

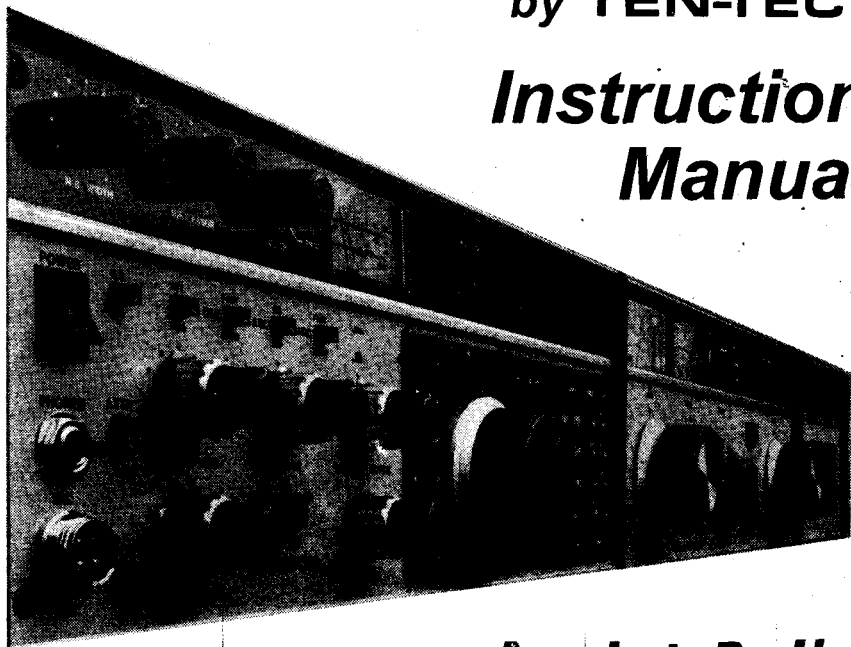
No. 1330**◆ Complete T-KIT with Case, Hardware ◆**

30 Meter CW Transceiver

Superhet receiver with 4-pole crystal filter,
3 watts RF output, QSK break-in keying,
VFO tuning of 10.10 -10.15 MHz WARC band

T-KIT
by **TEN-TEC**

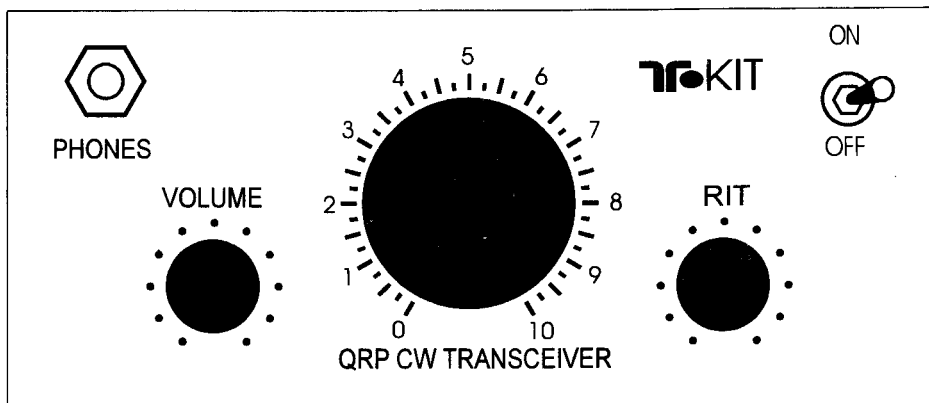
Instruction Manual



America's Best!

Kit Assembly and Instruction Manual for T-KIT Model No. 1330

30 Meter CW Transceiver



Guide to Table of Contents

Reference Section	Page 2
Assembly Section	Page 2
Table of Illustrations	Page 3
T-KIT Limited Warranty	inside back cover

***IMPORTANT: Please read Warranty Terms
BEFORE starting kit assembly.***

***. . . A quality electronics kit project from
T-KIT***

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Table of Contents

● REFERENCE SECTION

Transceiver Specifications	4
General Introduction	5
A Few Notes on "QRP" operation	6-7
Overview of Circuit Stages	8-10
Some Help with Terms & Abbreviations	11-13
Kit Parts List	14-17
Required & Optional Supplies, Tools	18
Component Reference Index	19-24
Power Supply Considerations	24
Operating Tips, Alignment Reminders	25
Note on Modifications	26
Using & Aligning the RIT control	27
Troubleshooting, Alignment Summary	28

● ASSEMBLY SECTION

Kit Assembly Suggestions	1-2
Getting Started	3
Overview of Kit Assembly Phases	4
Looking Ahead	5
Phase 1.0:	
Keying Circuit	6-10
Progress Test	9-10
Phase 2.0:	
Transceiver VFO	11-18
VFO Circuit Description	11
VFO Range Adjustment	17-18
Phase 3.0:	
Transmit Mixer and 10.1 MHz Bandpass Filter	19-22
Progress Test	22
Phase 4.0:	
Receiver IF Stages	23-27
Receiver Circuit Descriptions	27,34
Phase 5.0:	
Receiver BFO and Audio Amplifier	28-33
Progress Test, Basic Receiver Alignment	32-33
Phase 6.0:	
Receiver AGC and op-amp Audio Filter	34-36
Phase 7.0:	
Transmit Driver, Amplifier, Output Filter	37-42
Phase 8.0:	
Final Assembly and Alignment	43-48

Table of Illustrations & Charts

REFERENCE SECTION

Model 1330 Block Diagram	9
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ASSEMBLY SECTION

Overview of Top Groundplane Solder Points	5
Phase 1.0 Schematic & Board Layout	6
Phase 2.0 Schematic description	11
Phase 2.0 Circuit Board Illustration	12
VFO Circuit Parts List	13
Figure 2.1: Winding toroid L3	15
Pin numbering (rear view) of main tuning control	16
Enlarged VFO Schematic foldout	16b
Figure 2.3: Chart for VFO Coil Adjustment	18
Phase 3.0 Schematic Details	19
Phase 3.0 Circuit Board Illustration	20
Phase 4.0 Schematic Details	23
Phase 4.0 Circuit Board Illustration	24
Phase 5.0 Schematic Details	28
Phase 5.0 Circuit Board Illustration	29
Phase 6.0 Schematic Details	33
Phase 6.0 Circuit Board Illustration	34
Phase 7.0 Schematic Details	37
Phase 7.0 Circuit Board Illustration	38
Figure 7.1 Mounting Q15, Making T1, L8-L10	40
Figure 8.1 Headphone Jack Wiring Details	44
Log of Frequency Calibration	47
Solder Side Traces (for Checking Solder Bridges)	48

Foldout pages:

- X-Ray View of Circuit Board
- Mechanical Assembly Details
- VFO schematic (page 16A)

Supplementary Worksheet:

- Full Schematic
- Circuit Board Drawings for Phases 1.0 through 7.0

Conventions in this T-KIT Manual:

1. The 10.100 to 10.150 MHz WARC amateur band is generally referred to as 10.1 MHz or 30 meters.
2. The crystal-controlled 14.31818 MHz IF frequency may be referred to as "14.318 MHz."

T-KIT Model 1330 CW Transceiver Specifications

Frequency Coverage: VFO tuning of 10.100 - 10.150 MHz WARC band. Tuning range is adjusted during winding of one toroid in the VFO circuit.

Frequency Control: varactor tuned oscillator with potentiometer control. Temperature compensated LC components stabilize VFO.

RIT (receive incremental tuning): ± 1.5 KHz.

Antenna: 50 ohm unbalanced, SO-239 connector.

Power requirement: 12-14VDC, 35 mA. receive (no signal), 80 mA receive (S-9 signal), 800 mA on transmit.

Construction: Black texture painted clamshell-type steel top and bottom, aluminum panel/chassis, subpanel and heatsink. One 3.5"X5" double-sided circuit board.

Board-mounted Components:

216 including 4 IC's, 19 transistors, 13 diodes.

Front Panel Controls: main tuning, RIT, volume, DC on-off toggle.

Connectors: front panel 1/4" stereo phone jack; Rear panel SO239 for antenna, 3 RCA jacks for key, DC input, accessory DC output.

Dimensions: HWD 2.75"x6"x6". **Weight:** 2.25 lbs./1.02 kg.

TRANSMITTER:

- **RF Output:** 3 watts typical, no external adjustment
- **T/R Switching:** solid state, full break-in
- **CW offset and sidetone:** Adjustable 400-1000 Hz sidetone automatically track offset frequency. Sinewave sidetone has internal level adjustment.

RECEIVER:

- **Type:** single conversion superhet, JFET mixer
- **Sensitivity:** .25 μ V typical for 10 dB S/N
- **Selectivity:** 4-pole crystal ladder filter (1 KHz nominal bandwidth)
- **AGC:** audio derived
- **IF frequency:** 14.31818 MHz
- **Audio:** 300 mW @ 4 ohms, built-in 3" speaker

The T-KIT QRP CW Transceivers: A General Introduction

The T-KIT Model No. 1330 is the 30 Meter version in a series of HF CW "QRP" transceivers engineered by TEN-TEC for our kit-building customers. We invite you to enjoy this rich **combination** of classic ham radio experiences:

- serious, rewarding kit-building
- VFO-tuned QSK CW communication
- operating inexpensive but very effective equipment.

TEN-TEC introduced its first products in 1969. They were some of the first commercially produced QRP gear using transistors in place of fading tube technology. In fact, the earliest models were kits. Company direction rapidly moved to a series of increasingly sophisticated factory assembled QRP transceivers. Called "Argonauts," these rigs are collector's items today.

Nearly 30 years later finds TEN-TEC as the premier U.S. manufacturer of HF transceivers and linear amplifiers. Our goal for this kit project was to develop a series of monoband CW transceivers packing as much performance as possible for under \$100. We included sufficient features sure to make an experienced QRP operator smile. Just as important, a beginner can build this kit, put it on the air and enjoy the world of QRP.

You are about to construct a transceiver which will be easy and fun to use but which is quite sophisticated in design areas which we believe **really count**. We mean receiver selectivity and sensitivity, well-shaped CW keying, true QSK break-in keying, effective AGC, pleasant sidetone, and VFO stability quite excellent for varactor tuning.

We expect some customers to ask why we did not include this or that additional feature. Our reply is that "real radio" operating characteristics were our priority and we believe this is the best transceiver of this kind for the money.

Electronics training and reference publications have become ever more expensive. We think you will discover the experience of building, testing and learning about this CW transceiver to be a good hands-on course in contemporary RF design worth more than the price of the kit. We encourage you to become familiar with the circuit explanations integral to the process of building this transceiver kit.

A Few Notes on "QRP" Operation

TO EXPERIENCED QRP BUILDERS & OPERATORS: As you work through this manual, do keep in mind that we respect your know-how and experience. In turn, we hope you support our initiative to make kit-built QRP rigs understandable and affordable to other interested hams, including newcomers. This instruction manual is intended especially to help them. Please be patient if we go into a bit more detail than you find necessary!

NEW TO THE IDEA OF "QRP"?

Ham magazine columns and other publications show "QRP" operators to be a dedicated special-interest group, right along with VHF DXing, Satellites, Digital modes, Direction-finding and more. We encourage you to consult QRP-oriented columns and books to learn how to enjoy ham communication using minimal transmit power. Our main goal in this manual is to help you BUILD your transceiver and get it ready for reliable on-the-air communicating. We condense the experiences with QRP by the hams at TEN-TEC to the following few pointers . . .

● QRP: A Philosophy or Simple Mathematics?

About 100 watts RF output is the prevailing standard for today's HF transceivers. "QRP" operation is defined by its enthusiasts as RF output of 5 watts or less. An even more dedicated group of experimenters prefer "QRPP" activity with outputs of less than 1 watt. You may be intrigued by the philosophy and camaraderie of the QRP community or you may just want to take a small, lightweight rig on vacation trips. Either way, there are some basics about decibels, RF power output and the RST system useful to understand.

The effectiveness of today's QRP communicating is made possible especially by prevailing standards in **receiver circuit** design in virtually all HF transceivers. That's why S-5 signals on the meter can seem like "599" to the ear.

Keep these math facts in mind . . .

1. One "S-unit" (on a meter, not by ear) consists of a **6dB increase or decrease** in received signal strength.
2. Transmit power must be **increased 4 times (400%)** to achieve a received signal strength increase of **one S-unit**.
3. Conversely, lowering power to **25%** results in a received signal strength reduction of just one S-unit.
4. **Decibels over S-9:** a 10 dB increase in received signal strength requires a **tenfold** increase in transmit power!

● 30 Meter CW: Ideal for QRP

With a maximum of 250 watts RF output permitted on 30 meters, this band offers a fairly level playing field for QRP operating. Most "high power" stations are likely to be 100 watt transceivers. By the numbers, here's how a QRP signal would compare to the 250 watt maximum reported as "+10 over 9," given comparable antennas and propagation:

Transmit Power	S-Meter Report
250 watts	S9 + 10dB
25 watts	S9 <i>(remember: +10 dB over S-9)</i>
6.25 watts	S8 <i>needs X10 RF power, and you</i>
1.56 watts	S7 <i>lose only 1 S-unit when again</i> <i>reducing power to 1/4!!</i>

Let's say DX conditions are good, and a 100 watt signal earns consistent S-8 meter reports from DX. What happens with QRP?

Transmit Power	S-Meter Report
100 watts	S8
25 watts	S7 <i>(power reduced to 1/4)</i>
6.25 watts	S6 "
1.56 watts	S5 "

These examples illustrate one point: if higher-power stations are getting excellent reports along a given propagation path, simple math shows that 2-4 watt stations can expect fair to good RST reports. These examples presume comparable antennas. In fact, the S-unit gap can be even closer between a QRP station with an excellent antenna and a 100-watt station with mediocre antenna.

With no contest activity on 30 meters, and regular DX openings, newcomers will discover plenty of courteous operators who listen patiently for weaker signals. This is a band where QRP operating is especially popular and commonplace.

● **ANTENNAS:** A fun advantage of compact portable transceivers such as your Model 1330 is that you can easily liberate yourself from whatever space restrictions may exist where you live. GO to wherever you can easily put up an ideal antenna for a while. While limited-space antenna designs can work even with QRP power levels, it just makes good sense to set up the very best antenna you can, whenever you can. The space requirements for 30 meter antenna are modest, making it practical to experiment with gain designs.

Model 1330 CW Transceiver

OVERVIEW OF CIRCUIT STAGES

It is worth your time to study the T-KIT 1330 Transceiver Block diagram before beginning assembly. Doing so will give you the "big picture" of how the transceiver works and the purpose of each of the circuit blocks.

A. VFO

The VFO tunes any 50 KHz segment (perhaps as much as 70 KHz) within its approximate 4.2-4.15 MHz range and controls both transmit and receive frequency through separate mixer circuits. For more details of the VFO circuit design, see page 11 in the Assembly Section.

B. Receiver

10.1 MHz signals are mixed with the VFO signal to produce a 14.31818 MHz IF signal which is filtered and amplified through a series of stages before audio output. The receiver circuitry is explained on pages 27 and 34 in the Assembly Section.

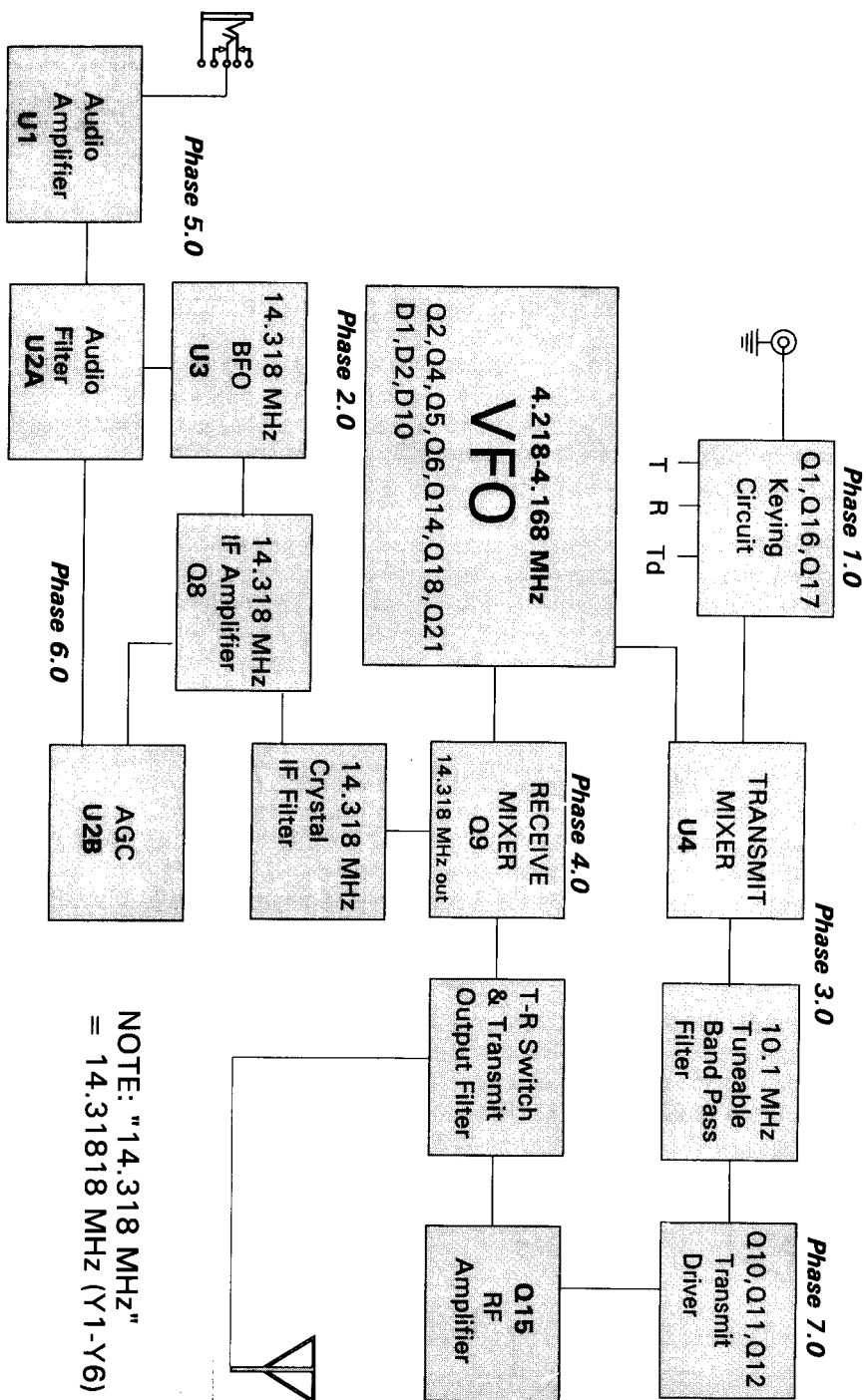
C. Keying, Transmit and T-R Circuitry

Transmit Mixer: U4, an NE612 double-balanced mixer uses external components that complete an oscillator circuit (C65, C66, C67, Y6, L14). This circuitry provides an oscillator signal that the NE612 mixes with the VFO signal to produce the output transmit signal. The IC is powered by the "T" voltage.

Double-Tuned Bandpass Filter: This circuit is simply made up of two separately tuned resonators in place to clean up any spurious transmit signals from the NE612, therefore providing a clean signal to the driver stage.

Transmit Driver Circuit: This circuitry takes a clean low level transmit signal from the double-tuned bandpass filter and provides the drive for the main power transistor. A power input of about $10\mu\text{W}$ will produce a power output of about 32mW to drive the PA (a power gain of about 35db). Q10 accepts the low input signal and passes the amplified signal on to Q11 and Q12. Q11 and Q12 form a complementary pair of transistors (an NPN and a PNP): neither will conduct at the same time.

Model 1330 CW Transceiver Block Diagram



NOTE: "14.318 MHz"
= 14.31818 MHz (Y1-Y6)

Transceiver Circuit Description, continued

Transmit PA Circuit: Q15, a 2SC2166 NPN power transistor takes the 32 mW of output power drive from the low level transmit driver stage and can deliver up to 4-5 watts of power output to the antenna (a power gain of about 20 dB). However, a typical 3 watts RF output is our published specification. D9 maintains a bias point.

