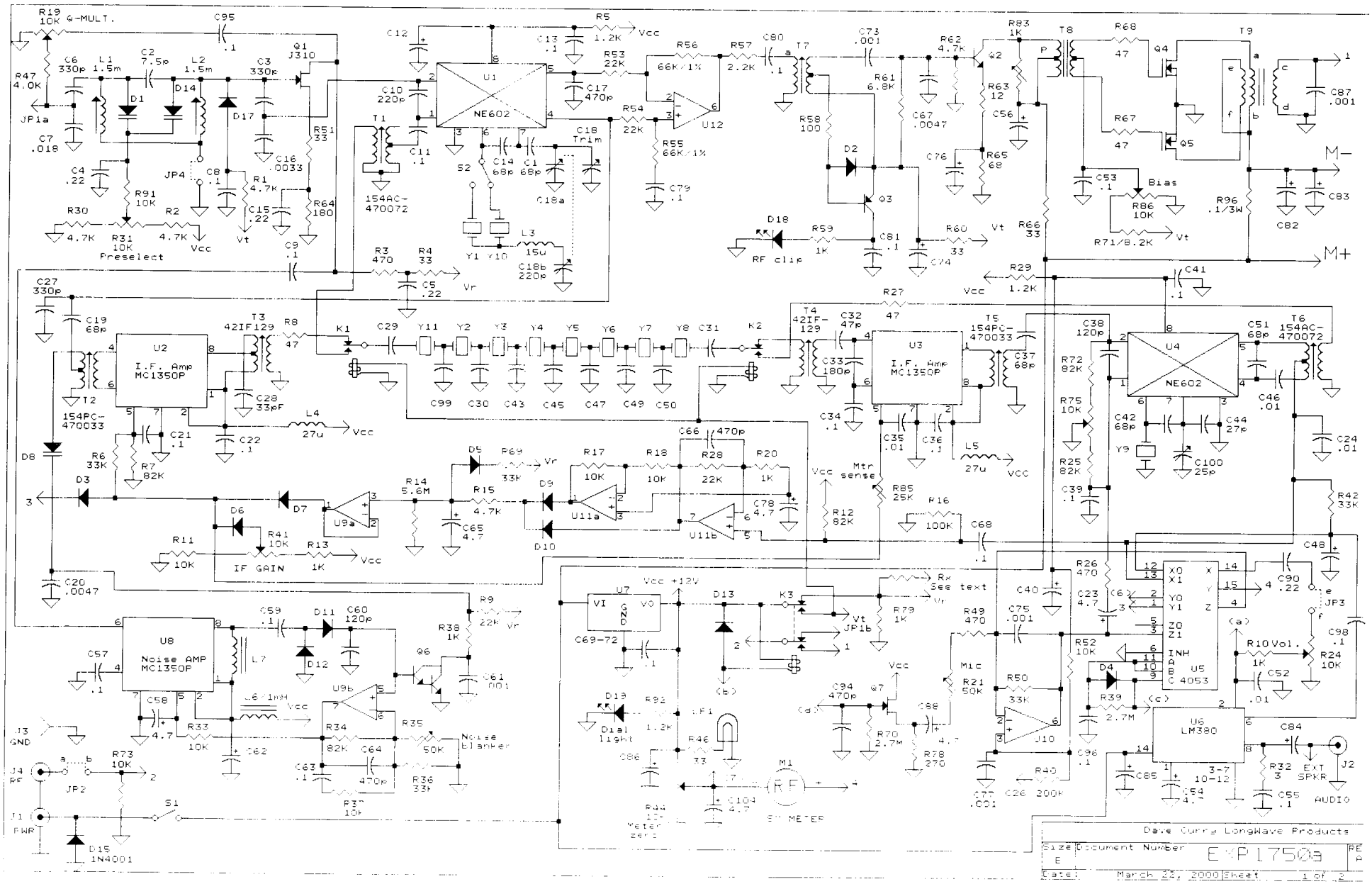
D2,3,4,5,6,7,9,10,11,12,13,16,17	1N914 DIODE	13
Hardware	1/4" Spacers	2
Hardware	2 Conductor zip cord.	1
Hardware	3/4" Standoff	1
Hardware	Bolt, 4/40	2
Hardware	CIRCUIT BOARD	1
Hardware	DIAL	1
Hardware	Heat sinks for Q4, Q5.	2
Hardware	Hook-up wire	1
Hardware	Nut, 4/40	2
Hardware	Screw, metric	1
J1	3.5MM PWR JACK	1
J2,6	3.5MM PHONE JACK	2
J3	Banana Jack	1
J4	BNC, PC Mount	1
JP1,2,3,4	Jumpers	4
K1,2	SPDT Relay	2
K3	DPDT Relay	1
L1,2	1.5mH VAR IND.	2
L3	15uH IND.	1
L4,5	27uH IND.	2
L6	1mH IND.	1
L7	5.6mH IND.	1
M1/LP1	"S" METER	1
Q1,7,9	J310 JFET	3
Q2	TIP29 TRANS.	1
Q3	2N2907 TRANS.	1
Q4,5	IRF510 MOSFET	2
Q6	MPSA13 TRANS.	1