Output Lowpass Circuit: Before the transmit signal is delivered to the antenna, it passes through this lowpass filter stage. These filters are designed to roll off just slightly above the cutoff frequency for the HF cw band for which they were designed, and attenuate all harmonic emissions to the required levels. Notice there are several quarter-wave filter sections placed "back-to-back." When the "Td" voltage is applied to D6, an effective short occurs across C100 and C88, presenting a very high impedance at C59 and C99. This ensures that the entire transmit signal is delivered to the antenna. Therefore, the topology for the transmit lowpass is a capacitive input/output 5th order Chebychev filter (C57, L8, C58, C98, L9, C59, and C99). This circuitry also helps to route properly the receive signals to the front end of the receiver. The topology for the receive filter is a capacitive input/output 3rd order Chebychev filter (C99, C59, L10, and C88). The receive signal then passes to the receiver front end (P4) via P3 and a RG174/U coax jumper.

T/R Switch Circuit: With a KEY line closure to ground, Q1 generates a "T" signal that provides power to all associated transmit circuitry, while Q16 and Q17 remove the "R" signal which effectively removes power from the J310 JFET mixer transistor Q9. D12 and C92 help to produce a delayed transmit (Td) signal that is important in determining output wave-shaping.

CW Sidetone: A trick is performed here where the transmit oscillator "leaks" back into the receive IF and beats with the receive oscillator. When the resulting tone is equal to the desired receive tone, the transceiver will be transmitting on the same frequency it is receiving (RIT control is centered), provided that the BFO and transmit mixer are both properly aligned. R61 is the sidetone audio level control.

SOME HELP WITH TERMS & ABBREVIATIONS

The following are intended to be helpful descriptions, not formal definitions. We try to use plain language as much as possible in this manual, avoiding unnecessary jargon.

BFO ♦ "Beat Frequency Oscillator," a receiver circuit stage which is required to hear CW (or SSB) signals as audio tones rather than as hisses or garble. If you do not understand how the 14.318 MHz crystal-controlled BFO stage "heterodynes" with the 10.1 MHz signal converted to 14.318 MHz IF, read up on this topic in any ARRL Handbook or other reliable RF-design reference. See also: IF.

BIFILAR ♦ refers to a coil with TWO separate but interconnected windings (T1).

BOARD ♦ Generally refers to "PC-board" or "printed circuit board."

BUFFER ♦ An electronic circuit stage, a sort of "referee" that tells its input and output not to mess with each other. Think about such a task! It may also provide amplified output of the incoming signal.

CARRIER ♦ Transmitted RF signal that is NOT "modulated." It is heard as a steady audio tone on BFO-equipped receivers or as a powerful silence (i.e. over-riding all background noise or hiss) on receivers in AM or FM mode.

CCW ♦ see CW below.

"CW" ♦ TWO common meanings in electronics: "Continuous Wave" for the communicating of morse code signals, or "Clockwise" to designate a point on a variable control. "CCW" therefore means "counterclockwise."

DIP ♦ "Dual Inline Package," referring to IC's and their sockets or any other component ("DIP Switch," etc.). The "line" refers to rows of PC-board or perfboard holes that are 0.1" apart. "Dual" means two rows. Therefore "SIP" would mean a SINGLE row device.

FILTER-ACTIVE

FILTER-CRYSTAL

FILTER-HI-PASS

FILTER-LOW-PASS

FILTER-BANDPASS

FILTER-PASSIVE

Filters are used in DC, Audio and RF circuits. Understanding them is essential electronics know-how.

GROUND PLANE ♦ ALL sections of a circuit board which are mechanically or electrically connected to DC and RF ground. In the 1330 transceiver design, almost ALL of the top or upper side (component side) of the board is a groundplane. The

term is also used in antenna design: if your antenna has a vertical radiating element, plus four (or more) horizontal elements connected to RF ground, the horizontal elements are called a "groundplane."

IF, Intermediate Frequency ♦ See "Superhet."

JUMPER ♦ Any wire soldered to interconnect points in a circuit not otherwise connected by board traces or other wiring. In addition to short jumpers made from hookup wire, your kit also uses "zero ohm resistors" which are short jumper wires in a resistor body painted with one black band.

KEY, "to key" ♦ to turn on a transmitter's carrier signal momentarily, whether by a telegraph code key (the root of this common radio jargon) or by a push-to-talk switch.

L-C ♦ A tuned circuit made of inductor (L) and capacitor (C).

LOCAL OSCILLATOR (LO) ♦ An oscillator in a superhet receiver whose output is mixed with another signal such as antenna input. See SUPERHET, VFO, BFO.

MIXER ♦ A circuit section which gets two or more inputs and delivers a single output. The output is equal to the sum of the input frequencies and also to the difference between them.

OP-AMP ♦ "Operational Amplifier," a high performance linear amplifier with an Inverting input, a Non-inverting Input and one Output.

ORIENT, orientation ♦ When we ask you to "orient" a kit part one way or the other, we're just asking you to get it RIGHT — per all the "orientation" illustrations or explanation which we provide. Transistors, diodes, IC's and electrolytic capacitors are parts for which correct orientation is essential. See: POLARITY

POLARITY ♦ Refers to the "+" and "-" sides of batteries, power supplies, power cables, electrolytic capacitors, etc.

RIT, "Receive Incremental Tuning" ♦ In transceivers, a control which permits slight adjustments of receiver frequency without changing the transmit frequency. See page 27.

RX ♦ Abbreviation for receive, receiver, receiving. [See: TX]

SHIELD ♦ The outer braid of audio or RF coaxial cable, or the aluminum case enclosing a coil or transformer. The metal case of a transceiver also performs an important RF shielding function. The shield blocks or protects a coil from the effect of nearby objects that would change its inductance. The shielding on cable prevents the inner wire from radiating (RF) or from picking up stray radiation such as AC hum.

SUPERHET ♦ a receiver circuit with one or more oscillator-mixer sections which converts the RF energy from the antenna to a different RF frequency before demodulation. This is called an "intermediate frequency" (IF). The receiver section of your transceiver is a single-conversion superhet. The IF is 14.31818 MHz, which is converted to audio by the BFO circuit.

TIN ♦ in soldering, to "tin" a wire or copper surface is to heat the wire or surface with the soldering iron so they become coated with a thin layer of solder.

TRIMMER ♦ either a capacitor or resistor, miniature and variable, intended to permit exact, final adjustment of circuit values.

TX ♦ Abbreviation for transmit, transmitter, transmitting.

T-R ♦ Abbreviation for "Transmit-Receive Switching", which can be accomplished by manual switches, relays or solid-state devices such as the transistors used in this transceiver.

VARACTOR ♦ a diode whose capacitance can be varied in step with the amount of DC voltage applied to it. The higher the voltage, the lower the capacitance. See also VCO.

VIA ♦ A wire (or "plated through") connection from a pad or groundplane on one side of a circuit board through a hole to a pad or groundplane on the other side.

VCO ♦ "Voltage Controlled Oscillator," an oscillator whose frequency is varied by DC voltage applied to varactor diodes, which change capacitance in step with the voltage level. The transceiver VFO is an application of VCO design.

VFO ♦ "Variable Frequency Oscillator." A tuneable (frequency variable) oscillator, perhaps with further buffer or amplifier stages, designed to control the frequency tuning range of a transmitter, receiver, transceiver (or perhaps a tuning accessory.)

ZENER DIODE ♦ a diode designed to have a very specific reverse breakdown voltage. This property makes the zener diode ideal for simple voltage regulators or precise voltage drop elements.

ZERO-BEAT ♦ A traditional expression referring to a received CW signal's audio tone being adjusted down from a "normal" listening audio frequency (e.g. 500-800 Hz) to a "null" of 0.00 Hz ("beats" or Hz/second). Tuning a reference signal to 0.00 Hz is useful in alignment procedures, and is best done so "by ear". If your transmit signal and a reference signal in the same frequency band can BOTH be tuned to such a 00.0 Hz audio null, with both signals monitored on a second receiver, you can be certain that both signals are on the same frequency for normal communications purposes. Identifying this exact null or center-point of any audible signal eliminates the possible and common alignment error of using the wrong sideband of either signal.

T-KIT Model 1330 30M CW Transceiver

KIT PARTS LIST

1. Check and organize all parts before starting construction.
2. See T-KIT Warranty if you suspect any parts are missing.
3. If "****" appears in the "Schematic" column for a common part value, please refer to the Component Reference Index to see all uses of that value.

A. Transceiver Circuit Board Parts

Quantity Schematic	Description and Value	Part No.
-----------------------	-----------------------	----------

● Fixed Resistors

The 3 color bands denote resistance value. The 4th band (gold) denotes 5% tolerance. All resistors are 1/4-watt unless specified otherwise.

5	☐ "zero ohm" jumper (single black band)	JMP1-4,L20	30353
1	☐ 10 ohm (brown-black-black)	R4	30115
1	☐ 47 ohm (yellow-violet-black)	R13	30122
6	☐ 100 ohm (brown-black-brown)	R36,38,43,57	30126
1	☐ 220 ohm (red-red-brown)	R16	30130
4	☐ 470 ohm (yellow-violet-brown)	R10,37,44,54	30134
2	☐ 560 ohm (green-blue-brown)	R9,R59	30135
1	☐ 680 ohm (blue-gray-brown)	R22	30136
9	☐ 1K (brown-black-red)	***	30138
4	☐ 1.5K (brown-green-red)	R1,2,R24,25	30140
5	☐ 2.2K (red-red-red)	***	30142
1	☐ 3.3K (orange-orange-red)	R42	30144
1	☐ 4.7K (yellow-violet-red)	R29	30146
1	☐ 5.6K (green-blue-red)	R11	30147
11	☐ 10K (brown-black-orange)	***	30150
1	☐ 22K (red-red-orange)	R23	30154
1	☐ 47K (yellow-violet-orange)	R14	30157
3	☐ 68K (blue-gray-orange)	R56,60,62	30159
1	☐ 82K (gray-red-orange)	R30	30160
4	☐ 100K (brown-black-yellow)	R7,8,26,49	30161
1	☐ 470K (yellow-violet-yellow)	R31	30078
1	☐ 1 megohm (brown-black-green)	R28	30173

● Disc Ceramic Capacitors

2	□	3 pF	C52,C63	23248
1	□	5 pF	C69	23249
1	□	10 pF	C64	23371
3	□	15 pF	C33,C101	23372
1	□	18 pF 5% NPO	C77	23302
2	□	56 pF	C24,C67	23379
3	□	33 pF	C27,34,47	23376
1	□	39 pF	C31	23377
3	□	47 pF	C22,65,70	23378
3	□	68 pF	C17,23,66	23381
2	□	82 pF	C60,C96	23383
2	□	91 pF	C53,C61	23384
1	□	120 pF	C50	23386
1	□	150 pF NPO (marked 151)	C83	23388
2	□	150 pF N80 (marked N80-151J)	C29,C30	23494
2	□	220 pF (marked 221)	C14,C16	23396
1	□	270 pF (marked 271)	C15	23397
2	□	330 pF (marked 331)	C57,C88	23398
1	□	470 pF (marked 471)	C84	23400
2	□	680 pF (marked 681)	C58,C59	23402
1	□	750 pF (marked 751)	C49	23403
2	□	.001 μ F (marked 102)	C39,C43	23245
22	□	.01 μ F (marked 103)	***	23260
6	□	.1 μ F (marked 104)	***	23261

● Film Capacitors (5% tolerance)

2	□	.001 μ F (marked 102)	C54,C62	23282
1	□	.0022 μ F (marked 222)	C8	23286
2	□	0.22 μ F (marked 224)	C37	23344

● Other Capacitor Types

1	□	910 pF polystyrene 5% (axial leads)	C28	23019
1	□	0.22 μ F electrolytic	C93	23262
3	□	1 μ F electrolytic	C12,25,86	23264
1	□	3.3 μ F electrolytic	C80	23265
2	□	4.7 μ F electrolytic	C1,C41	23310
6	□	10 μ F electrolytic	***	23266
2	□	33 μ F electrolytic	C9,C36	23308
2	□	100 μ F electrolytic	C3,C19	23189
1	□	470 μ F electrolytic	C7	23228

● Inductors, Coil-Making Supplies:

3	□	Shielded 1.3 μ H coil (marked 30-35)	L1,L7,L14	21058
4	□	Shielded 2.8 μ H coil (marked 30-34)	L6,12,13,18	21057
1	□	Shielded 5.8 μ H coil (marked 30-33)	L5	21056
1	□	6-hole wideband ferrite choke	L15	21179
1	□	Molded 10 μ H inductor (brown-black-black-silver)	L16	21124

Inductors, cont.

2	☐	Molded 100 μ H inductor (brown-black-brown-gold)	L11,L17	21164
2	☐	Molded 820 μ H inductor (gray-red-brown-gold)	L2,L4	21095
4	☐	T44-2 Toroid Coil Core (RED)	L3,L8-10	21171
1	☐	3/8" Toroid Coil Core (GREEN)	T1	21089
1	☐	Coil winding wire (SEE Model 1330 WIRE PAK)		87201

● Integrated Circuits

1	☐	LM386 audio amplifier IC	U1	25335
1	☐	LM358N dual op-amp IC	U2	25117
2	☐	NE612AN mixer/oscillator IC	U3,U4	25319

● Transistors and Diodes

12	☐	NPN transistor type 2N4124	***	25258
2	☐	PNP transistor type 2N4126	Q1,Q12	25385
3	☐	PNP transistor, type 2N5087	Q4,16,17	25001
1	☐	Transistor, JFET type J310	Q9	25115
1	☐	Transistor, RF power type 2SC2166	Q15	25339
6	☐	1N4148/914 silicon diode	***	28001
1	☐	PIN diode, type 1SV80 (note green band)	D5	28062
2	☐	1N4002 silicon rectifier diode	D7,D8	28000
1	☐	1N4007 silicon rectifier diode	D6	28043
2	☐	MV209 varactor diode	D1,D10	28050
1	☐	8.2 volt zener diode, type 1N756A	D2	28019

● Other Components, Electrical Hardware:

1	☐	Circuit Board for Model 1330		93272-3A
3	☐	10K potentiometer (volume, tuning controls)	R6,R18,R46	30267
1	☐	1K trimmer potentiometer (sidetone level)	R61	30618
6	☐	HC-49 style Crystal, 14.31818 MHz	Y1-Y6	48216
1	☐	"Silpad" TO-126 insulator (to mount Q15)		38215
1	☐	#4 nylon shoulder washer (to mount Q15)		38058
1	☐	Triple RCA-type phono jack board		35023
1	☐	DPDT toggle switch	DC power	32110

WIRE PAK: 87201

1	☐	18" Length of RG-174/U mini coax cable		46025
1	☐	#24 hookup wire pack: red, white, black)		
1	☐	Coil winding wire (#28 enameled, #24 enameled, plus twisted pair for T1)		

1	☐	3" round speaker		47011
1	☐	SO-239 RF connector		35007
1	☐	1/4" stereo headphone jack		35219

B. Cabinet/Chassis Sections and Finishing Hardware

1	☐	Front panel/chassis assembly for Model 1330 . . .	93269-DP2A
1	☐	Front subpanel, aluminum	93273
1	☐	Rear heatsink, aluminum	93274
1	☐	Speaker mounting plate	93161
1	☐	Steel bottom cabinet shell	93271-DP
1	☐	Steel top shell cover	93270-DP
14	☐	#4-40 3/8" screw, phillips [zinc]	60003
2	☐	#4-40 1/2" screw, phillip, [zinc]	60005
2	☐	Spacer, steel 1/4"	98077
15	☐	#4 lock washer	51002
16	☐	#4-40 hex nuts	54002
4	☐	#6X3/8" sheet metal screw (black)	65003
1	☐	#4 solder lug	41039
1	☐	Self-locking cable tie	77007
4	☐	Rubber bumper feet (self-adhesive)	42001
2	☐	Control knob	81559
1	☐	Main Tuning knob	93029
1	☐	Setcrew (for Tuning knob)	65015
1	☐	.050" hex allen wrench (for front panel knobs)	38040
1	☐	Model 1330 T-KIT instruction manual	74345
1	☐	Model 1330 Assembly Pictorial/Schematic sheet	74346

Suggestion: Use the allen wrench supplied to install the No. 65015 setscrew into the Tuning Knob NOW, so it will not be lost!

About the "Component Reference Index" (Pages 19 ff.)

The preceding Parts List shows the quantity of each type of part supplied in your kit. The Component Reference Index on the following pages of this manual, keyed to the schematic diagram, identifies the assembly step for each part as well as descriptive information about selected parts. Add your own notes as you grow more familiar with the circuit. This Index is your assurance (and ours!) that every component is accounted for in the Assembly Steps, cross-checked to the full schematic and sectional schematic diagrams.

A "*" for any part value in the preceding Parts List simply means that more than 4 or 5 of that value are used in the circuit and can be identified in the Component Index as well as on the schematic diagram and in the assembly steps.***

What YOU provide to build and operate this T-KIT QRP CW Transceiver

REQUIRED, NOT SUPPLIED:

- ☐ Regulated, well-filtered 12-14 Volts DC supply (1 amp minimum)
- ☐ Antenna for 30 meter band with 50-ohm coax feedline
- ☐ thin-diameter rosin core solder
- ☐ CW key, keyer or keyboard system
- ☐ Latex enamel (Tuning knob index striping)
- ☐ Wax candle or thermal glue gun (to secure L3 VFO coil)

MINIMUM TOOLS FOR KIT ASSEMBLY:

- ☐ 15 to 35 watt soldering iron
- ☐ diagonal cutters or wire "nippers"
- ☐ needle-nose pliers
- ☐ #4-40 miniature socket wrench (or other wrench, utility pliers)
- ☐ adjustable wire stripping tool
- ☐ Medium phillips screwdriver
- ☐ Small flat screwdriver or coil alignment tool
- ☐ set of alligator-clip jumper leads

MINIMUM TEST EQUIPMENT:

- ☐ VOM for DC voltage measurements
- ☐ 10.1 MHz signal source (another transceiver, reference oscillator, etc.)
- ☐ digitally-accurate HF receiver (to adjust VFO coverage)
- ☐ RF SWR/Wattmeter designed for typical HF use

OPTIONAL TOOLS & TEST EQUIPMENT:

- ☐ Frequency Counter
- ☐ RF SWR/Wattmeter specifically designed for QRP HF use
- ☐ RF signal generator
- ☐ "Desoldering" tool
- ☐ 50-ohm dummy load such as T-KIT Model 1203

(Note: home-made dummy loads should be made from non-inductive carbon, not wirewound resistors.)

T-KIT Model 1330 10.1 MHz CW Transceiver

COMPONENT REFERENCE INDEX

(See Kit Parts List for TEN-TEC part numbers not repeated below.)

■ **CAPACITORS** (el. = electrolytic; 5%F = mylar film; all others are disc ceramic)

Reference	Description	Step No.	Part No.	Circuit Notes:
C1	4.7 μ F el.	1-9		Keying
C2	.01 μ F	1-23		Keying
C3	100 μ F el.	5-15		Audio amplifier
C4	.1 μ F	5-18		Audio amplifier
C5	.1 μ F	5-19		Audio amplifier
C6	10 μ F el.	5-14		Audio amplifier
C7	470 μ F el.	5-16		Audio amplifier
C8	.0022 μ F 5%F	5-17		Audio amplifier
C9	33 μ F el.	6-10		Audio filter
C10	.01 μ F	6-2		Audio filter
C11	.01 μ F	6-8		Audio filter
C12	1 μ F el.	6-9		Audio filter
C13	<i>not used</i>			
C14	220pF	4-30		IF crystal filter
C15	270pF	4-31		IF crystal filter
C16	220pF	4-32		IF crystal filter
C17	68pF	4-33		IF crystal filter
C18	.1 μ F	5-10		BFO
C19	100 μ F el.	5-5		BFO
C20	<i>not used</i>			
C21	.01 μ F	5-9		BFO
C22	47pF	5-7		BFO
C23	68pF	5-8		BFO
C24	56pF	5-6		BFO
C25	1 μ F	5-40		BFO
C26	.01 μ F	2-47		VFO
C27	33pF	2-42		VFO
C28	910pF Polyst.	2-34		VFO
C29	150pF N80	2-35		VFO
C30	150pF N80	2-36		VFO
C31	39pF	2-44		VFO
C33	15pF	2-39		VFO
C34	33pF	2-43		VFO
C35	.01 μ F	2-48		VFO
C36	33 μ F	2-51		VFO
C37	0.22 μ F 5% F	2-38		VFO
C38	10 μ F el.	2-50		VFO
C39	.001 μ F	2-46		VFO
C40	10 μ F	6-20		AGC
C41	4.7 μ F el.	6-19		AGC

C42	.1 μ F	6-22	AGC
C43	.001 μ F	6-21	AGC
C44	.01 μ F	4-43	Receiver IF amp
C45	.01 μ F	4-44	Receiver IF amp
C46	.01 μ F	4-45	Receiver IF amp
C47	33pF	4-42	Receiver IF amp
C48	15pF	4-41	Receiver IF amp
C49	750pF	4-15	Receiver IF mixer
C50	120pF	4-18	Receiver IF mixer
C51	<i>not used</i>		
C52	3pF	4-16	Receiver IF mixer
C53	91pF	4-19	Receiver IF mixer
C54	.001 μ F 5%F	4-14	Receiver IF mixer
C55	.01 μ F	4-20	Receiver IF mixer
C56	.01 μ F	4-21	Receiver IF mixer
C57	330pF	7-30	Transmit LPF and T-R
C58	680 pF	7-31	Transmit LPF and T-R
C59	680 pF	7-32	Transmit LPF and T-R
C60	82 pF	3-15	TX mixer output filter
C61	91 pF	3-16	TX mixer output filter
C62	.001 μ F 5%F	3-17	TX mixer output filter
C63	3 pF	3-12	TX mixer output filter
C64	10pF	3-14	TX mixer output filter
C65	47pF	3-7	Transmit mixer
C66	68pF	3-8	Transmit mixer
C67	56pF	3-6	Transmit mixer
C68	.01 μ F	3-10	Transmit mixer
C69	5pF	2-55,3-2	Transmit mixer
C70	47pF	3-9	Transmit mixer
C71	.01 μ F	7-12	Transmit driver
C72	.01 μ F	7-13	Transmit driver
C73	.1 μ F	7-15	Transmit driver
C74	.01 μ F	7-14	Transmit driver
C75	10 μ F	7-16	Transmit driver
C76	.1 μ F	7-20	RF power amplifier
C77	18pF	2-41	VFO
C78	.01 μ F	2-49	VFO
C79	.01 μ F	1-24	Keying
C80	3.3 μ F	1-10	Keying
C81	10 μ F	1-7	Keying
C82	.01 μ F	1-25	Keying
C83	150pF	2-37	VFO
C84	470pF	2-45	VFO
C85	<i>not used</i>		
C86	1 μ F	3-5	Transmit mixer
C87	.01 μ F	7-36	Transmit LPF and T-R
C88	330pF	7-33	Transmit LPF and T-R
C90	.01 μ F	4-24	Receiver IF mixer

C91	.01 μ F	4-22	Receiver IF mixer
C92	10 μ F el.	1-7	Keying
C93	.22 μ F el.	4-13	Receiver IF mixer
C95	.01 μ F	4-23	Receiver IF mixer
C96	82pF	4-17	Receiver IF mixer
C97	<i>not used</i>		
C98	<i>not used</i>	7-34	Transmit LPF and T-R
C99	<i>not used</i>	7-35	Transmit LPF and T-R
C100	<i>not used</i>		
C101	15pF		VFO

■ DIODES

Reference	Description	Step No.	Part No.	Circuit Notes:
D1	MV209	2-25a	28050	VFO (varactor)
D2	8.2v zener	2-26	28062	VFO
D3	1N4148	6-11	28001	AGC
D4	1N4148	6-12	"	AGC
D5	1SV80	6-13	28062	AGC
D6	1N4007	7-23	28043	T-R switching
D7	1N4002	7-1	28000	Transmit driver
D8	1N4002	7-2	"	Transmit driver
D9	1N4148	7-17	28001	RF power amplifier
D10	MV209	2-25b	28050	VFO (RIT varactor circuit)
D11	1N4148	1-4	28001	Keying
D12	1N4148	1-5	"	Keying
D13	1N4148	4-6	"	Receiver IF mixer

■ INDUCTORS

Reference	Description	Step No.	Part No.	Circuit Notes:
L1	1.3 μ H	5-3	21058	BFO adjust
L2	820 μ H	2-24	21095	VFO
L3	5.4 μ H toroid	2-52ff.	(wind)	VFO range set
L4	820 μ H	6-23	21095	AGC
L5	5.8 μ H	4-35		Receiver IF amp
L6	2.8 μ H	4-1	21057	Receiver IF mixer
L7	1.3 μ H	4-3	21058	Receiver IF mixer
L8	.8 μ H toroid	7-27	(wind)	Transmit LPF and T-R
L9	.8 μ H toroid	7-28	"	Transmit LPF and T-R
L10	.8 μ H toroid	7-29	"	Transmit LPF and T-R
L11	100 μ H	7-24	21164	Transmit LPF and T-R
L12	2.8 μ H	3-11	21057	TX mixer output filter
L13	2.8 μ H	3-13	"	TX mixer output filter
L14	1.3 μ H	3-3	21058	Transmit mixer
L15	wideband RFC	7-5	21179	Transmit driver
L16	10 μ H	2-22	21124	VFO
L17	100 μ H	2-23	21164	VFO
L18	2.8 μ H	4-2	21057	Receiver IF mixer
L20	0-ohm jumper	4-25	30353	IF crystal filter
T1	Bifilar Toroid	7-21	(wind)	RF power amplifier

■ INTEGRATED CIRCUITS

Ref.	Description	Step No.	Part No.	Circuit Notes:
U1	LM386	5-11	25335	Audio amplifier
U2A	LM358	6-1	25117	Audio filter
U2B	LM358	6-1	"	AGC
U3	NE612	5-1	25319	BFO
U4	NE612	3-1	"	Transmit mixer

■ TRANSISTORS

Ref.	Description	Step No.	Part No.	Circuit Notes, if any:
Q1	2N4126	1-1	25385	Keying
Q2	2N4124	2-27	25258	VFO
Q4	2N5087	2-33	25001	VFO
Q5	2N4124	2-28	25258	VFO
Q6	2N4124	2-29	"	VFO
Q7	2N4124	6-14	"	AGC
Q8	2N4124	4-34	"	Receiver IF amp
Q9	J310 JFET	4-4	25115	Receiver IF mixer
Q10	2N4124	7-4a	25258	Transmit driver
Q11	2N4124	7-4b	"	Transmit driver
Q12	2N4126	7-3	25385	Transmit driver
Q13	<i>not used</i>			
Q14	2N4124	2-30	25258	VFO
Q15	2SC2166	8-1	25339	RF power amplifier
Q16	2N5087	1-2	25001	Keying
Q17	2N5087	1-3	"	Keying
Q18	2N4124	2-31	25258	VFO
Q19	2N4124	4-5a	"	Receiver IF mixer
Q20	2N4124	4-5b	"	Receiver IF mixer
Q21	2N4124	2-32	"	VFO

■ RESISTORS

All resistors are 1/4-watt, 5% tolerance unless specified otherwise

Reference	Description	Step No.	Part No.	Circuit Notes:
R1	1.5K	1-11		Keying
R2	1.5K	1-12		Keying
R3	2.2K	1-13		Keying
R4	10	5-12		Audio amplifier
R5	10K	5-13		Audio amplifier
R6	10K POT	5-20	30267	Audio: Volume Control
R7	100K	6-6		Audio filter
R8	100K	6-7		Audio filter
R9	560	6-4		Audio filter
R10	470	6-3		Audio filter
R11	5.6K	6-5		Audio filter
R12	2.2K	5-2		BFO
R13	47	4-7		Receiver IF mixer

R14	47K	2-19		VFO
R15	10K	2-10		VFO
R16	220	7-8		Transmit driver
R17	2.2K	2-8		VFO
R18	10K POT	2-62	30267	VFO Main Tuning
R19	10K	2-11		VFO
R20	<i>not used</i>			
R21	<i>not used</i>			
R22	680	2-4		VFO
R23	22K	2-18		VFO
R24	1.5K	2-6		VFO
R25	1.5K	2-7		VFO
R26	100K	6-17		AGC
R27	10K	6-16		AGC
R28	1M	6-18		AGC
R29	4.7K	6-15		AGC
R30	82K	4-39		Receiver IF amp
R31	470K	4-40		Receiver IF amp
R32	2.2K	4-38		Receiver IF amp
R33	1K	4-37		Receiver IF amp
R34	1K	4-9		Receiver IF mixer
R35	<i>not used</i>			
R36	100	4-8		Receiver IF mixer
R37	470	7-37		Transmit LPF and T-R
R38	100	7-7		Transmit driver
R39	<i>not used</i>	7-6		Transmit driver
R40	1K	7-9		Transmit driver
R41	1K	7-10		Transmit driver
R42	3.3K	7-11		Transmit driver
R43	100	7-18		RF power amplifier
R44	470	7-19		RF power amplifier
R45	10K	2-12		VFO
R46	10K POT	2-61	30267	VFO (RIT control)
R47	10K	2-13		VFO
R48	10K	2-14		VFO
R49	100K	2-21		VFO
R50	1K	1-14		Keying
R51	1K	1-15		Keying
R52	1K	1-16		Keying
R53	1K	1-17		Keying
R54	470	1-18		Keying
R55	10K	2-15		VFO
R56	68K	2-20		VFO
R57	100	2-2		VFO
R58	2.2K	2-9		VFO
R59	560	2-3		VFO
R60	68K	4-11		Receiver IF mixer
R61	1K trimmer	4-36	30618	Sidetone level

R62	68K	4-12	Receiver IF mixer
R63	10K	4-10	Receiver IF mixer
R64	10K	2-16	VFO
R65	10K	2-17	VFO
R66	1K	2-5	VFO
R67	100	8-15	headphone jack
R68	100	8-15	headphone jack

■ OTHER COMPONENTS

Reference	Description	Step No.	Part No.	Circuit Notes:
JMP1	0 ohm jumper	1-19	30353	
JMP2	0 ohm jumper	1-20	"	
JMP3	0 ohm jumper	1-21	"	
JMP4	0 ohm jumper	1-22	"	
Y1	14.31818 MHz	4-26	48216	IF crystal filter
Y2	14.31818 MHz	4-27	"	IF crystal filter
Y3	14.31818 MHz	4-28	"	IF crystal filter
Y4	14.31818 MHz	4-29	"	IF crystal filter
Y5	14.31818 MHz	5-4	"	BFO
Y6	14.31818 MHz	3-4	"	Transmit mixer

DC Power Supply Considerations

The transceiver is designed to operate from 13.8 volts DC for maximum RF output and receiver volume. When designing battery packs for portable operation, be mindful that "slightly" lower voltages (such as 11-12 volts) will result in considerable reduction in RF output. As a rule, 10 cells (Alkaline or NiCad) in series will be more satisfactory than 8. It is worth the effort to understand the current ratings of the numerous kinds of batteries available today. As just one example, a small AA NiCad cell can handle intermittent loads of up to 2 amps, in contrast to the 480 mA rating of a much larger alkaline D cell.

Typical current consumption (at 13.8 volts DC):

Receive: 35 mA

Transmit: 750 mA

Some Operating Tips

The functions of the front panel controls are obvious and simple. However, do keep in mind that the RIT control must remain at the 12:00 position (and must be properly aligned as part of kit assembly) in order for your transmit frequency to be the same as that of a station you are calling. The RIT (receive incremental tuning) feature is explained on page 27.

It is important, of course, that other stations hear your QRP signal exactly on their operating frequency. This requires correct adjustment of Transmit Mixer coil L14, so it is useful to repeat the following alignment information from Phase 8.0:

To make sure you are transmitting on the same frequency as stations you are hearing, L14 must be adjusted using a reference signal which can be heard on both the Model 1330 receiver and a second receiver. The reference signal can be actual 40 meter CW activity or a source such as an RF signal generator.

1. With the RIT control centered at the 12:00 position, tune the 1330 receiver to the reference signal at the audio pitch you generally prefer.
2. On the second receiver, tune in the reference signal to the same audio pitch.
3. While keying the 1330 transmitter (using a dummy load), adjust L14 until your transmit signal is the same pitch in the other receiver as the reference signal. This adjustment places your transmit signal exactly on the other station's frequency. [If you are concerned about which sideband of your signal or the reference signal you are hearing in the other receiver, tune both signals to a perfect "zero-beat" or null.]

The most important single operating suggestion we can offer is to just ignore the fact you are using what many folks label a "QRP" ham station. In the decades before 100 watt transceivers became the commercial norm, "10 Watt DC input" transmitters were home-built and commonly sold as both kits and factory-built equipment with no use of the "QRP" label. Your Model 1330 is just such a 10 Watt rig by those classic standards:

$$750\text{mA} \times 13.8\text{VDC} = 10.35 \text{ watts DC Input}$$

Modifications

We understand that little changes to the original design of any equipment is a basic tradition of ham radio. *Any modifications to the published design of this transceiver kit product are the sole responsibility of the user.* We suggest that you build and align the transceiver as specified before trying any changes.

Very simple changes could include re-assigning the auxiliary DC phono jack to some other purpose such as a frequency counter output or external speaker, or making creative use of the extra toggle switch pole.

There is sufficient space within the cabinet to add your own accessories such as an electronic keyer or battery charging circuit, etc. The four screws for the speaker mounting plate provide support for neatly mounting circuit board subassemblies

Note on T-KIT Model 1553 Keyer Board: If you decide to add this inexpensive keying circuit to your transceiver, keep in mind that the common line for keyer paddle input must not be grounded. Also, you will not need to implement the keyer's sidetone circuit.

Your Modification Notes:

Using and Aligning the RIT Control:

Correct use and alignment of the RIT (*receive incremental tuning*) feature of your transceiver is essential to successful operating. RIT permits fine tuning of the receive frequency without disturbing the transmit frequency. RIT also permits the technique of calling DX slightly off frequency in pileups. Because most operators expect to hear you on their exact frequency, the RIT is normally set to the center (12:00) position. That setting works only if the RIT circuit is aligned correctly.

In short, this alignment consists of confirming that the VFO operates on exactly the same frequency in both transmit and receive when the RIT control knob is centered. The RIT can be aligned by several different methods. For any of these methods, the following steps are performed:

- ☐ ☐ The RIT control knob is NOT yet installed.
- ☐ ☐ Turn the shaft of R46 to its approximate mid-point.
- ☐ ☐ Turn on DC power, observe transmit frequency (key down), adjust R46 shaft in receive mode (key up.)
- ☐ ☐ Carefully mount the control knob with its index stripe exactly at the center (12:00) mark on the panel.

A. Frequency Counter Method

- ☐ Connect the counter probe to the side of R13 nearest Q4.
- ☐ Key transmitter and note exact VFO frequency.
- ☐ Unkey, adjust R46 shaft to same reading noted in transmit.
- ☐ Mount RIT knob as explained above.

B. Receiver Method

- ☐ Run some hookup wire from the receiver antenna input to within a couple feet of the Model 1330. (You will be listening for the VFO signal rather than the transmitter signal.)
- ☐ Tune the receiver between 4.218 and 4.168 MHz until you hear the VFO signal at an audio pitch you like.
- ☐ Key the transmitter: a steady series of "dah's" is helpful.
- ☐ Adjust R46 shaft until there is NO difference in audio pitch in receive and transmit.
- ☐ Mount RIT knob as explained above.

C. DC Voltage Method (DVM recommended):

- ☐ Connect a DC voltmeter to TP1 (+) and ground (-).
- ☐ Key transmitter and note DC voltage reading exactly.
- ☐ Unkey, adjust R46 shaft to same reading noted in transmit.
- ☐ Mount RIT knob as explained above.

NOTE: This method is sufficient but not quite as precise as the frequency counter or receiver method.

TROUBLESHOOTING GUIDE **and Summary of Alignment Procedures**

If your transceiver suddenly stops working or becomes erratic, check first for a broken or damaged hookup wire, connector or switch, the most common cause of all electronic equipment failure. Then, re-examine all solder connections.

The most helpful troubleshooting information is found in the circuit descriptions and progress tests performed after every assembly phase except Phase 4.0 (Receiver IF). **Study the schematic blocks:** the progress tests can be repeated by temporarily removing coupling capacitors between stages.

VFO Tuning Range is controlled by the winding of L3 and the spacing of its turns. See Phase 2.0 in the Assembly Section.

Receiver Alignment in General: Alignment of the receiver section consists of adjusting L6, L18, L7 and L5 for maximum received signal level or background noise. You can do this by ear or by observing the readings of an AC voltmeter connected to the speaker terminals. See page 28, Assembly Section.

RIT Alignment. There are three methods for aligning the RIT circuit, explained on page 27.

Transmit Power Check: Connect 50 ohm dummy load or antenna with RF wattmeter and a key. If using an antenna, tune to a clear frequency and use proper callsign ID. While keying the transmitter, adjust L12 and L13 for maximum RF output. If RF output is not at least 3 watts, the coil windings may be spread too far apart, compress them and recheck RF output. Also, make certain that your DC power source is capable of supplying 12-14V @ 1 amp.

Sidetone Adjustment: Adjust trimmer R61 for preferred volume level. Sidetone pitch is a combined result of correct settings of L14 (transmit mixer) and L1 (BFO). See below.

Am I On Frequency? Review Phase 8.0 and the L14 alignment information repeated on Page 26 of this section.

T-KIT Model 1330 10.1 MHz CW Transceiver Kit Assembly

1. Be sure to read the terms of the T-KIT Limited Warranty **BEFORE** you start soldering! It explains both our responsibilities and yours.

2. Please **USE** the bits of knowledge and wisdom capsulized on the back cover of your T-KIT Instruction Manual!

3. Check and organize all parts per the Kit Parts List before you start soldering. Electronics hobbyists have many different ways of sorting and organizing small parts: standing them on a block of styrofoam or in the holes along the edge of corrugated cardboard, arranging them in an egg carton or muffin tin, or making logical piles in a small tray.

4. **Soldering:** If you are inexperienced, ask an experienced friend or any electronics repair technician to show you how it's done. Then do practice soldering/de-soldering on a junked circuit board before working on your kit. Here's what is important:

- ✓ **Keep the soldering iron tip CLEAN**, using a damp sponge
- ✓ **Let the heated connection itself melt the solder**, not the iron tip
- ✓ **Use a thin diameter of rosin-core solder**
- ✓ **Use good work lighting**; don't be embarrassed to use a magnifier

5. **De-soldering** is the opposite of soldering and is a more tedious procedure. Again, a repair technician in particular has the experience to show you the best techniques. Take care not to damage circuit board pads or traces — save yourself from desoldering agony by installing the right part the right way the first time!

6. Unless instructed to install an occasional part on the bottom (copper "solder side"), **ALL parts are inserted into the top silkscreened side**, with leads passing through the holes to the bottom solder side. (This advice may seem insulting, but some folks DO carefully mount and solder all parts on the copper side of the board and wonder why the kit won't work!)

7. **Insert all parts as close to the board surface as possible** before soldering and trimming. Excess wire length above the board can cause unwanted oscillations.

8. **IC Sockets:** Your kit uses 4 8-pin DIP IC's intended for soldering directly to the board. You can install your own socket unless we specifically advise against it. Use the same care in soldering sockets and inserting IC's as for soldering the IC directly. Most technicians find that sockets can cause more problems than permanently-installed IC's.

9. **About your Kit Manual:** Don't "Solder first and ask questions later"! The success of your project depends on your willingness to study the published directions attentively. Check your kit package for any update sheet(s) to supplement this manual. **Use the double □ □ check blocks** to review your work (ideally with someone else) before connecting voltage.

***You will find it very valuable
to read this entire manual from cover to cover
and organize all your parts before doing any soldering.***

10. **Tools:** The Parts List lists the "minimum" tools needed for this particular project. However, you'll appreciate owning a more varied collection of small tools for electronics work: the selection at RadioShack™ is good, with the lower-priced versions being quite sufficient. If you have NO small tools or previous experience, their 64-2801 10-piece soldering set is a good start. If buying your first voltmeter ("multitester"), you may find the "analog" meter type easier to use at first than the digital kind.