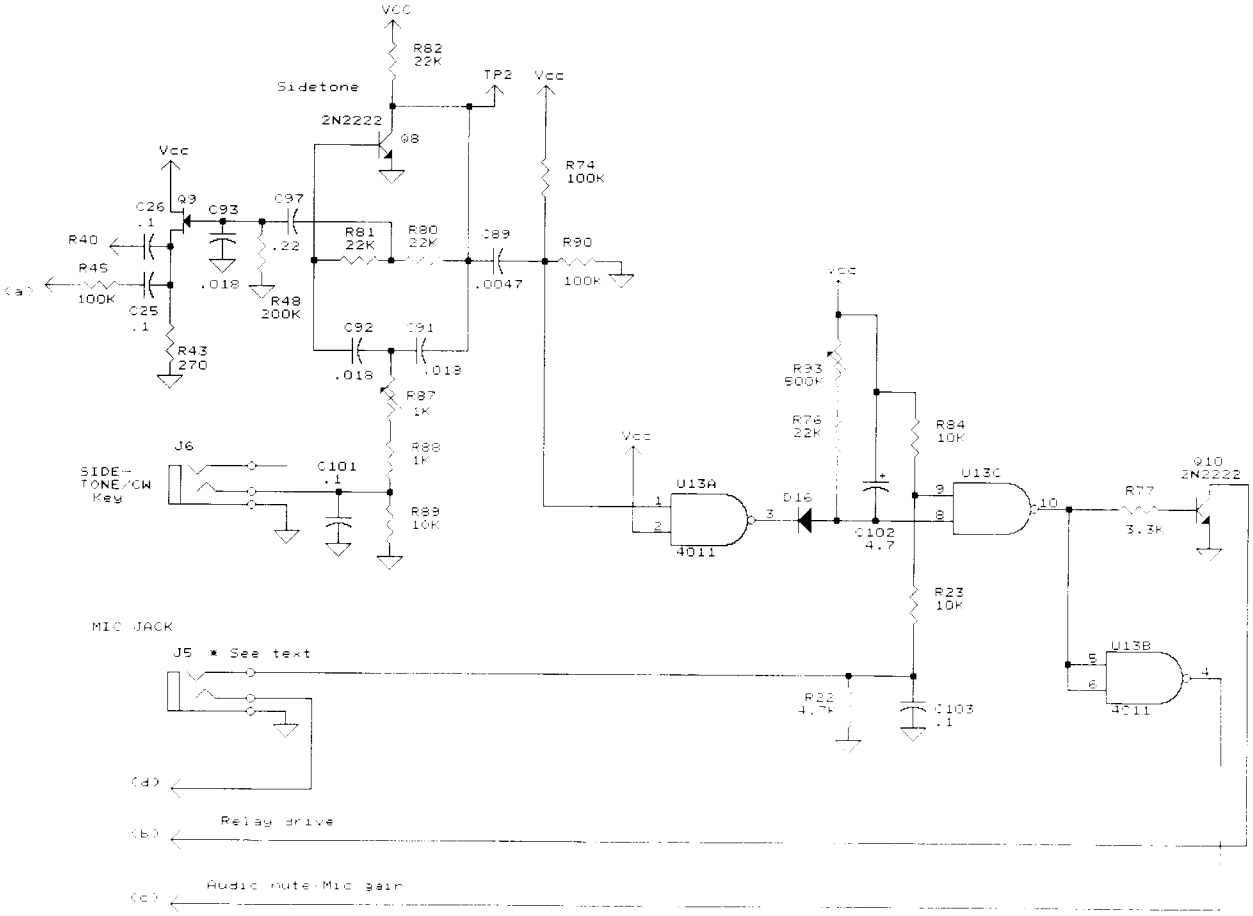
Q8,10	2N2222 TRANS.	2
R1,2,15,22,30,62	4.7K OHM RES.	6
R10,13,20,38,59,79,88	1K OHM RES.	7
R11,17,18,23,33,37,52,73,84,89,91	10K OHM RES.	11
R12,7,25,34,72	82K OHM RES.	5
R14	5.6M OHM RES.	1
R16,45,74,90	100K OHM RES.	4
R19,24,31,41	10K PC POT	4
R21	50K PC TRIMPOT	1
R3,26,49	470 OHM RES.	3
R32	3 OHM RES.	1
R35	50K PC POT	1
R4,46,51,60,66	33 OHM RES.	5
R40,48	200K OHM RES.	2
R43,78	270 OHM RES.	2
R44,75,86	10K TRIMPOT	3
R47	4.0K Ohm, 1%	1
R5,29	1.2K OHM RES.	2
R55,56	66.5K OHM RES. 1%	2
R57	2.2K OHM RES.	1
R58	100 OHM RES.	1
R6,36,42,50,69	33K OHM RES.	5
R61	6.8K OHM RES.	1
R63	12 OHM RES.	1
R64	180 OHM RES.	1
R65	68 OHM RES.	1
R70,39	2.7M OHM RES.	2
R71	8.2K OHM RES.	1
R77	3.3K OHM RES.	1
R8,27,67,68	47 OHM RES.	4