Kit Assembly: Getting Started

Before you do **ANY** soldering,
we encourage you to do the following:

- ☐ Check and organize your kit parts in whatever way is most convenient for you.
- ☐ Go through this entire manual: familiarize yourself with its organization and illustrations.
- ☐ Prepare a clean, well-lighted workspace.
- ☐ PLEASE study the **ASSEMBLY OVERVIEW** (page 4)

Installing Parts on the Circuit Board:

When we say "**INSTALL**" a part, we mean:

- ☐ Choose correct part value
- ☐ Insert in correct PC Board location
- ☐ Insert *correctly*, if there is a right way and wrong way such as for diodes, IC's, electrolytic capacitors, transistors etc.
- ☐ Solder all wires or pins
- ☐ Trim or "nip" excess wire lengths

When we say "**PREPARE**" a length of hookup wire or coax, this is what we mean:

- ☐ **CUT** the correct color of wire to the specified length
- ☐ **STRIP** about 1/8" insulation from each end
- ☐ **TIN** one or both ends, as directed

To "**TIN**" a wire, coax shield, component lead or an area of the circuit board means to heat the object or area until it can melt a thin coating of solder to make further soldering easier.

USE ROSIN-CORE SOLDER ONLY,
of a type intended for electronic PC-board assembly.
(Available at electronics distributors or Radio Shack stores.)
DO NOT use hardware store solder, paste or flux.
Solder contains LEAD: wash hands before eating!

Model 1330 CW Transceiver Kit Assembly OVERVIEW

☐ **Phase 1.0**

Keying and DC Input Circuits

Building and testing this section first simply gets the kit-building project off to a good start. The keying circuit controls T, R and Td voltages. You will make easy VOM tests to confirm performance.

☐ **Phase 2.0**

4.218 - 4.168 MHz VFO Circuit

Building, testing, adjusting and understanding this VFO circuit is essential to a satisfying experience of building and operating your transceiver. Allow enough time to do this major section carefully.

☐ **Phase 3.0**

Transmit Mixer and 10.1 MHz Filter Circuit

This relatively short construction phase gives you an early opportunity to hear the keying of your own 30 meter signals in another receiver.

☐ **Phase 4.0**

14.31818 MHz Receiver IF Stages

A. Receiver Mixer Stage

B. 14.31818 MHz 4-pole Crystal Filter

C. 14.31818 MHz IF Amplifier

No practical progress testing of this work is possible, so careful attention to assembly steps is quite important. **Note:** this IF frequency is usually referred to as 14.318 MHz for simplicity.

☐ **Phase 5.0**

Receiver BFO and Audio Amplifier Stages

Completion of these two IC circuits permits testing and aligning of basic receiver operation before adding the op-amp circuits.

☐ **Phase 6.0**

Receiver Audio Preamp/Filter and AGC

Completion of this phase finishes up the receiver section.

☐ **Phase 7.0**

Transmit Driver, RF Amplifier & Output Filter

This phase completes all circuit board work with the exception of actually installing the RF transistor and heatsink assembly. An optional test of low-level driver output is explained.

☐ **Phase 8.0**

Final Assembly and Alignment

This will be the "fun" part, provided that it is not rushed! Bad hookup wire connections are a primary cause of electronic equipment failure. You will be referred back to the Reference pages for RIT alignment.

Looking Ahead . . .

REMINDER: Check your kit package carefully for any supplementary bulletins or other printed information which may affect the assembly steps in this manual.

Your notes on manual supplements or corrections:

See Page 48 Now: This presents a right-reading view of the circuit board very helpful in checking if nearby pads indeed are joined by a trace, or if an accidental solder bridge was made!

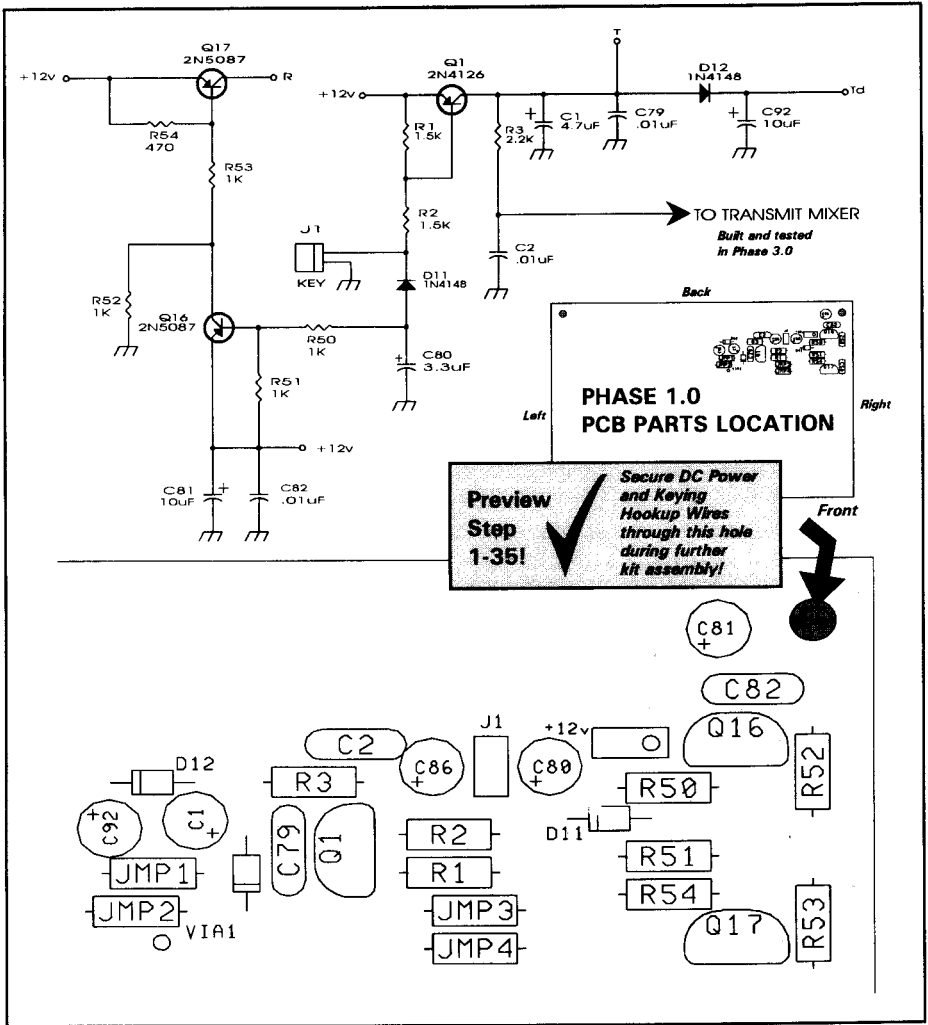
Installing "Groups" of Parts: The protocol in this manual for lists of resistors or capacitors to be installed in an assembly phase is to start with the lowest value and go up. This is only one of several possible orders. When working with such groups, install parts in whichever order is most convenient and logical to you, but be sure to use all the check boxes as you go.

Order of Kit Assembly: While we recommend that you follow the published order of assembly phases, there are a few steps which are little projects in themselves and which can be done whenever you like before they are actually needed:

- ☐ Winding L3, T1, L8, L9, L10 toroid coils
- ☐ Index stripe on Main Tuning knob
- ☐ Prepare Frequency Log (page 47), which may be done anytime after Phase 3.0, provided that the VFO coil has been secured permanently.

Phase 1.0

Keying and DC Input Circuits



KIT CONSTRUCTION TIP: This drawing is reproduced on the separate folded sheet supplied with your kit (Part No. 74346). It also includes similar drawings for Phases 2.0 through 7.0 as well as the complete schematic. The sheet is provided to minimize the need to turn back to the drawings while following the assembly steps. You may find it helpful to mark installed parts with a highlighter.

Phase 1.0 Assembly Steps

Keying and DC Input Circuitry

This phase is completed first mainly because it is a very good warm-up to the process of selecting and installing circuit board components. No frequency-determining parts are involved, but correct part identification and orientation is every bit as critical in this phase as in all others. After completing this keying circuit, you will build the VFO, which is the heart of the transceiver circuit. Detailed explanations provided in this section about correct polarity and component orientation will NOT be repeated in further assembly phases. Any errors in this section can only increase problems in further transceiver construction stages

☒ ☒ 1-1. Select a 2N4126 PNP transistor, being careful not to mix it up with the numerous 2N4124 NPN transistors used throughout the circuit. Install Q1, type 2N4126, aligning the flat side as outlined on the board itself and board drawings.

☒ ☒ 1-2. Install transistor Q16, PNP type 2N5087.

☒ ☒ 1-3. Install transistor Q17, also type 2N5087.

☒ ☒ 1-4. The 1N4148 diodes are most easily recognized by the simple fact that six are used in the circuit. Select two of them and install one 1N4148 diode at D11, making sure the banded cathode end is aligned as outlined on the board.

☒ ☒ 1-5. Install diode D12, type 1N4148 per step 1-4.

☐ ☐ 1-6. **Please Read:** General Note on ELECTROLYTIC capacitors: these capacitors are polarized and must be installed only one way, just as transistors and diodes. The (+) side is the longer of the two leads and is marked on the circuit board silkscreen. If the screening is obscured, be sure to refer to the sectional drawing in this manual. The dark stripe on the capacitor identifies the (-) side, which is also the shorter wire. *In further phases of kit assembly, the reminder to observe correct polarity will be expressed simply as: !!±!!*

☒ ☒ 1-7. Install electrolytic capacitor C81, 10 μ F with correct polarity per 1-6. !!±!!

☒ ☒ 1-8. Install electrolytic capacitor C92, also 10 μ F with correct polarity per 1-6. !!±!!

☒ ☒ 1-9. Install electrolytic capacitor C1, 4.7 μ F with correct polarity per 1-6. **!! $\pm$!!**

☒ ☒ 1-10. Install electrolytic capacitor C80, 3.3 μ F with correct polarity per 1-6. **!! $\pm$!!**

GENERAL NOTE on non-polarized components. Resistors, ceramic disc or mylar film capacitors, jumpers, and molded inductors may be installed "either way." However, you will find it convenient for later double-checking of your work if all resistors are installed with the first band toward the same direction on the board. Also, if it appears that a capacitor is to be installed next to a larger part such as a shielded coil, it is good practice to orient the capacitor so its markings remain visible for later double-checking.

Install the following resistors:

☒ ☒ 1-11. Resistor R1, 1.5K (brown-green-red).

☒ ☒ 1-12. Resistor R2, also 1.5K.

☒ ☒ 1-13. Resistor R3, 2.2K (red-red-red).

☒ ☒ 1-14. Resistor R50, 1K (brown-black-red).

☒ ☒ 1-15. Resistor R51, also 1K.

☒ ☒ 1-16. Resistor R52, also 1K.

☒ ☒ 1-17. Resistor R53, also 1K.

☒ ☒ 1-18. Resistor R54, 470 ohms (yellow-violet-brown).

Install the following "0 ohm" jumpers, which resemble resistors but with a single black band:

☒ ☒ 1-19. Jumper JMP1.

☒ ☒ 1-20. Jumper JMP2.

☒ ☒ 1-21. Jumper JMP3.

☒ ☒ 1-22. Jumper JMP4.

Note: the 5th "0 ohm" jumper in your kit will be installed as "L20" later.

Install the following ceramic disc capacitors:

☒ ☒ 1-23. Capacitor C2, .01 μ F (marked 103Z).

☒ ☒ 1-24. Capacitor C79, also .01 μ F.

☒ ☒ 1-25. Capacitor C82, also .01 μ F.

☒ ☒ 1-26. *Reserved*

☒ ☒ 1-27. *Reserved*

☒ ☒ 1-28. Install the remaining "0 ohm" jumper in the position for L20. (L20 is a molded inductor in other transceiver models.)

☒ ☒ 1-29. Double-check all work performed in Phase 1 so far.

☒ ☒ 1-30. Prepare four 4" lengths of #24 hookup wire as explained on Assembly Section page 3:

- ☐ 4" RED (+DC)
- ☐ two 4" BLACK (Ground)
- ☐ 4" WHITE (Key)

☒ ☒ 1-31. Solder one end of the RED wire to the pad nearest Q16 within the silkscreened rectangle labeled "+12V."

☒ ☒ 1-32. Solder one end of one BLACK wire to the other pad within the silkscreened rectangle labeled "+12V." Notice that this hole is common to the top groundplane.

☒ ☒ 1-33. Solder one end of the WHITE wire to the pad nearest R2 within the silkscreened rectangle labeled "J1."

☒ ☒ 1-34. Solder one end of the other BLACK wire to the other pad within the silkscreened rectangle labeled "J1." Notice that this hole is common to the top groundplane.

☒ ☒ 1-35. Pass all four wires between C81 and C82 down through the mounting hole in the corner of the board. This will prevent the wire connections from breaking during further assembly and testing. Leave them in this position until final mechanical assembly of the transceiver.

Phase 1.0 Progress Test

☒ ☒ 1-36. Using alligator clip jumpers as needed, connect a BLACK wire to -12VDC and also to the black probe lead of your multimeter.

☒ ☒ 1-37. Be sure your DC power source is turned OFF, then connect the RED wire to +12DC.

☒ ☒ 1-38. Set your multimeter to a range suitable for measuring 12 volts DC and connect the red (+) probe to either end of R3.

☒ ☒ 1-39. Turn on DC voltage: there should be NO voltage indicated on the meter.

☒ ☒ 1-40. Touch the WHITE keying line wire to the black wire or any other convenient ground point: the meter should immediately indicate about +12V and drop slowly back to 0 when the connection is broken. (Don't be concerned about the delayed voltage drop: with no circuitry yet connected to the T voltage line, the electrolytic capacitors discharge gradually.)

☒ ☒ 1-41. The above keying test may be repeated with your meter probe connected to the CATHODE of D12. You will see the same meter indication regardless of which way D12 was installed, so make sure the banded cathode end is oriented correctly.

☒ ☒ 1-42. Turn off DC voltage and disconnect all leads. If the keying circuit does not behave as explained in the preceding steps, double-check every connection and component. Proceed to Phase 2.0 only if you have observed proper operation of the keying circuit as described.

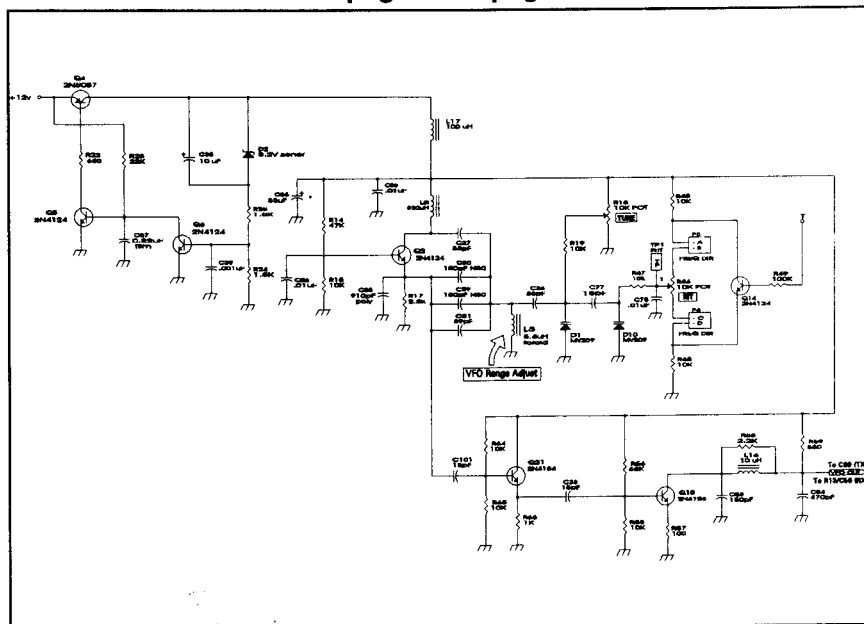
☐ ☐ **REMINDER:** This sectional board drawings for Phases 1.0 through 7.0 as well as the complete schematic are reproduced on the separate folded sheet supplied with your kit (Part No. 74346). The sheet is provided to minimize the need to turn back to the drawings while following the assembly steps. You may find it helpful to mark installed parts with a highlighter.

Phase 2.0 Schematic Details

VFO Circuit Description:

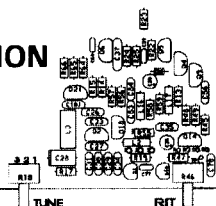
This circuit not only includes an oscillator and tuning components, but also a stable voltage regulator, buffer, amplifier and filtering before the VFO signal is delivered to the JFET mixer and transmit stages. The oscillator is simply an LC-tuned Colpitts configuration with specially chosen temperature compensating components to provide quite amazing stability. Since the tuning is voltage controlled, a stable regulator is required. D2, an 8.2V zener diode, along with Q4, Q5 and Q6 provide just the stable voltage needed to run the oscillator and the MV209 varactors. R16 is the main tuning control, providing a range of voltages from 0 to 9.2 volts to D1, an MV209 varactor. D1 is coupled into the main LC circuit via C34. D10 is the other MV209 varactor. R49 is the RIT control providing a range of voltages from 3 to 6 volts to D10, and lightly coupled to the LC circuit via C77. Q14 turns off RIT during transmit, while P5 and P6 set the correct frequency tuning direction depending upon which model is assembled. Q21 makes up a buffer stage, while Q18 and associated circuitry amplifies the VFO and provides some selectivity.

NOTE: An ENLARGED schematic of the VFO circuit is bound into this manual as a fold-out page after page 16 of this section.

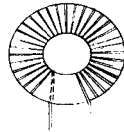


☐ Phase 2.0 4.218-4.168 MHz VFO Circuit

Phase 2.0 PCB PARTS LOCATION

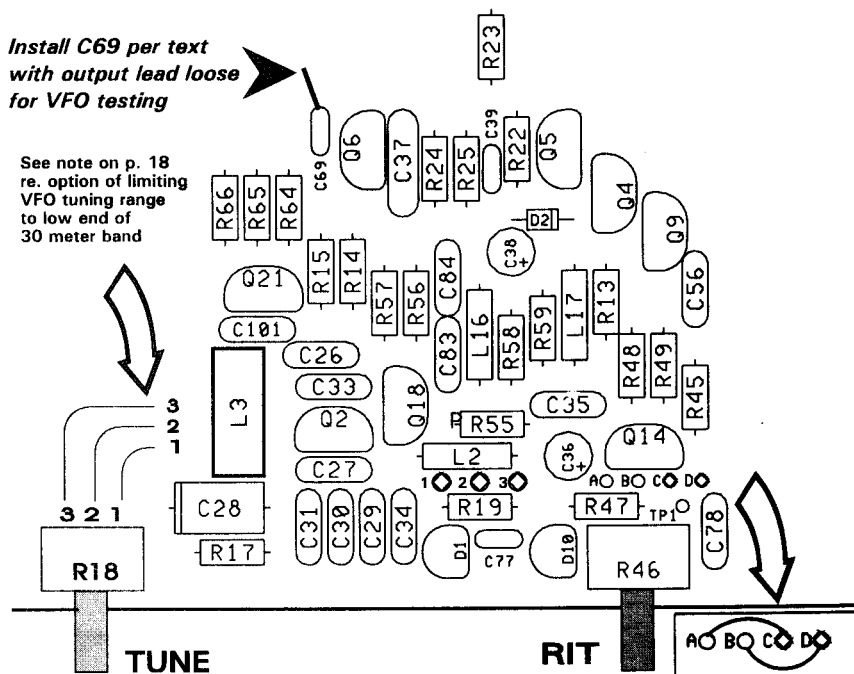


L3 =
29 turns #28
on T-44 core



*Install C69 per text
with output lead loose
for VFO testing*

See note on p. 18
re. option of limiting
VFO tuning range
to low end of
30 meter band



Phase 2.0 Assembly Steps: 4.218 - 4.168 MHz VFO

Constructing and testing the transceiver VFO circuit is easily an evening's project in itself. Correct functioning of the VFO is, of course, at the very heart of the transceiver's performance.

□ □ 2-1. Optional But Recommended: Select all parts required for building the VFO per Chart 2.1. Set aside the other kit parts.