R83	1K PC POT	1
R85	25K TRIMPOT	1
R87	1K TRIMPOT	1
R9,53,54,76,80,81,82	22K OHM RES.	7

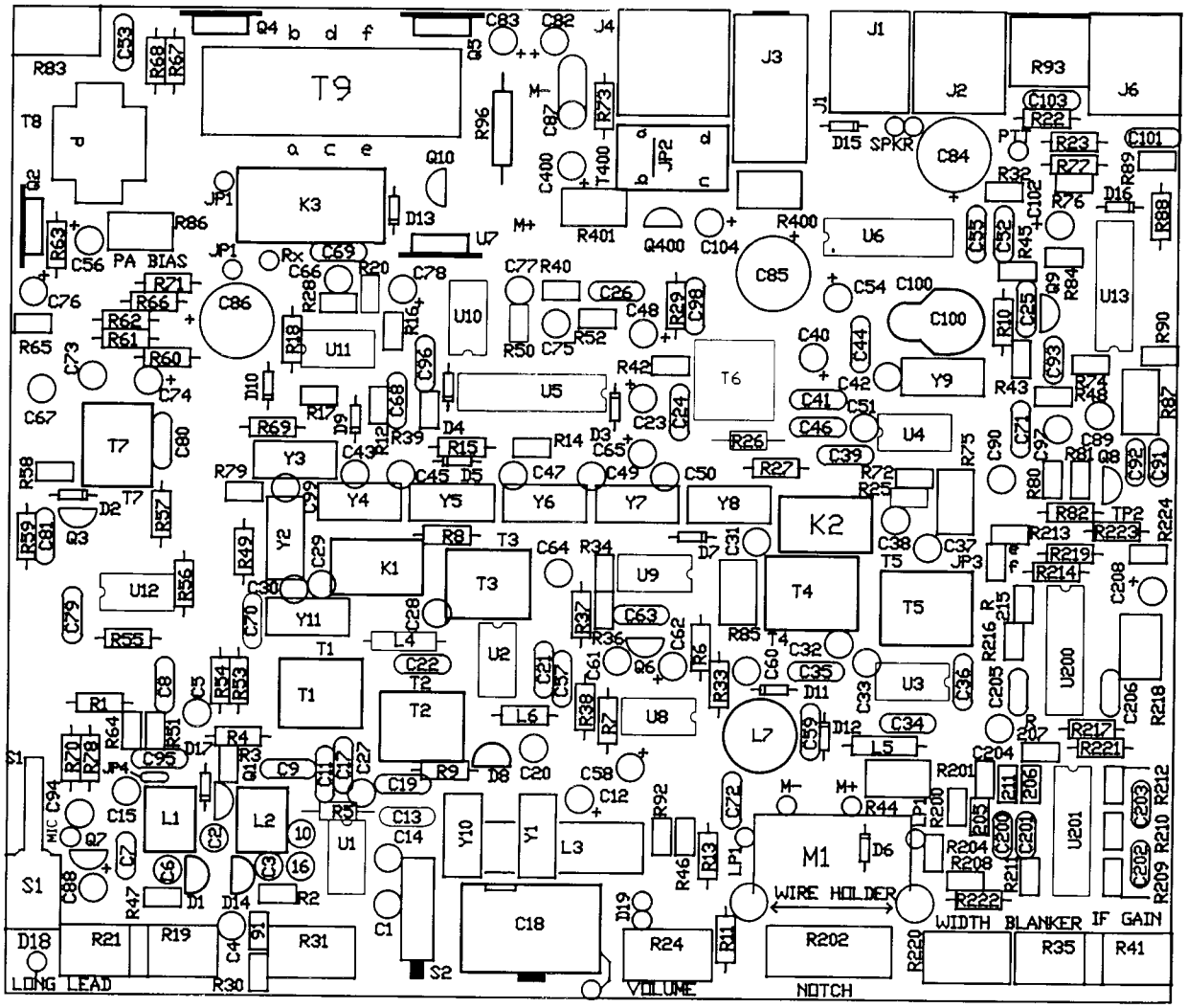
R92: 2K resistor for optional dial light.

R93	500K PC POT	1
R93	500K PC TRIMPOT	1
R96	.1/ 3W OHM RES.	1
S1	SPDT PC SWITCH	1
S2	Push Switch	1
S2C	S2 CAP	1
T1,6	154AC470072 TRANS.	2
T2,5	154PC470033 TRANS.	2
T3,4	42IF129 TRANS.	2
T7	RMC502182 TRANS.	1
T8	TL030 TRANS.	1
T9	Toroid Trans.	1
U1,4	NE602 IC	2
U10,12	TL071 IC	2
U11	TL072 IC	1
U13	4011 IC	1
U2,3,8	MC1350P IC	3
U5	4053 IC	1
U6	LM380 IC	1
U7	7812 IC	1
U9	5532 IC	1
Y1	10.1819 XTAL	1
Y2,3,4,5,6,7,8,11	10 MHZ XTAL'S	8
Y9	9.9995 MHZ XTAL	1

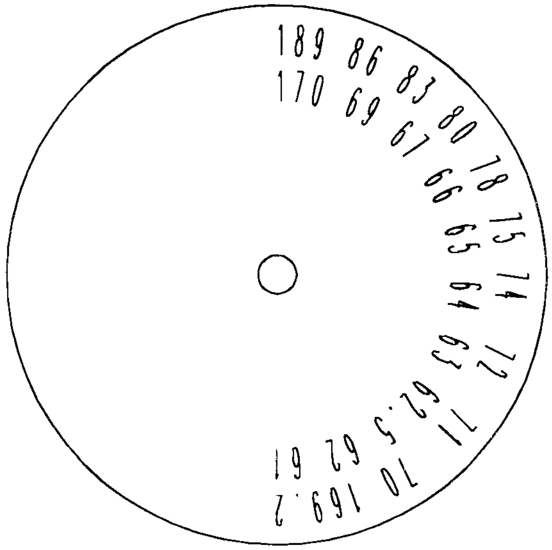

R19 10K Q-MULT.
C95 .1
Q1 J310
L1 1.5m
L2 1.5m
C2 7.5p
C3 330p
C6 330p
R47 4.0K
JP1a
C7 .018
D1
D14
D17
C4 .22
JP4
C8 .1
R1 4.7K
C15 .22
R64 180
R30 4.7K
R31 10K Preselect
R2 4.7K
Vcc
Vt
C9 .1
R91 10K
R51 33
C16 .0033
C10 220p
C11 .1
T1 154AC-470072
C12
C13 .1
R5 1.2K
U1 NE602
R53 22K
C17 470p
R54 22K
R56 66K/1%
R57 2.2K
R55 66K/1%
C79 .1
U12
C80 .1
T7
C73 .001
R61 6.8K
R58 100
D2
Q3
C67 .0047
R62 4.7K
R63 12
C56
C76
R65 68
R83 1K
Q2
T8
R68 47
Q4
R67 47
Q5
T9
C87 .001
C53 .1
Bias
R86 10K
R71/8.2K
Vt
M-
M+
R96 .1/3W
C82
C83
C18 Trim
C18a
C14 68p
C1 68p
S2
L3 15u
Y1 Y10
C18b 220p
D18
RF clip
R59 1K
C81 .1
R60 33
C74
R66 33
R29 1.2K
Vcc
C41 .1
R3 470
R4 33
C5 .22
Vr
R27 47
C27 330p
C19 68p
U2 I.F. Amp MC1350P
T3 42IF129
R8 47
K1
C29
Y11 Y2 Y3 Y4 Y5 Y6 Y7 Y8
C31
K2
T4 42IF-129
C32 47p
C33 180p
U3 I.F. Amp MC1350P
T5 154PC-470033
C37 68p
C34 .1
C35 .01
C36 .1
L5 27u
C38 120p
U4 NE602
C51 68p
T6 154AC-470072
C46 .01
R72 82K
R75 10K
R25 82K
C42 68p
C44 27p
Y9
C100 25p
C24 .01
C39 .1
T2 154PC-470033
C28 33pF
L4 27u
C21 .1
C22 .1
R6 33K
R7 82K
D8
D3
C99 C30 C43 C45 C47 C49 C50
C66 470p
R28 22K
R17 10K
R18 10K
R20 1K
D5
R69 33K
D9
D10
U11a
U11b
C78 4.7
R14 5.6M
R15 4.7K
C65 4.7
U9a
D6
D7
R41 10K IF GAIN
R11 10K
R13 1K
Vcc
Mtr sense
R85 25K
R16 100K
C68 .1
R12 82K
R42 33K
C48
C20 .0047
C90 .22
JP3
U7 78L05
Vcc +12V
C69-72 .1
D13
K3
Rx See text
R79 1K
Vt
JP1b
R9 22K
R38 1K
C59 .1
D11
C60 120p
D12
Q6
C61 .001
U8 Noise AMP MC1350P
C57 .1
C58 4.7
L7 .6-1mH
R33 10K
C62
R34 82K
C64 470p
R35 50K
Noise Blanker
C63 .1
R36 33K
R37 10K
U9b
D19 Dial light
R32 1.2K
RF1
R44 10K Meter zero
R46 33
C86
M1 RF S+ METER
C104 4.7
C94 470p
Q7
R70 2.7M
C88 4.7
R78 270
C26 200P
C77 .001
R40
R49 470
C40
C75 .001
R26 470
C23 4.7
R52 10K
R50 33K
U10
D4
R39 2.7M
C96 .1
U5 CD 4053
R10 Vol. 1K
C52 .01
R24 10K
C98 .1
U6 LM380
C84
C85
C54 4.7
R32 3
C55 .1
EXT SPKR
J2
AUDIO
J3 GND
J4 RF
J1 PWR
JP2
R73 10K
S1
D15 1N4001
Dave Cutting LongWave Products
Size E
Document Number E-VP1750a
Date: March 25, 2000 Sheet 1 of 2