		CHART 2.1
		Model 1330
		VFO Parts
☐ C26,35,78	.01 μ F [3] (marked 103)	
☐ C27,34	33pF [2]	
☐ C28	910pF Polystyrene	
☐ C29,30	150pF N80 [2] (marked N80 151)	
☐ C31	39pF	
☐ C33,101	15pF [2]	
☐ C36	33 μ F electrolytic	
☐ C37	.22 μ F mylar film (marked 224)	
☐ C38	10 μ F electrolytic	
☐ C39	.001 μ F ceramic disc (marked 102)	
☐ C77	18pF	
☐ C83	150pF NPO (marked 151)	
☐ C84	470pF (marked 471)	
☐ D1,10	MV209 varactor diode [2] (transistor-like body, only 2 leads)	
☐ D2	8.2v zener diode (silver body, only zener diode in circuit)	
☐ L3	VFO Toroid (Red T-44 core and #28 green enameled wire.)	
☐ L16	10 μ H (brown-black-gold-gold)	
☐ L17	100 μ H (brown-black-brown-gold)	
☐ L2	820 μ H (gray-red-brown-gold)	
☐ Q2,Q5,Q6		
☐ Q14,18,21	2N4124 [6]	
☐ Q4	2N5087	
☐ R57	100 (brown-black-brown)	
☐ R59	560 (green-blue-brown)	
☐ R22	680 (blue-gray-brown)	
☐ R66	1K (brown-black-red)	
☐ R24,R25	1.5K [2] (brown-green-red)	
☐ R17,R58	2.2K [2] (red-red-red)	
☐ R15,19,45,47,48,55		
☐ 64,65	10K [8] (brown-black-orange)	
☐ R23	22K (red-red-orange)	
☐ R14	47K (yellow-violet-orange)	
☐ R56	68K (blue-gray-orange)	
☐ R49	100K (brown-black-yellow)	
☐ R18,R46	10K potentiometer [2]	

Install the following resistors:

- ✓✓ 2-2. Resistor R57, 100 ohms, (brown-black-brown).
- ✓✓ 2-3. Resistor R59, 560 ohms, (green-blue-brown)
- ✓✓ 2-4. Resistor R22, 680 ohms, (blue-gray-brown)
- ✓✓ 2-5. Resistor R66, 1K (brown-black-red)
- ✓✓ 2-6. Resistor R24, 1.5K (brown-green-red)
- ✓✓ 2-7. Resistor R25, also 1.5K
- ✓✓ 2-8. Resistor R17, 2.2K (red-red-red)
- ✓✓ 2-9. Resistor R58, also 2.2K.
- ✓✓ 2-10. Resistor R15, 10K (brown-black-orange)
- ✓✓ 2-11. Resistor R19, also 10K.
- ✓✓ 2-12. Resistor R45, also 10K.
- ✓✓ 2-13. Resistor R47 also 10K.
- ✓✓ 2-14. Resistor R48, also 10K.
- ✓✓ 2-15. Resistor R55, also 10K.
- ✓✓ 2-16. Resistor R64, also 10K.
- ✓✓ 2-17. Resistor R65, also 10K.
- ✓✓ 2-18. Resistor R23, 22K (red-red-orange)
- ✓✓ 2-19. Resistor R14, 47K (yellow-violet-orange)
- ✓✓ 2-20. Resistor R56, 68K (blue-gray-orange)
- ✓✓ 2-21. Resistor R49, 100K (brown-black-yellow)

Install the following molded inductors:

- ✓✓ 2-22. Coil L16, 10 μ H (brown-black-black).
- ✓✓ 2-23. Coil L17, 100 μ H (brown-black-brown).
- ✓✓ 2-24a. Coil L2, 820 μ H (gray-red-brown). *SAVE the wire leads nipped from L2, noting that they are heavier gauge than the other component leads.*

✓✓ 2-24b. Install the wire leads cut from L2 into the two holes for the VFO toroid coil L3, letting the wires stand about 1/2" above the board. These two wires will serve as very convenient tack-soldering points for testing and adjusting the frequency coverage of the VFO coil before final installation.

✓✓ 2-25a. Install varactor diode D1, type MV209. (These diodes have same body style as the small transistors, but only 2 leads. Orient the flat side as outlined on the board.

✓✓ 2-25b. Install varactor diode D10, also type MV209 per 2-25.

✓✓ 2-26. Install zener diode D2, type 1N756A with correct cathode band orientation.

Install the following 2N4124 NPN transistors:

- ✓✓ 2-27. Transistor Q2, type 2N4124.
- ✓✓ 2-28. Transistor Q5, type 2N4124.
- ✓✓ 2-29. Transistor Q6, type 2N4124.

- ☒ ☒ 2-30. Transistor Q14, type 2N4124.
- ☒ ☒ 2-31. Transistor Q18, type 2N4124.
- ☒ ☒ 2-32. Transistor Q21, type 2N4124.
- ☒ ☒ 2-33. Install PNP transistor Q4, type 2N5087.
- ☒ ☒ 2-34. Install C28, the 910 pF polystyrene capacitor, with its red polarizing band oriented as outlined on the board.
- ☒ ☒ 2-35. Identify the two "N80" 150 pF capacitors in your kit, clearly marked "N80 151." Install one as C29.
- ☒ ☒ 2-36. Install C30, 150 pF "N80" per 2-35.
- ☒ ☒ 2-37. Install C83, 150 pF NPO. It is simply marked "151J."
- ☒ ☒ 2-38. Install C37, .22 μ F mylar film (marked 224).

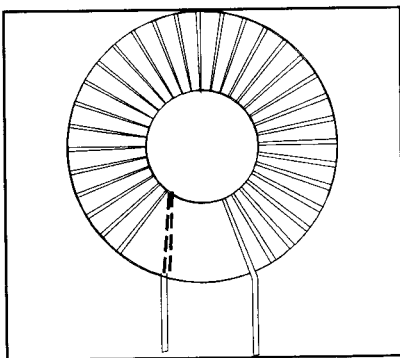
Install these remaining ceramic disc capacitors, noting that C77 has narrower lead spacing than the other two 18 pF capacitors:

- ☒ ☒ 2-39. Capacitor C33, 15 pF.
- ☒ ☒ 2-40. Capacitor C101, also 15 pF.
- ☒ ☒ 2-41. Capacitor C77, 18 pF. (0.1" lead spacing)
- ☒ ☒ 2-42. Capacitor C27, 33pF
- ☒ ☒ 2-43. Capacitor C34, also 33pF
- ☒ ☒ 2-44. Capacitor C31, 39pF
- ☒ ☒ 2-45. Capacitor C84, 470 pF (marked 471).
- ☒ ☒ 2-46. Capacitor C39, .001 μ F (marked 102)
- ☒ ☒ 2-47. Capacitor C26, .01 μ F (marked 103)
- ☒ ☒ 2-48. Capacitor C35, also .01 μ F.
- ☒ ☒ 2-49. Capacitor C78, also .01 μ F.

- ☒ ☒ 2-50. Install C38, 10 μ F electrolytic. !! $\pm$!!

- ☒ ☒ 2-51. Install C36, 33 μ F electrolytic. !! $\pm$!!

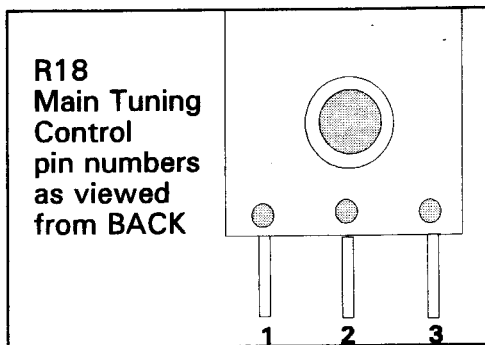
- ☒ ☒ 2-52. Wind 29 turns of #28 enameled wire (green) on a red T-44 toroid core. The turns should be fairly close together and are counted as 29 passes through the **center** of the core. Take your time to make sure that no turns cross over each other and that no kinks are created in the wire.



- ✓✓ 2-53. Scrape the enamel insulation from the two wire ends and tin the bare copper. Also flow a bit of solder on both of the stiff wires mounted in the position for L3 in step 2-24b.
- ✓✓ 2-54. Tack-solder the VFO toroid coil to the two L3 test point wires. (Tack" soldering means to make a temporary connection using as little solder as may be needed.)
- ✓✓ 2-55. Insert ONE lead of capacitor C69, 5 pF, into the hole for the pad nearest R15. Solder and trim this connection, letting the other lead stand free.
- ✓✓ 2-56. *reserved*
- ✓✓ 2-57. Notice the four pads near Q14 labeled A-B-C-D. Prepare two white hookup wires about 1" long.
- ✓✓ 2-58. Solder one hookup wire jumper from pad A to pad C.
- ✓✓ 2-59. Solder the other jumper from pad B to pad D.
- ✓✓ 2-60. Install 10K potentiometer R46 (RIT control). Before soldering, be sure the control pins are seated flush against the board as far as they will go.
- ✓✓ 2-61. Prepare three 2.5" lengths of white hookup wire and solder one end of each to the 3 pads labeled "1-2-3" between R19 and L2.
- ✓✓ 2-62. Solder the other three wire ends to pins 1, 2 and 3 of a 10K potentiometer, R18, Main Tuning control, as identified in the Phase 2.0 circuit board drawing on page 12.

If you are interested in REDUCING the VFO tuning range to provide maximum bandspread of the CW portion of the 30 meter band, see bottom of page 18 before soldering.

Important: the pin numbering on the drawing on page 12 presumes R18 to be oriented as illustrated.



Phase 2.0 Progress Test: VFO Operation and Tuning Range

Here, we want to verify that the VFO circuit indeed "works" and to adjust the VFO coil L3 for the frequency range you desire. This adjustment could also be made at the end of Phase 3.0 (Transmit Mixer) when it becomes possible to measure or hear actual 10.1 MHz signals. While the VFO frequency can be checked with a nearby receiver, using a frequency counter makes the procedure much easier.

☐ ☐ 2-63. If you are using a frequency counter, connect it to the loose end of C69. If you are using a receiver, connect a short length of hookup wire to C69 to serve as an antenna.

☐ ☐ 2-64. Connect 12 volts DC to the red and black DC supply wires as you did for Phase 1.0 testing. The VFO runs continually during receive and transmit (i.e., it is not keyed).

☐ ☐ 2-65. If you are using a frequency counter, you will immediately see a frequency reading somewhere in the range of 3.9 to 4.3 MHz. Notice that rotating the tuning control shaft clockwise *lowers* the frequency. Make a note of the highest and lowest VFO frequencies.

☐ ☐ 2-66. If listening for the VFO signal in a nearby receiver, set the receiver to 4.2 MHz and slowly rotate the Model 1330 tuning control until you hear the VFO signal. If you do not hear it, retune your receiver to various reference frequencies in the 3.5 to 4.5 Mhz range until you find it. Then make a note of the highest and lowest frequencies.

Do not be alarmed by instability of the VFO signal as you bump the circuit board — the VFO coil must be secured to the board with wax or glue to ensure desired stability. This will be done after setting the frequency range you desire.

☐ ☐ 2-67. Spread or compress the turns of L3 to obtain the frequency coverage you want per Figure 2.3 on page 18. You may need to remove one turn of the coil to obtain the coverage you want. If you become confused or are undecided, the VFO coil can be adjusted or changed during the Phase 3.0 test or even later.

☐ ☐ 2-68. When you are satisfied with the tuning range of the VFO, remove the temporary mounting wires and install L3 in the normal manner. For maximum mechanical stability, we recommend dripping melted wax from a candle into the area

where the bottom of the coil touches the board. Hot-melt glue may also be used. Do this only after you are happy with the VFO tuning range. You will be referred back to this step in other phases of kit assembly.

☐ ☐ 2-69. When testing is completed, secure the tuning control to the RIT control with a rubber band to prevent wire damage.

Fig. 2.3: Model 1330 VFO Coil Adjustment Examples

The VFO has a tuning range of ***about*** 70 KHz, with 50 KHz being the specified range.

VFO RANGE	30 METER BAND COVERAGE
4.218 - 4.168 MHz	10.100 - 10.150 MHz (50 KHz range)
4.218 - 4.188 MHz	10.100 - 10.130 MHz (see note below)
4.228 - 4.158 MHz	10.090 - 10.160 MHz (70 KHz range)

Important to understand:

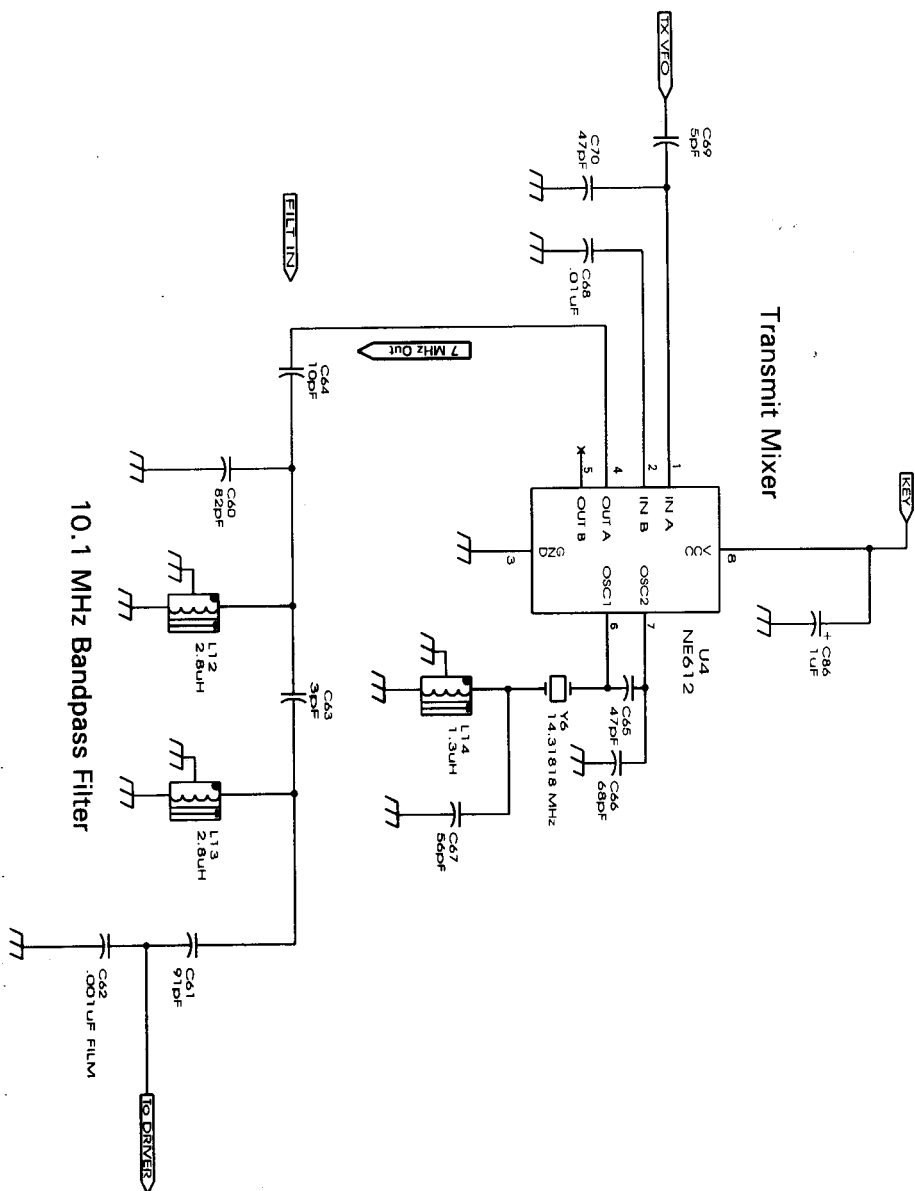
- **Spreading out** the turns of L3 decreases inductance and therefore raises the VFO frequency, which in turn **LOWERS** the 10.1 MHz tuning range.
- **Compressing** the turns of L3 increases inductance and therefore lowers the VFO frequency, which in turn **RAISES** the 10.1 MHz frequency.

Optimizing 30 Meter Tuning. The 50-70 KHz VFO tuning range easily covers the entire 10.1-10.15 MHz WARC band. While CW may be operated anywhere in the band, the convention is that CW operators use the first 30 KHz of the band, or less, with the upper 20 KHz used for data modes. Reducing the tuning range of the VFO to spread the first 20 or 30 KHz of the band across the tuning dial consists of reducing the voltage variation applied to the varactor diodes. For 30 KHz VFO range, do the following:

- ☐ ☐ Install a 1K resistor in series with pin 1 of R16.
- ☐ ☐ Install a 10K resistor in series with pin 3 of R16.
- ☐ ☐ Adjust winding of L3 for desired tuning range.

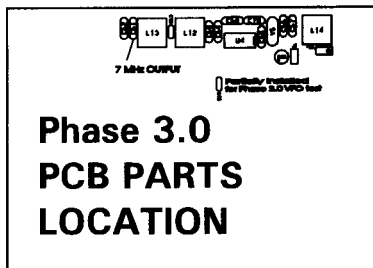
Other resistance values may be tried. The use of a frequency counter simplifies this procedure considerably.

Phase 3.0 Schematic details

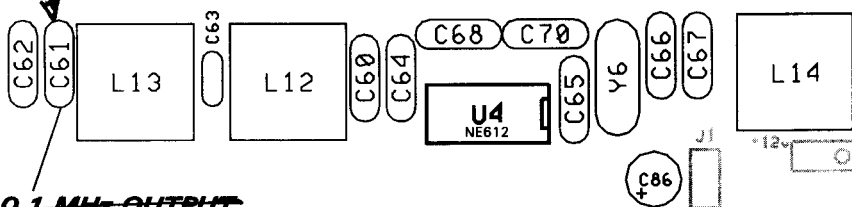


Phase 3.0

Transmit Mixer and 10.1 MHz Filter Circuit

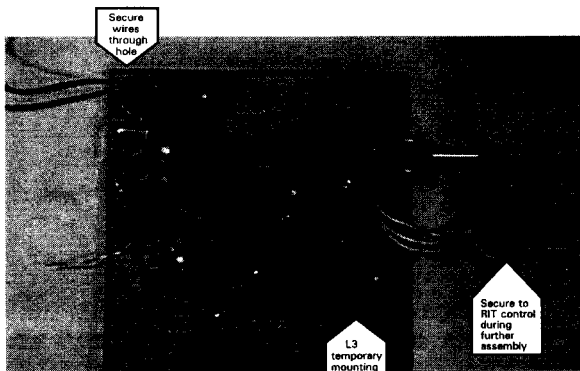


10.1 MHz output



Was partially installed for
Phase 2.0 VFO testing

Transceiver circuit board assembly in progress,
with Phases 1.0 and 2.0 completed, plus Transmit Mixer in Phase 3.



This digital photo is provided
to give a progress overview only.
Follow drawings and assembly
steps for specific procedures.

When we shot this, only one
black ground wire was installed,
and the Transmit Mixer signal
was tested at C64.

Phase 3.0 Assembly: Transmit Mixer, 10.1 MHz Filter

Our purpose in constructing these low-level transmit stages immediately after the VFO is that you soon will be able to use another 30 meter transceiver or receiver to establish the preferred tuning range of the transceiver and secure the VFO toroid coil.

A. Transmit Mixer

- ☒ ☒ 3-1. Install U4, type NE612, being sure to align the notched end (pins 1 and 8) exactly as outlined on the circuit board. The use of an IC socket is not recommended.
- ☒ ☒ 3-2. Insert the other lead of C69 (5 pF, in VFO area) into position and complete installation of C69.
- ☒ ☒ 3-3. Identify shielded coil L14, 1.3 μ H, marked 30-35, and install it, soldering both mounting tabs as well as the pins.
- ☒ ☒ 3-4. Install oscillator crystal Y6, 14.31818 MHz.
- ☒ ☒ 3-5. Install electrolytic capacitor C86, 1 μ F. !! $\pm$!!

Install the following disc ceramic capacitors:

- ☒ ☒ 3-6. Capacitor C67, 56 pF. (0.2" lead spacing)
- ☒ ☒ 3-7. Capacitor C65, 47 pF.
- ☒ ☒ 3-8. Capacitor C66, 68 pF.
- ☒ ☒ 3-9. Capacitor C70, 47 pF.
- ☒ ☒ 3-10. Capacitor C68, .01 μ F (marked 103).

B. 10.1 MHz Low Pass Filter

- ☒ ☒ 3-11. Identify shielded coil L12, 2.8 μ H, marked 30-34, and install it, soldering both mounting tabs as well as the pins. **VERY**
- ☒ ☒ 3-12. Install disc ceramic capacitor C63, 3 pF.
- ☒ ☒ 3-13. Identify shielded coil L13, 2.8 μ H, marked 30-34, and install it, soldering both mounting tabs as well as the pins.