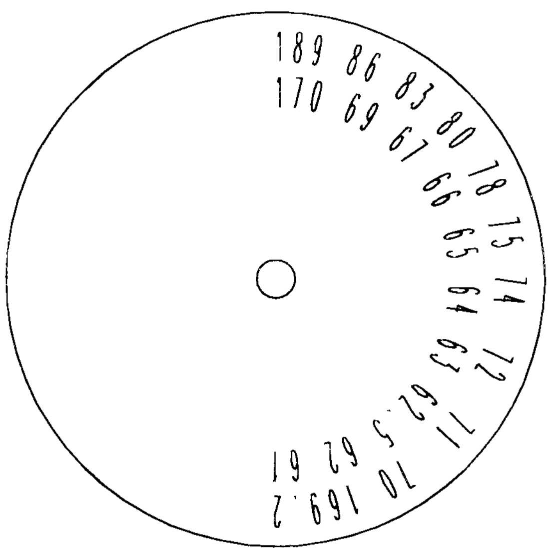


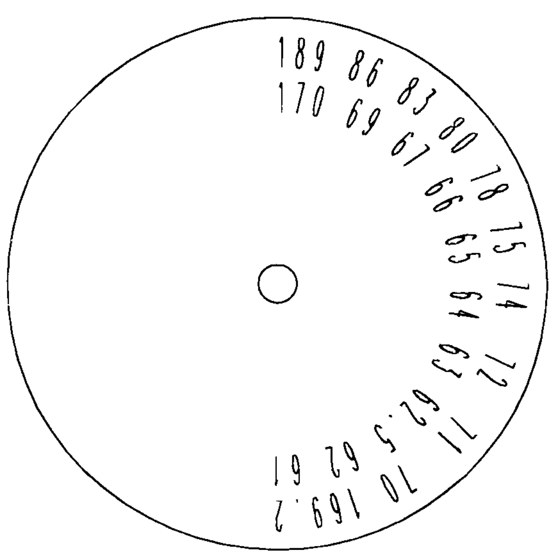
All capacitors in uF,
unless otherwise shown.
All resistance in Ohms.
Vt: 12 Volt transmit only
Vr: 12 Volt receive only.
Vcc = Input Voltage
Vcc = 12 VDC



EXP1750Z Top Overlay


189 86 83 80 78 75 74 72 71 70 169.2
170 69 67 66 65 64 63 62.5 62 61


189 86 83 80 78 75 74 72 71 70 169.2
170 69 67 66 65 64 63 62.5 62 61


189 86 83 80 78 75 74 72 71 70 169.2
170 69 67 66 65 64 63 62.5 62 61

RF CURRENT DETECTOR

The RF Current Detector adds the convenience of monitoring the output current to the antenna during transmission. Knowing the value of antenna current, and even more important, where the peak of the antenna current is in relationship to the desired frequency is a very important clue in optimizing your signal.

Monitoring the antenna current would reveal low output and would allow you to adjust and peak the current by adjusting the antenna loading coil to the correct frequency. When the antenna is resonant on the same frequency of operation, you will see a substantial increase in output current.

Remember that transmitting antenna's at these frequencies have sharp tuning and can occasionally wander off frequency. The current meter will help keep you antenna always on frequency and make you aware of any abnormalities.

ASSEMBLY

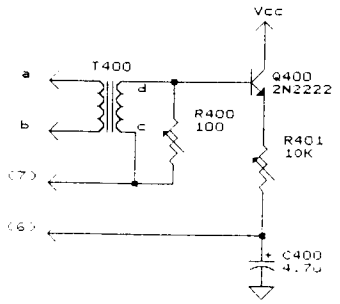
The circuit board has an area at the rear marked for components with a part designator in the 400's. Five components are used for the current detector.

1. Start with the toroid transformer. Remove jumper "JP2" (next to RF Jack J4) if it has been installed.
2. Wind 20 turns of small-insulated wire evenly around toroid. Set toroid aside temporarily.
3. Solder a 2" bare wire into T400 hole marked "a". Size of wire should be approx. 20-24 Ga.
4. Install toroid leads into holes marked "c" and "d". Pull wires firmly from the solder side and solder. Remove excess leads.
5. Pull bare wire from point "a" through toroid and into hole marked "b". Solder wire and remove any excess lead length.
6. Install remaining components.