Install the following disc ceramic capacitors:

☒ ☒ 3-14. Capacitor C64, 10 pF.

☒ ☒ 3-15. Capacitor C60, 82 pF

Read before installing C61:

☒ ☒ 3-16. Capacitor C61, 91 pF, but leave the lead nearest Q10 loose just as you did for C69 and VFO test.

☒ ☒ 3-17. Install *mylar film* capacitor C62, .001 μ F (marked 102).

Phase 3.0 Progress Test

In brief, this is a repeat of the VFO test procedure done at the end of Phase 2.0 building. What's new is that you will use the keying circuit and will look for 10.1 MHz signals on your frequency counter or receiver.

☐ ☐ 3-18. Set up whatever keying procedure seems most useful to you: it can be as simple as touching the black and white wires from J1 to each other.

☐ ☐ 3-19. Connect a length of wire such as alligator clip jumpers to the loose end of C61. (If using a frequency counter, connect its probe here.)

☐ ☐ 3-20. If using a receiver for testing, tune it to a 30 meter frequency where you would expect to hear your signal.

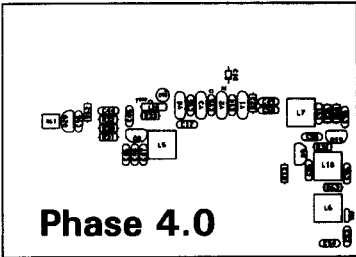
☐ ☐ 3-21. Connect DC power, close the keying circuit and rotate the main tuning control until you hear your signal.

☐ ☐ 3-22. With the circuit still keyed, and providing a 10.1 MHz signal to the monitor receiver or counter, turn the slug of L14 just enough to verify that doing so changes the frequency.

☐ ☐ 3-23. Adjusting L12 and L13 may cause an audible peaking of signal strength or receiver S-meter reading. However, adjusting these coils is part of final transmit alignment.

☐ ☐ 3-24. If you have not yet secured the VFO coil (L3) as discussed in the Phase 2.0 testing, you can make further adjustments of L3 as desired, observing the actual 7 MHz tuning range. You can secure this coil now or even later.

☐ ☐ 3-25. When finished testing, complete the installation of C61.



Phase 4.0 Assembly: 14.31818 MHz Receiver IF Stages

- A. Receiver Mixer Stage
- B. 14.318 MHz 4-pole Crystal Filter
- C. 14.318 MHz IF Amplifier

It is important to assemble these receiver stages with extra care, because no practical progress testing can be done until after the BFO and Audio Amplifier stages in Phase 5.0 are completed. Any mistakes will require rechecking your work through five receiver stages.

A. Receiver Mixer Stage

- ☒ ☒ 4-1. Install shielded coil L6, 2.8 μ H (marked 30-34, blue tuning slug.) Solder both mounting tabs as well as the pins.
- ☒ ☒ 4-2. Install shielded coil L18, also 2.8 μ H, per step 4-1.
- ☒ ☒ 4-3. Install shielded coil L7, 1.3 μ H (marked 30-35, yellow tuning slug.) Solder both mounting tabs as well as the pins.
- ☒ ☒ 4-4. Install transistor Q9, type J310 JFET.
- ☒ ☒ 4-5a. Install transistor Q19, NPN type 2N4124.
- ☒ ☒ 4-5b. Install transistor Q20, NPN type 2N4124.
- ☒ ☒ 4-6. Install diode D13, type 1N4148 with correct cathode polarity as outlined on the board

Install the following resistors:

- ☒ ☒ 4-7. Resistor R13, 47 ohms (yellow-violet-black).
- ☒ ☒ 4-8. Resistor R36, 100 ohms (brown-black-brown).
- ☒ ☒ 4-9. Resistor R34, 1K (brown-black-red).
- ☒ ☒ 4-10. Resistor R63, 10K (brown-black-orange).
- ☒ ☒ 4-11. Resistor R60, 68K (blue-gray-orange).
- ☒ ☒ 4-12. Resistor R62, also 68K.
- ☒ ☒ 4-13. Install capacitor C93, 0.22 μ F electrolytic. !! $\pm$!!
- ☒ ☒ 4-14. Install *mylar film* capacitor C54, .001 μ F (marked 102).
- ☒ ☒ 4-15. Install *disc* capacitor C49, 750 pF (marked 751).

Install the following ceramic disc capacitors:

- ☒ ☒ 4-16. Capacitor C52, 3 pF.
- ☒ ☒ 4-17. Capacitor C96, 82 pF.
- ☒ ☒ 4-18. Capacitor C50, 120 pF (marked 121).
- ☒ ☒ 4-19. Capacitor C53, 91 pF.
- ☒ ☒ 4-20. Capacitor C55, .01 μ F (marked 103).
- ☒ ☒ 4-21. Capacitor C56, also .01 μ F.
- ☒ ☒ 4-22. Capacitor C91, also .01 μ F.
- ☒ ☒ 4-23. Capacitor C95, also .01 μ F.
- ☒ ☒ 4-24. Capacitor C90, also .01 μ F.

B. 4-Pole Crystal Filter

- ☒ ☒ 4-25. If not already done in Phase 1.0, install a "zero ohm" jumper in the position for L20.

Install the filter crystals and capacitors in whatever order you consider most convenient:

- ☒ ☒ 4-26. Crystal Y1, 14.31818 MHz.
- ☒ ☒ 4-27. Crystal Y2, 14.31818 MHz.
- ☒ ☒ 4-28. Crystal Y3, 14.31818 MHz.
- ☒ ☒ 4-29. Crystal Y4, 14.31818 MHz.
- ☒ ☒ 4-30. Capacitor C14, 220 pF (marked 221).
- ☒ ☒ 4-31. Capacitor C15, 270 pF (marked 271).
- ☒ ☒ 4-32. Capacitor C16, 220 pF (marked 221).
- ☒ ☒ 4-33. Capacitor C17, 68 pF.

C. 11 MHz IF Amplifier

- ☒ ☒ 4-34. Install transistor Q8, NPN type 2N4124.
- ☒ ☒ 4-35. Identify correctly and install shielded coil L5, 5.8 μ H, which is stamped **30-33**.
- ☒ ☒ 4-36. Install R61, the 1K trimmer pot. Be careful not to crush the mounting legs when inserting them into the board holes. It is normal to have some space between the bottom of the device and the circuit board.

Install these resistors:

- ☒ ☒ 4-37. Resistor R33, 1K (brown-black-red).
- ☒ ☒ 4-38. Resistor R32, 2.2K (red-red-red).
- ☒ ☒ 4-39. Resistor R30, 82K (gray-red-orange).
- ☒ ☒ 4-40. Resistor R31, 470K (yellow-violet-yellow).

Install these disc ceramic capacitors:

- ☒ ☒ 4-41. Capacitor C48, 15 pF.
- ☒ ☒ 4-42. Capacitor C47, 33 pF
- ☒ ☒ 4-43. Capacitor C44, .01 μ F (marked 103).
- ☒ ☒ 4-44. Capacitor C45, also .01 μ F.
- ☒ ☒ 4-45. Capacitor C46, also .01 μ F.
- ☒ ☒ 4-46. Double-check the installation of each part in the preceding three circuit stages. Doing so is your best assurance that the receiver will perform properly.

About These Receiver Stages

A. JFET Mixer Circuit: This circuit uses a J310 JFET as a mixer to convert antenna signals to an IF. The VFO is applied to the source through C56, while the RF input from the antenna is applied to the gate. C49, C50, and L7 tune the drain to the 14.318 MHz IF frequency. C53, C54, L6, C52, C96 and L18 make up a double-tuned bandpass filter to provide some front-end selectivity.

B. Crystal Filter: The IF contains a 4-pole crystal filter providing a 3dB bandwidth of about 1KHz. The shape factor is about 5:1 with better than a 70dB ultimate. (A coil for L20 is used to provide impedance matching in the 20 Meter version only).

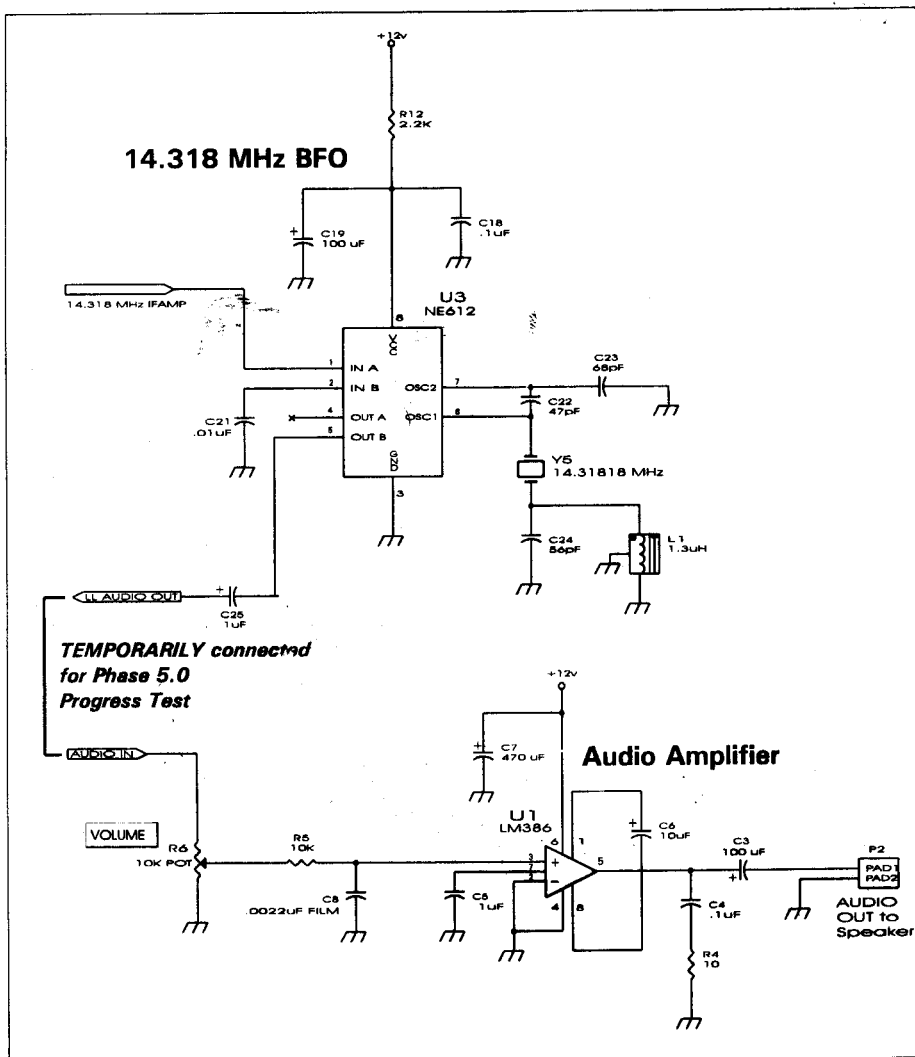
C. IF Amplifier: Q8 provides most of the IF gain. This NPN transistor is set in a common-base configuration. This not only allows for moderate gain, but also provides well matched loading for the 4-pole crystal filter stage preceding it. C47, C48, and L5 provide tuning of the collector at the IF frequency, and R61 and associated circuitry are used to set the sidetone level in transmit.

Coming in Phase 5.0 . . .

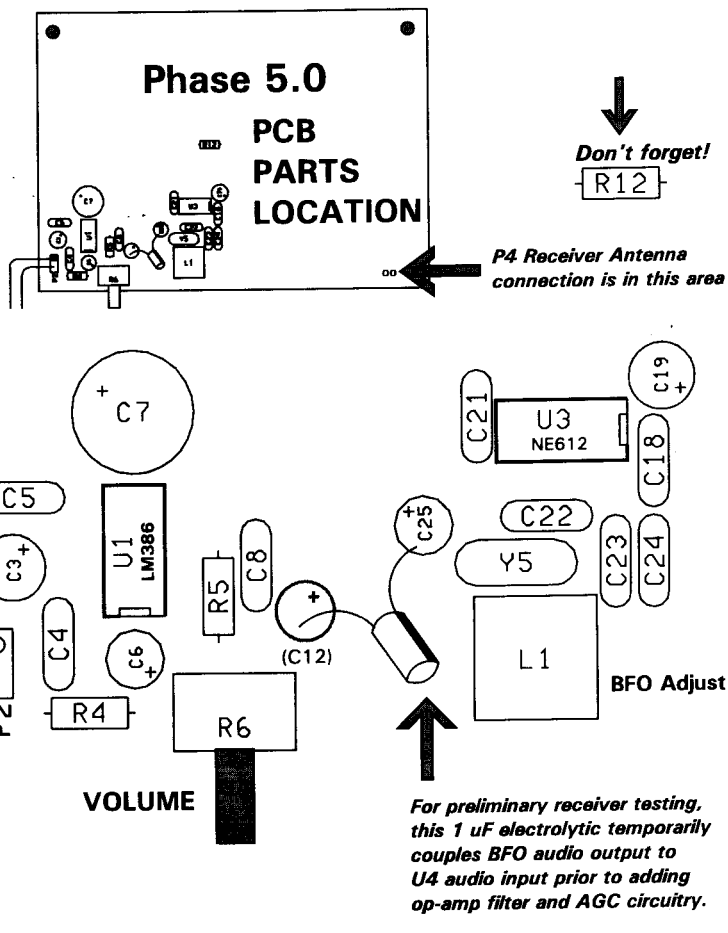
BFO (Audio Mixer): An NE612 double-balanced mixer is used to mix the IF signal with its 14.318 Mhz crystal oscillator to supply the audio signal. The oscillator uses external components (C22, C23, C24, Y5, L1) to set and pull the required frequency.

Audio Amplifier: The gain of the LM386 Audio Amplifier IC is set by C6, a 10 μ F electrolytic, for maximum voltage gain (200). The LM386 runs off of a supply voltage of +12 V, into a 4 Ohm speaker, for maximum rated audio output power level of about 300 mW. You will find the speaker audio levels to be quite generous.

Phase 5.0 Schematic Details



☐ Phase 5.0 Receiver BFO and Audio Amplifier Stages



Phase 5.0: Receiver BFO and Audio Output

A. BFO Circuit

- ☒ ☒ 5-1. Install U3, type NE612, being sure to align the notched end (pins 1 and 8) exactly as outlined on the circuit board. Do not use an IC socket for U3.
- ☒ ☒ 5-2. Install resistor R12, 2.2K (red-red-red) [near L5].
- ☒ ☒ 5-3. Identify shielded coil L1, 1.3 μ H, marked 30-35, and install it, soldering both mounting tabs as well as the pins.
- ☒ ☒ 5-4. Install crystal Y5, 14.31818 MHz.
- ☒ ☒ 5-5. Install electrolytic capacitor C19, 100 μ F. $\pm 10\%$

Install the following disc ceramic capacitors:

- ☒ ☒ 5-6. Capacitor C24, 56 pF.
- ☒ ☒ 5-7. Capacitor C22, 47 pF.
- ☒ ☒ 5-8. Capacitor C23, 68 pF.
- ☒ ☒ 5-9. Capacitor C21, .01 μ F (marked 103).
- ☒ ☒ 5-10. Capacitor C18, .1 μ F (marked 104).

NOTE: C25 is part of this circuit and couples the low level audio output from pin 5 of U3 to the U2 op amp circuitry to be built up after initial receiver testing. C25 will be installed temporarily to couple the BFO audio to the LM386 audio input for this testing.

B. Audio Amplifier Circuit

- ☒ ☒ 5-11a. Install U1, type LM386, being sure to align the notched end (pins 1 and 8) exactly as outlined on the circuit board. The use of an 8-pin DIP socket is not recommended.
- ☒ ☒ 5-11b. Solder pin 4 of U1 to the top groundplane in addition to the bottom trace already done.

Install the following resistors:

- ☒ ☒ 5-12. Resistor R4, 10 ohms (brown-black-black).
- ☒ ☒ 5-13. Resistor R5, 10K (brown-black-orange).

Install these capacitors with attention to type and polarity:

- ☒ ☒ 5-14. Capacitor C6, 10 μ F electrolytic. !! $\pm$!!
- ☒ ☒ 5-15. Capacitor C3, 100 μ F electrolytic. !! $\pm$!!
- ☒ ☒ 5-16. Capacitor C7, 470 μ F electrolytic. !! $\pm$!!
- ☒ ☒ 5-17. Capacitor C8, .0022 μ F **mylar film** (marked 222).
- ☒ ☒ 5-18. Capacitor C4, .1 μ F disc ceramic (marked 104).
- ☒ ☒ 5-19. Capacitor C5, also .1 μ F disc ceramic
- ☒ ☒ 5-20. Install the Volume Control, R6, 10K potentiometer.

Optional:

If you would like to have the front subpanel installed for preliminary receiver testing, first install the following few parts which are part of Phase 6.0 circuitry and easier to install without the subpanel in place:

- ☐ ☐ 5-21. Capacitor C10, .01 μ F disc ceramic (marked 103).
 - ☐ ☐ 5-22. Resistor R10, 470 ohms (yellow-violet-brown).
 - ☐ ☐ 5-23. Resistor R9, 560 ohms (green-blue-brown).
 - ☐ ☐ 5-24. Resistor R11, 5.6K ohms (green-blue-red).
 - ☐ ☐ 5-25. Mount the front subpanel to the Volume and RIT controls using the washers and nuts supplied. Then mount the Tuning control to the subpanel.
 - ☐ ☐ 5-26. Prepare a 3" white #24 hookup wire and solder one end to the pad nearest C3 within the rectangle labeled P2.
 - ☐ ☐ 5-27. Prepare a 3" black #24 hookup wire and solder one end to the other (ground) pad within the rectangle labeled P2.
 - ☐ ☐ 5-28. **Temporary Antenna Connection:** Solder a piece of bare wire trimmed from a resistor to the pad nearest C53 in the area labeled P4 which is near the other front corner of the board.
- (If you prefer not to make a connection which must be unsoldered later, you can install one end of the RG174/U coax jumper as explained in Step 7-38 ff. During further assembly, this jumper should be secured with tape to the front subpanel to prevent damage to the connections.)

Phase 5.0 Progress Test

Many more parts have been installed on the board since the last Progress Tests for VFO tuning and the Transmit mixer stage. No progress testing was proposed after Phase 4.0 kit construction work, simply because it would be difficult to observe useful data without lab-grade test equipment. However, we can now align the receiver mixer and IF amplifier stages. The testing can be done with a signal from another transceiver or signal generator. If the band is active and all components were installed correctly, this test can also be done with on-the-air 30 meter activity.

☐ ☐ 5-29. Without cutting its leads, temporarily install a 1 μ F electrolytic capacitor as illustrated in the circuit board drawing on page 29.

☐ ☐ 5-30. Set up your station transceiver for lowest power 30 meter operation into a dummy load and tune it to a frequency you would expect to hear with your Model 1330 receiver.

☐ ☐ 5-31. Make a temporary connection of the white and black wires from P2 to the speaker supplied in your kit. Use alligator clip jumpers, or tack-solder the wires to the speaker terminals. (Expect audio quality during this test to be poor, not at all representative of the receiver performance with the op-amp circuitry installed and the speaker properly enclosed.)

☐ ☐ 5-32. Connect an antenna or a few feet of hookup wire to the antenna input connection prepared in step 5-28.

☐ ☐ 5-33. Turn the slug of L1 counter-clockwise until it is flush with the top of the shield can.

☐ ☐ 5-34. Connect DC power. (Keying will not be needed at this time, because the sidetone is not likely to be audible yet.)

Alignment Methods: When peaking a coil for maximum signal strength, some builders prefer to do so by ear. A very precise method is to connect an analog VOM to the speaker output wires, with the meter set to **lowest AC voltage range**. Expect average on-the-air signals to deflect the meter by only a fraction of a volt. But a strong local test signal such as from your station rig will provide good meter movement for easy adjustments.

☐ ☐ 5-35. Key your station transceiver and rotate the main tuning control until you hear the test signal. Peak this signal by ear or by the AC voltmeter method.

□ □ 5-36. Adjust L1 clockwise, noting the change in signal pitch. Set L1 to an audio pitch which suits your operating preference. This setting also has the effect of establishing the IF passband, which is why it is useful to do this adjustment carefully. Any future adjustment will require realignment of the transmit mixer.

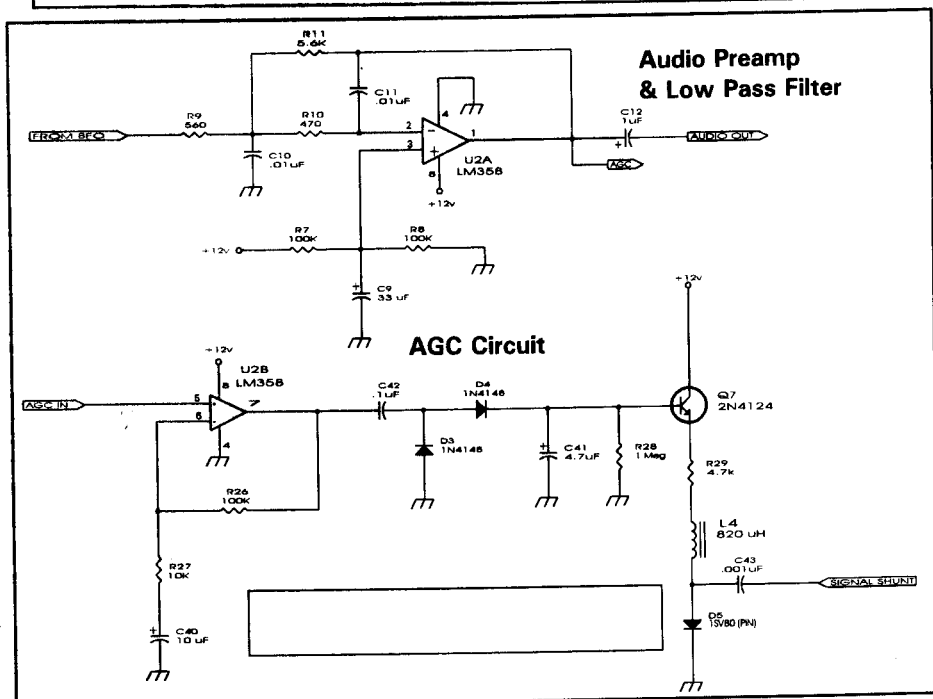
□ □ 5-37. **Receiver Alignment in General:** Alignment of the receiver section consists of adjusting L6, L18, L7 and L5 for maximum received signal level or background noise.

□ □ 5-38. Align the receiver coils per 5-37.

□ □ 5-39. Further testing at this point consists essentially of tuning around until you are satisfied that the receiver works. But keep in mind that completion of Phase 6.0 will result in dramatic improvement in audio quality. If you have not yet secured the VFO coil (L3), expect the receiver to be very sensitive to movement of the board.

✓ □ 5-40. Remove the temporary 1 μ F electrolytic capacitor and install it permanently as C25. !!±!!

Phase 6.0 Schematic Details

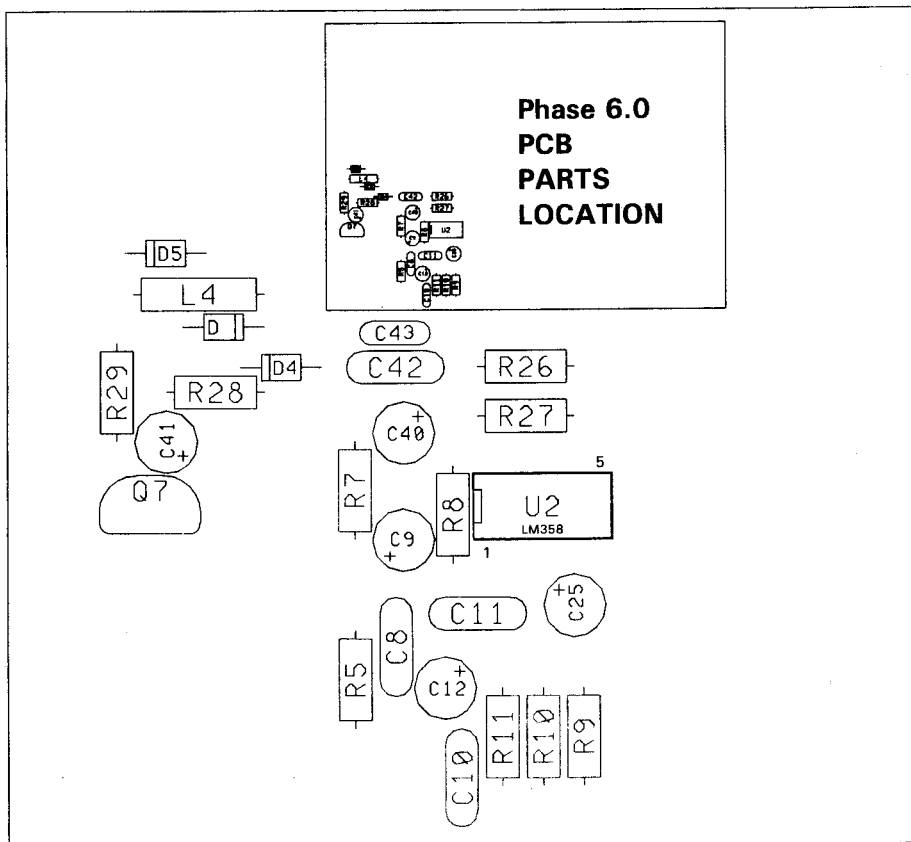


Phase 6.0

Receiver Audio Preamp/Filter and AGC

Audio Lowpass Gain Stage: This circuit uses one-half of a LM358 dual op amp to not only provide an some audio gain (about 20dB), but also to roll off the audio response above 1KHz.

AGC Circuit: The other half of the LM358 dual op amp is used to pick up and amplify a sample of the audio signal. D3 and D4 rectify the audio signal and drive transistor Q7. D5 is a 1SV80 PIN diode, which works in such a way that, the more current through the diode, the more of a short circuit it presents. The stronger the audio signal, the higher the rectified DC. This drives Q7 harder, which supplies more current to diode D5. The signal is shunted through C43 off of the collector of the IF amplifier transistor in relation to the amount of current through D5.



Phase 6.0 Assembly: Audio Preamp/Filter and AGC

A. Audio Preamp and Low Pass Filter (U2A):

☒ ☒ 6-1. Install U2, type LM358, being sure to align the notched end (pins 1 and 8) exactly as outlined on the circuit board. The use of your own 8-pin DIP socket is your option if you like to compare the characteristics of various dual op-amp IC's.

If you mounted the front subpanel in Phase 5.0, you were instructed to install the following parts. If you chose not to do so, install them now:

- ☒ ☒ 6-2. Capacitor C10, .01 μ F disc ceramic (marked 103).
- ☒ ☒ 6-3. Resistor R10, 470 ohms (yellow-violet-brown).
- ☒ ☒ 6-4. Resistor R9, 560 ohms (green-blue-brown).
- ☒ ☒ 6-5. Resistor R11, 5.6K ohms (green-blue-red).

Install the remaining U2A circuit parts:

- ☒ ☒ 6-6. Resistor R7, 100K (brown-black-yellow).
- ☒ ☒ 6-7. Resistor R8, also 100K.
- ☒ ☒ 6-8. Capacitor C11, .01 μ F disc ceramic (marked 103).
- ☒ ☒ 6-9. Capacitor C12, 1 μ F electrolytic !! $\pm$!!
- ☒ ☒ 6-10. Capacitor C9, 33 μ F electrolytic !! $\pm$!!

B. AGC Circuit

- ☒ ☒ 6-11. Install diode D3, type 1N4148 with correct cathode band orientation.
- ☒ ☒ 6-12. Install diode D4, also type 1N4148.
- ☒ ☒ 6-13. Install PIN diode D5, type 1SV80 with correct cathode band orientation. (glass body, green cathode band).
- ☒ ☒ 6-14. Install transistor Q7, NPN type 2N4124.

Install the following resistors:

- ☒ ☒ 6-15. Resistor R29, 4.7K (yellow-violet-red).
(Be VERY careful: the end of R29 closest to L4 is soldered to a pair of "island" pads within a groundplane area. Be sure not to short [bridge] these connections to the groundplane!)
- ☒ ☒ 6-16. Resistor R27, 10K (brown-black-orange).

- ☒ ☒ 6-17. Resistor R26, 100K (brown-black-yellow).
- ☒ ☒ 6-18. Resistor R28, 1 megohm (brown-black-green).

Install these capacitors:

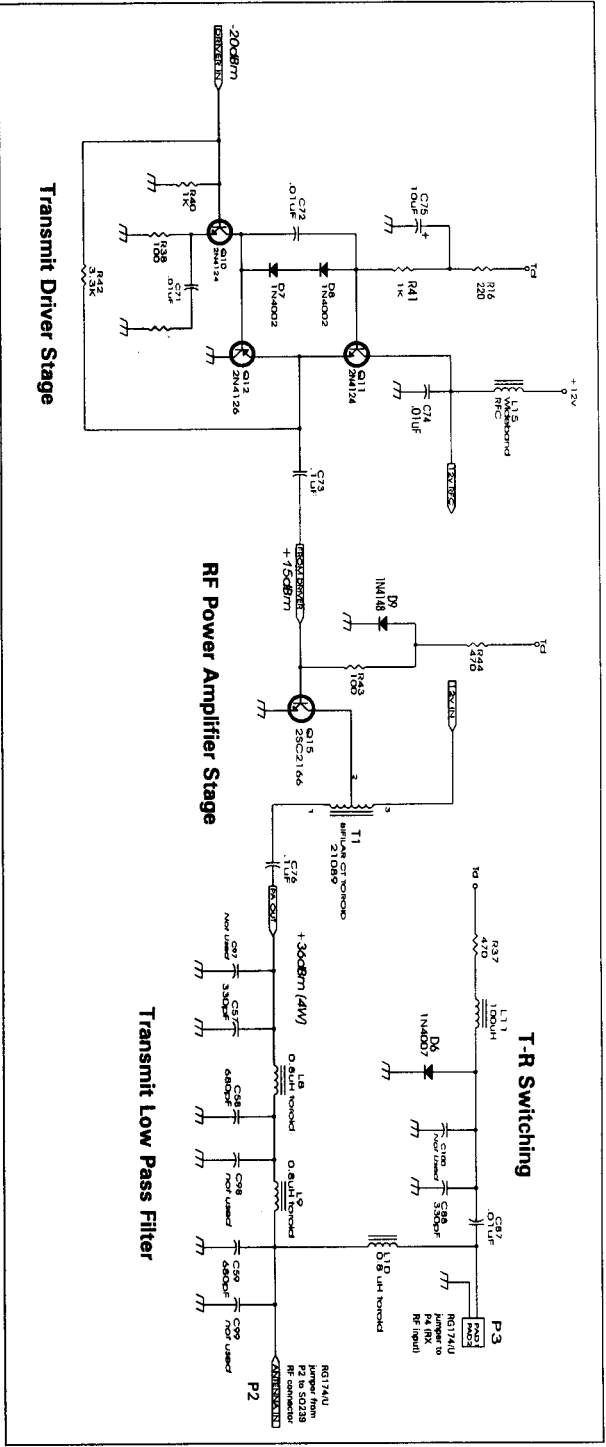
- ☒ ☒ 6-19. Capacitor C41, 4.7 μ F electrolytic !! $\pm$!!
- ☒ ☒ 6-20. Capacitor C40, 10 μ F electrolytic !! $\pm$!!
- ☒ ☒ 6-21. Capacitor C43, .001 μ F disc (marked 102).
- ☒ ☒ 6-22. Capacitor C42, .01 μ F disc (marked 104).
- ☒ ☒ 6-23. Install molded inductor L4, 820 μ H (gray-red-brown).
(Be VERY careful: the end of L4 closest to R29 is soldered to a pair of "island" pads within a groundplane area. Be sure not to short [bridge] these connections to the groundplane!)

- ☐ ☐ 6-24. *reserved*
- ☐ ☐ 6-25. *reserved*
- ☐ ☐ 6-26. *reserved*

Phase 6.0 Progress Test

At this point the receiver is finished and also capable of detecting a low-level CW keying sidetone signal.

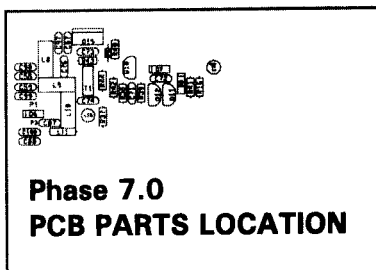
- ☐ ☐ 6-27. Connect antenna, speaker and DC power as for the Phase 5.0 tests. Also, set up whatever method of keying you wish.
- ☐ ☐ 6-28. Turn on DC power and operate all controls as you wish.
- ☐ ☐ 6-29. Key the transmit mixer stage: adjusting both trimmer R61 and BFO coil L1 should result in an audible sidetone, but do not expect much volume at this stage. (The sidetone circuit expects to sample the full output power of the RF transistor.)
- ☐ ☐ 6-30. Adding the op-amp circuitry will have no effect on alignment of the RF and IF stages done in Phase 5.0. Follow the steps in Phase 5.0 for any further receiver alignment.
- ☐ ☐ 6-31. If you have some reason to let the radio serve as only a receiver for a while, perhaps as a licensing incentive for a family member, or because it is a club or class project, proceed to Phase 8.0 and select the appropriate steps for wiring the power switch, phono jacks, antenna connector and headphone jack. Then perform the obvious final assembly steps, carefully setting aside the remaining parts for later completion of the transceiver.



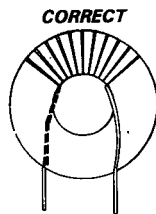
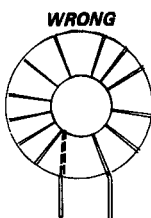
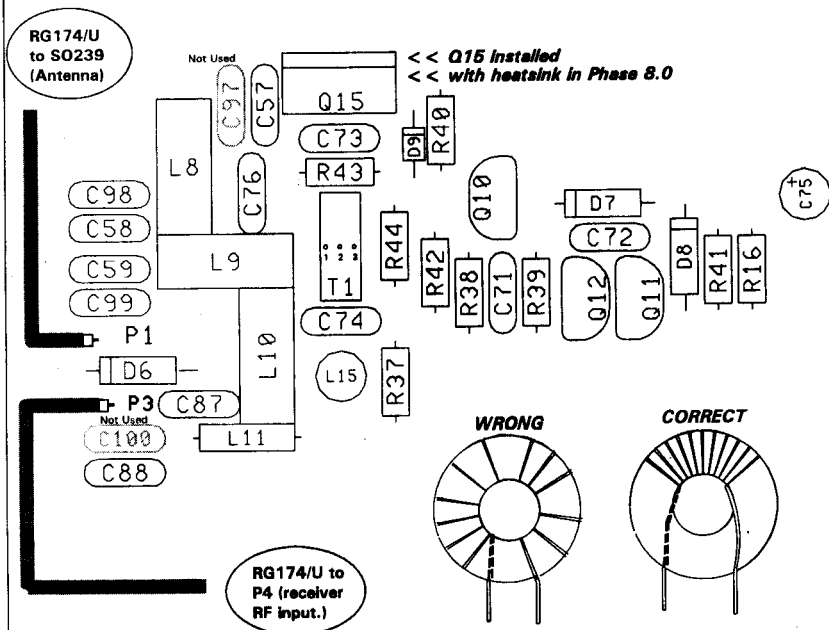
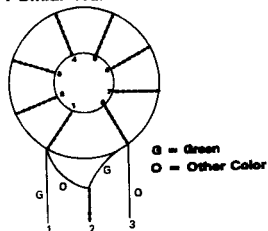
Phase 7.0 Schematic Details

Phase 7.0

Transmit Driver, RF Amplifier & Output Filter



T1 Bifilar Transformer



L8, L9, L10 = 11 turns #24
CLOSEWOUND on T-44 core*

*Turns counted as passes through center of toroid core

REMINDER: All toroid winding directions follow the convention of counting turns through the center hole of the toroid core. Scrape the enamel from the ends of the coil winding before soldering.

Phase 7.0: Transmit Driver, RF Amplifier & Output Filter

A. Driver Stage

☒ ☒ 7-1. Install diode D7, type 1N4002, with correct cathode band orientation, being careful not to confuse it with 1N4007.

☒ ☒ 7-2. Install diode D8, type 1N4002, with correct cathode band orientation, being careful not to confuse it with 1N4007.

☒ ☒ 7-3. Install transistor Q12, **PNP type 2N4126**.

☒ ☒ 7-4a. Install transistor Q10, NPN type 2N4124.

☒ ☒ 7-4b. Install transistor Q11, NPN type 2N4124.

☒ ☒ 7-5. Install L15, the 6-hole wideband ferrite RF choke.

Install these resistors:

☒ ☒ 7-6. *reserved (R39 is NOT USED in this model)*

☒ ☒ 7-7. Resistor R38, 100 ohms (brown-black-brown).

☒ ☒ 7-8. Resistor R16, 220 ohms (red-red-brown).

☒ ☒ 7-9. Resistor R40, 1K (brown-black-red).

☒ ☒ 7-10. Resistor R41, also 1K.

☒ ☒ 7-11. Resistor R42, 3.3K (orange-orange-red).

☒ ☒ 7-12. **Read Carefully:** To install C71, .01 μF (marked 103), leave 1/4" of the lead furthest from Q10, bend and solder to the ground end of R38. Trim as needed.

Install these ceramic disc capacitors:

☒ ☒ 7-13. Capacitor C72, also .01 μF .

☒ ☒ 7-14. Capacitor C74, also .01 μF .

☒ ☒ 7-15. Capacitor C73, .1 μF (marked 104).

☒ ☒ 7-16. Install capacitor C75, 10 μF electrolytic. !! $\pm$!!

B. RF Amplifier (Q15, 2SC2166)

☒ ☒ 7-17. Install diode D9, type 1N4148, with correct cathode band orientation.

☒ ☒ 7-18. Install resistor R43, 100 ohms (brown-black-brown.)

☒ ☒ 7-19. Install resistor R44, 470 ohms (yellow-violet-brown.)

☒ ☒ 7-20. Install disc ceramic capacitor C76, .1 μF (marked 104).

Procedure for Winding Transformer T1:

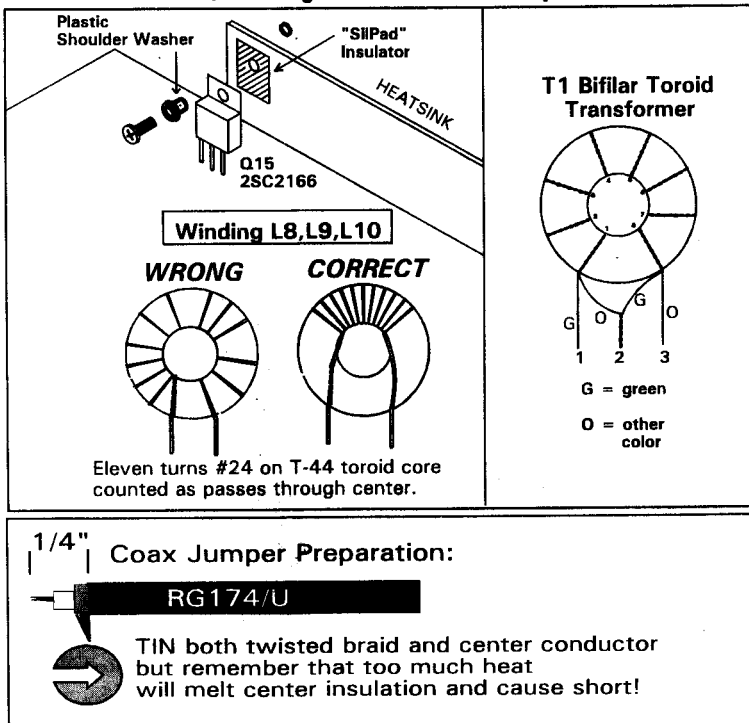
OVERVIEW: Transformer T1 is a bifilar toroid wound on the green/gray toroid core smaller than the red T-44 cores used for the VFO coil and transmit low pass filter. It is made by winding 8 passes of the twisted pair of two different colors of #28 enameled wire through the center of the core, then correctly connecting these windings to form two ends with centertap. **Scrape the enamel from the wire ends before soldering.**

✓✓ 7-21. Make and install toroid transformer T1 per the preceding explanation and Figure 7.1.