ALLIGNMENT

Send a CW signal into a known load, such as 50 Ohms.
If a RF current meter is available, insert it between the load and transmitter to monitor the current. If not available, use an oscilloscope to check the P/P Voltage across the load and, with the help of Ohms law, deduce the RMS current. Remember to get the RMS Voltage first by; Vpp/2 x .707= Vrms.
Adjust R400 for best linearity and R401 for the desired current meter range.
If an RF current higher than 1 Amp is expected, you can set R401 for half the indicated meter reading, IE; meter reading of .6 = 1200 mA, or 1.2A.
DO NOT leave the transmitter on for extremely long periods of time if you're adjusting for higher current levels.

RF CURRENT DETECTOR



T400: a/b: 1 turn, c/d: 20 turns.
Adjust R400 for best linearity, R401 for desired range.

RF OUTPUT CURRENT DETECTOR			
Size A	Document Number	RFD	REV A
Date:	July 24, 1999	Sheet	of

CW/NOTCH FILTER INSTALLATION

Assembly notes: All resistors are ¼ Watt, 5% tolerance unless noted.
Metal film resistors should be checked with an Ohmmeter to confirm the value before installing.
Be sure to install "Black" potentiometers on the solder side of the circuit board.

1. Remove "S" meter from circuit board (if already installed). The M+ and M- do not need to be cut, only the wire band that holds the meter should be temporarily unsoldered.
2. R202; Dual potentiometer (6 pins). Install on the *solder side.*
3. R220; Width control. Potentiometer similar to notch control (no inscription on component). Install on the *solder side.*
4. R218; 10K Ohm PC trim potentiometer, marked "10K".
5. C208; 4.7uF electrolytic capacitor. Note polarity.
6. R216, R223, R224; 10K Ohm resistor. R216 and R224 mounts vertically.
7. R204, R208; 150 Ohm 1% metal film (Blue color). Both mount vertically.
8. R203, R209; 634K Ohm 1% metal film (Blue color). Both mount vertically.
9. R200, R206, R207; 316K Ohm 1% metal film (Blue color).
10. R213, R214, R215, R219; 66K Ohm 1% metal film (Blue color). R213 and R215 mount vertically.
11. R201, R205, R210, R211, R212; 100K Ohm 1% metal film (Blue color). All mount vertically.
12. R217; 4.7K Ohm resistor.
13. R221; 6.8K Ohm resistor.
14. R222; 1K Ohm resistor.
15. U200, U201; Quad Op-Amp, "TL074". Note polarity. Tip: Insertion is easier if you bend each row of IC leads using a flat surface, such as a table.
16. C205, C206; .018uF mylar "green" capacitor, marked "2A183FT" (or similar).
17. C200, C201, C202, C203; .0047uF mylar "green" capacitor, marked "2A392JT" (or similar).
18. C204; .22uF "yellow" capacitor, marked "224M".
19. Using wire cutters, remove JP3.

ALIGNMENT

1. Connect a signal generator, speaker, and power supply to the transceiver.
2. Connect a frequency counter across the speaker leads to monitor the frequency of the CW tone. Turn Notch control (R220) fully clockwise, and Width control (R220) fully counter clockwise.
3. Turn the transceiver ON, and set the signal generator frequency to 175 KHz. Turn the Frequency dial of the transceiver (C18) to the 12 O'Clock position. Adjust the audio and IF gain as necessary for a comfortable volume. Adjust the signal generator for a frequency counter reading of 1 KHz (increase volume if frequency counter fails to display frequency).
4. Disconnect frequency counter and connect an oscilloscope across the speaker. Adjust scope amplitude to .5V/Div, and sweep to .2 ms/Div.
5. Turn CW filter *width* potentiometer (R220) fully clockwise.
6. Locate PC trimmer potentiometer (R218) and adjust for a peak response, as indicated on the oscilloscope.

Your filter is now complete. The Notch control (R202) is usually turned fully clockwise when it is not being used, while the CW filter is usually fully counter-clockwise when not used.
It is easier to spend time experimenting with the two filters than for me to give you some lengthy, boring, lecture as to how they should be operated. The filter is straight forward, and will become second nature once understood.