✓✓ 7-22. Mount the Q15 2SC2166 RF power transistor to the aluminum heatsink, using the "silpad" insulator and plastic shoulder washer as illustrated. Use a 1/2" #4-40 screw, with a #4 lock washer between the back of the heatsink and a #4-40 nut. Use your VOM to verify that there is no short from the metal heatsink back of the transistor to the aluminum heatsink. **Set aside the Q15/heatsink assembly until instructed to install it at the beginning of Phase 8.0.**

Figure 7.1:

Installation of Q15, Winding T1, L8-L10, Coax Preparation



C. Low Pass Filter and T-R Switch

- ☒ ☒ 7-23. Install diode D6, type 1N4007, with correct cathode band orientation.
- ☒ ☒ 7-24. Install molded inductor L11, 100 μ H (brown-black-brown.)
- ☒ ☒ 7-25. For easier toroid winding, cut the heavier #24 enameled wire into three equal lengths.
- ☒ ☒ 7-26. Toroid coils L8, L9 and L10 are identical with a value of 0.8 μ H and consist of 11 turns (**counting the number of passes through the center of the core**) on the T-44 red toroid cores. The turns should be wound fairly close to each other; spreading them out uniformly will result in a very noticeable decrease in RF output due to the sharp roll-off frequency of the filter design. **Scrape the enamel from the wire ends before soldering**
- ☒ ☒ 7-27. Make and install toroid L8 per step 7-26.
- ☒ ☒ 7-28. Make and install toroid L9 per step 7-26.
- ☒ ☒ 7-29. Make and install toroid L10 per step 7-26.

Install the following disc ceramic capacitors:

- ☒ ☒ 7-30. Capacitor C57, 330 pF (marked 331).
 - ☒ ☒ 7-31. Capacitor C58, 680 pF (marked 681).
 - ☒ ☒ 7-32. Capacitor C59, also 680 pF.
 - ☒ ☒ 7-33. Capacitor C88, 330 pF.
 - ☒ ☒ 7-34. *reserved*
 - ☒ ☒ 7-35. *reserved*
 - ☒ ☒ 7-36. Capacitor C87, .01 μ F (marked 103).
- NOTE: C97-C100 are *not used* in this model.

- ☒ ☒ 7-37. Install resistor R37, 470 ohms (yellow-violet-brown).
- ☐ ☐ 7-38. **Coax Preparation:** Cut two 6" lengths of RG174/U coax and strip 1/4" of the outer black insulation from each end. Do this stripping carefully so as not to cut the stranded shield. Use a pin to gently unbraid both shields, then twist the unbraided wires to form neat stranded conductors. TIN all 4 of these twisted conductors so that there are no loose strands. **Do this tinning carefully: too much solder heat will melt the inner insulation and short out the shield to the center conductor.** Then strip 1/8" insulation from the 4 inner conductors. (If you choose also to tin the center conductor, keep in mind that too much solder flow will make it impossible to insert the center conductor into its board hole.)

- □ 7-39. Solder the center conductor of one coax jumper to the non-grounded pad in the silkscreened rectangle labeled P4 in the receiver section (corner near RIT control). You probably will want to remove the subpanel for easier soldering. Solder the shield to the groundplane.
- □ 7-41. Solder the other end of the coax jumper to the pads labeled P3 near D6, C87.
- □ 7-42. Reviewing 7-39 as needed, install one end of the other coax jumper to the pads labeled P1.

Optional Transmit Driver Test

If you are confident in the work you have done in Phase 7.0, proceed now to final assembly in Phase 8.0. If you prefer to verify proper operation of the other transmit circuitry before installing the RF power transistor, do the following:

- □ 7-43. Tack-solder a scrap of bare wire from the trace common to C73 and the base of Q15 and the trace with 4 pads joining L8,C76,C57,C97. This is the equivalent of shorting the base to the collector of Q15, which is not yet installed.
- □ 7-44. Mount a #4 solder lug to the SO-239 connector using a #4-40 screw and nut. Solder the coax jumper from P1 to the connector. This connection is permanent, though the screw will need to be removed and reinstalled to mount the connector.
- □ 7-45. Connect a 50 ohm dummy load through a QRP RF wattmeter to the SO-239 connector. A 47 ohm carbon resistor may be used as a dummy load.
- □ 7-46. Provide some method for keying the transmitter, then reconnect DC power.
- □ 7-47. Keying the transmitter should give an RF meter indication of a fraction of a watt. Adjusting L12 and L13 should peak the indicated power. If you are sure from experience that your meter can indicate RF power under 100 mW, and you get no indication at all, there most likely is a problem which should be checked by reviewing your work. If you are unsure of your meter sensitivity, try using the lowest AC voltage range of your VOM as an RF detector.
- □ 7-48. Disconnect DC power and REMOVE THE JUMPER WIRE installed in Step 7-43 when you are finished with this test.

□ Phase 8.0

Final Assembly and Alignment

- □ 8-1. Set the RF transistor/heatsink assembly into position and solder Q15 after making sure the 3 leads of Q15 are seated evenly in the circuit board holes as far as they will go in.
- □ 8-2. Solder a bare wire trimmed from a resistor to the pad behind R46 labeled TP1. (You will be measuring voltages at this point to set the RIT control. If more convenient for your style of test leads, a short length of hookup wire could be soldered here and trimmed later.)
- □ 8-3. Set the transceiver board assembly into the main chassis /panel and mount the front subpanel and heatsink to the chassis with three each #4-40 screws, #4-40 nuts and #4 lockwashers.
- □ 8-4. Secure the rear of the board to the chassis with the two #4 steel spacers and two each 1/2" #4-40 screws, #4-40 nuts and #4 lockwashers. (Of course, pull out the hookup wires which had been secured in one hole.)
- □ 8-5. Mount the SO-239 antenna connector (wired per step 7-44) with the #4 lug, screw and nut. Use an additional #4-40 screw, nut and lockwasher to mount the other side.
- □ 8-6. Mount the triple RCA connector board in place using four #4-40 screws, #4-40 nuts and #4 lockwashers.
- □ 8-7. Mount the DPDT toggle switch on the front panel and solder the RED wire from "+ 12V" to either of the **bottom** switch terminals.
- □ 8-8. Solder the BLACK wire from "+ 12V" to the ground lug on the RCA jack board nearest the antenna connector.
- □ 8-9. Solder the WHITE wire from J1 to the center pin of the RCA jack labeled "KEY."
- □ 8-10. Prepare a 5.5" length of RED hookup wire and solder one end to the + 12VDC RCA jack.
- □ 8-11. Solder the other end of the red + 12VDC wire to the center terminal of the power switch (on the same side as the other switch wire already installed.)

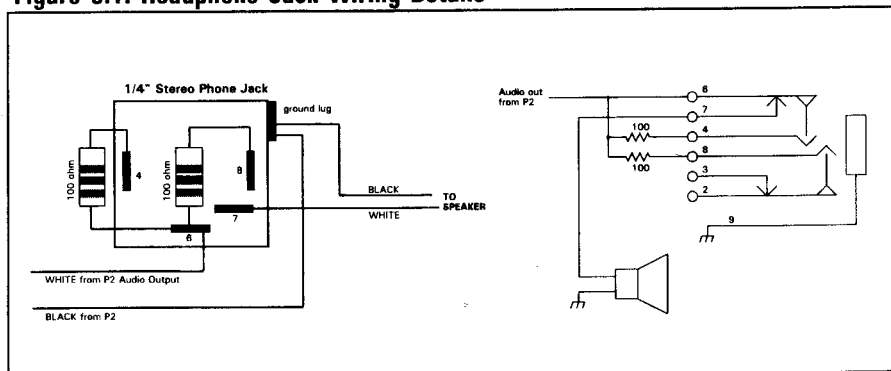
❑❑ 8-12. Solder the black wire from the keying circuit (J1) to the other ground lug on the RCA phono jack board.

❑❑ 8-13. To assure good grounding, recheck the tightness of all rear connector mounting hardware.

❑❑ 8-14. Prepare a 4" white and 4" black hookup wire: twist them as desired to serve as the speaker cable.

❑❑ 8-15. Using the remaining two 100 ohm resistors, the speaker cable and the wires from P2 (LM386 audio output), wire the 1/4" headphone jack as illustrated in Figure 8.1.

Figure 8.1: Headphone Jack Wiring Details



❑❑ 8-16. Preparation of Main Tuning Knob

With a small arts/crafts brush or even a Q-tip, paint a drop of WATER-based (latex or acrylic) enamel into one groove of the main tuning knob. Don't worry if some paint is left on the outer rim of the knob outside the groove. Let the paint dry about 10 minutes, then try cleaning off any excess paint outside the groove with a DRY smooth cloth or paper towel. If necessary, moisten the towel very slightly to help dissolve unwanted paint traces. Rub patiently. The result should be a uniform coating of paint within one groove on the side of the knob. If you used a water-based paint and did a lousey job, don't worry at all. Promptly use a wet rag or toothbrush to scrub out the paint: rinse the knob, dry it and try the painting again.

We suggest water-based paint simply because there's no way that using water as a solvent or cleaner can damage the knob itself. If you have other skills and experience with art or model-finishing, just use the paint and techniques most familiar to you. Use a #4 Allen wrench to insert and secure the supplied allen-type #4-40 set-screw into the tuning knob.

❑❑ 8-17. Mount the Main Tuning and Volume Control knobs with their index stripes set to correspond to the panel markings. Do not install the RIT Control knob just yet.

□ □ 8-18. **RIT Alignment.** Connect a key, DC power and a 50 ohm dummy load to the transceiver. Three possible methods of RIT alignment are detailed on page 29 of the Reference Section. Perform this alignment as explained, then return to this section.

□ □ 8-19. **Transmit Power Check:** Connect 50 ohm dummy load or antenna with RF wattmeter and a key. If using an antenna, tune to a clear frequency and use proper callsign identification. While keying the transmitter, adjust L12 and L13 for maximum RF output.

If the output power seems considerably lower than you expected, check both the DC supply voltage and the winding of toroid coils L8-L10. 14 volts DC will produce noticeably more RF output than, say, 11.5 volts. If the coil windings are spread too far apart, compress them and recheck RF output.

To make sure you are transmitting on the same frequency as stations you are hearing, L14 must be adjusted using a reference signal which can be heard on both the Model 1330 receiver and a second receiver. The signal can be actual 30 meter CW activity or a source such as an RF signal generator.

□ □ 8-20. With the RIT control centered in the 12:00 position, tune the 1330 receiver to the reference signal at the audio pitch you generally prefer.

□ □ 8-23. On the second receiver, carefully tune in the reference signal to the same audio pitch.

□ □ 8-24. While keying the 1330 transmitter (using a dummy load), adjust L14 until your transmit signal is at the same pitch ("on top of") as the reference signal in the other receiver. This adjustment places your transmit signal exactly on the other station's frequency.

[If you are concerned about which sideband of your signal or the reference signal you are hearing in the other receiver, tune both signals to a perfect "zero-beat" or null. See glossary pages in Reference Section if you are unfamiliar with this concept.]

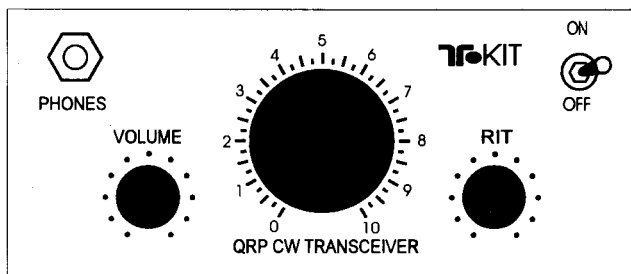
- □ 8-26. Attach the four rubber bumper feet to the bottom cabinet shell.
- □ 8-27. Mount the speaker to the top shell using the aluminum speaker mounting plate and four each #4-40 screws and nuts and #4 lockwashers.
- □ 8-28. Solder the wires from the phone jack to the speaker terminals.
- □ 8-29. Solder a jumper between the center pins of the two +DC RCA jacks.
- □ 8-30. Set the transceiver assembly into the bottom shell.
- □ 8-31. Mount the top shell using the four black self-tapping screws.

Tuning Dial Calibration

While there can be numerous schemes for marking favorite frequencies on the front panel tuning scale, we believe that the simplicity of a frequency chart will serve the needs of most operators.

To make a frequency chart for your transceiver, simply transmit into a 50-ohm dummy load while listening on another receiver, noting various frequencies of importance or interest on a chart such as the sample on page 47. Use the capabilities of your word processing software to create a custom frequency card for your radio's band coverage.

It is solely the responsibility of the licensed amateur operator using this transceiver to know and observe the band edge limits appropriate for one's class of license.



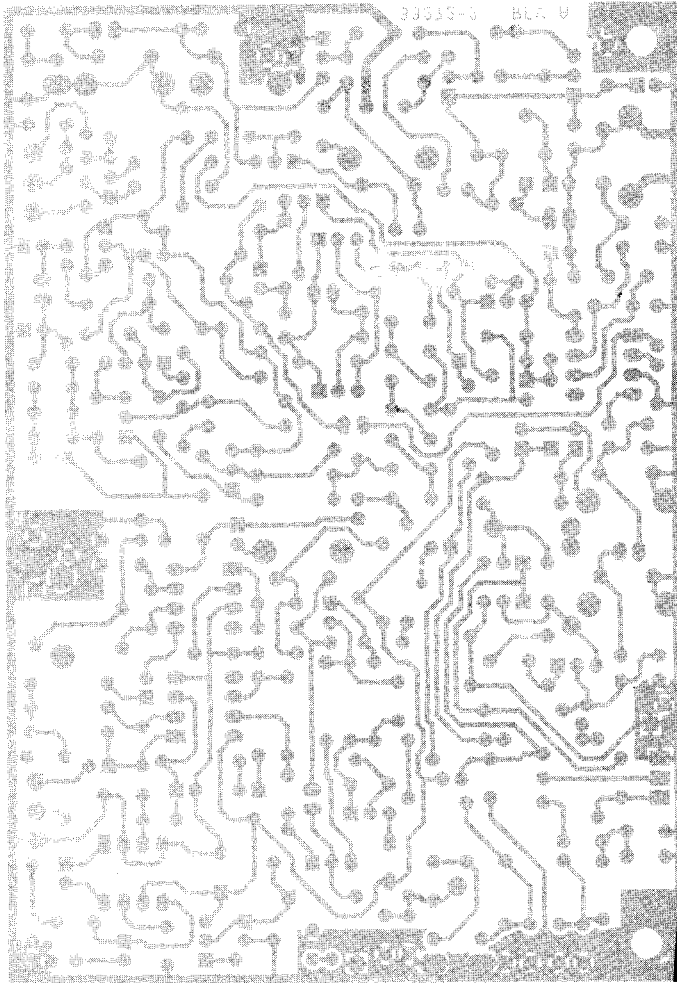
T-KIT Model 1330 CW Transceiver Log of Frequency Calibration

MHz	DIAL	Your Notes
10.100		
10.101		
10.102		
10.103		
10.104		
10.105		
10.106*		
10.107		
10.108		
10.109		
10.110		
10.111		
10.112		
10.113		
10.114		
10.115		
10.116		
10.117		
10.118		
10.119		
10.120		
10.121		
10.122		
10.123		
10.124		
10.125		
10.126		
10.127		
10.128		
10.129		
10.130		
10.150		

*30 Meter QRP CW Calling Frequency

Checking for SOLDER BRIDGES

The purpose of this direct bottom view of the traces and pads is to help you confirm quickly whether any nearby points are intentionally joined, in which case a flow of solder between them is OK. Circuit board layout Copyright 1996 by TEN-TEC, Inc. All Rights Reserved.



T-KIT Limited WARRANTY

Please read carefully BEFORE building your kit.

This Limited Warranty applies solely to KITS sold by TEN-TEC, Inc. under the trade name "T-KIT." The terms of this Warranty do not apply to other products of any kind manufactured by TEN-TEC, Inc., nor shall any other warranties published by TEN-TEC, Inc., or any TEN-TEC customer service policies for its manufactured products, be construed as applicable to T-KIT products.

1. All components and hardware supplied as parts of a kit are warranted to be free from manufacturing defect for one year from date of purchase.
2. The original purchaser has the option of examining the kit and manual for 30 days. If you choose within this period not to construct the kit, you may return the entire unassembled kit at your own expense for full credit toward any other TEN-TEC product, or a refund, less original shipping/handling charges.
3. This warranty is voided if acid-core solder is used in construction. USE ROSIN-CORE SOLDER ONLY, of a grade designed for electronic PC-board assembly. WARNING: solder contain LEAD, which is known to cause birth defects or other reproductive harm. Avoid breathing solder fumes, which may cause pulmonary irritation or damage. After handling any solder, wash hands with soap and water before eating.
4. TEN-TEC, Inc. warrants this device to function as described in its documentation provided that it is assembled and used correctly in accord with all printed directions. It is your responsibility to follow all directions in the instruction manual, to identify components correctly and to use good workmanship and proper tools in constructing this kit.
5. We do not accept the return of partially-assembled kits for repair or refund.
6. If you believe a kit part is missing, do a thorough sorting of all parts, checking each off on the parts list in the manual. Check all bags, envelopes or boxes carefully. Simply call, fax, or write, and we will promptly replace any missing part. Even if you find an exact replacement part locally, please notify us so we may assist other customers.
7. If your kit does not work after final assembly, please follow these three steps in order:
 - A. Double-check EVERY step in the assembly manual and any troubleshooting tips provided.
 - B. Ask an experienced ham or hobbyist friend to review your work. A fresh set of eyes can catch a detail which you may have overlooked.
 - C. If necessary, you are welcome to ask for T-KIT Technical Assistance at 423-453-7172. (Technical Assistance for T-KITS is available ONLY through THIS number.)
8. **Factory Inspection or Service.** If you wish to return a kit for professional inspection or repair, there is a minimum charge of \$20.00, payable by cash, check, money order or credit card charge authorization. There is no need to call or write for authorization; simply send your kit with a note explaining the problem, and provide authorization to make repairs at prevailing hourly shop rates. To minimize extra cost to you we reserve the right simply to send you replacement parts with notes on how to solve your problem. If we find that a part was defective in manufacture, there will be NO CHARGE to repair your kit unit. Our technicians will make the determination whether a part was defective in manufacture or was damaged during installation.
9. TEN-TEC, Inc. reserves the right to revise this Limited Warranty, to change or discontinue any kit product or revise its instruction manual with no liability to previous purchasers. However, if you complete any Kit Registration form which may be supplied with a kit, you will receive periodic technical news from us, including tips, special offers on upgrades. Individual kit manuals may contain Warranty extensions or limitations for that specific kit product.
10. TEN-TEC, Inc., is not liable for any consequences from use or abuse of any T-KIT or part contained therein.

T-KIT BY TEN-TEC

A division of TEN-TEC, Inc. • 1185 Dolly Parton Parkway • Sevierville, Tennessee 37862

RESISTOR Ω REFRESHER

Multiply both digits of first 2 bands by 3rd Band:

black	0	0	X 1
brown	1	1	X 10
red	2	2	X 100
orange	3	3	X 1000
yellow	4	4	X 10,000
green	5	5	X 100,000
blue	6	6	X 1,000,000
violet	7	7	
gray	8	8	
white	9	9	
gold	--	--	X 0.1

✓ Examples . . .

red-red-gold = 2.2 Ω
red-red-black = 22 Ω
red-red-brown = 220 Ω
red-red-red = 2200 Ω (2.2K)
red-red-orange = 22K
4th Band = mfr's tolerance.
Gold = 5% Silver = 10%

Some Ham Band ★ Highlights ★

✓ WARC Bands

10.100 - 10.150
18.068 - 18.168
24.890 - 24.990

✓ National Calling Frequencies (Simplex):

29.600 FM
50.110 SSB DX
50.200 USA SSB
51.700 Packet
52.525 FM
144.20 SSB
146.52 FM
222.10 CW-SSB
223.50 FM
432.10 CW
446.00 FM

✓ Easy QRP CW

7.040
10.106
14.060

✓ Easy Space to Earth

29.357 RS-10 Series
Satellite CW beacon
145.55 FM SAREX & MIR
space-earth downlinks

MOLDED μ H INDUCTORS

look very much like resistors, but don't "resist" much -- just check them out on your meter to read less than 1-2 Ω , much lower than resistors in your kit. Values are in μ H (microhenries), to 1000 μ H per resistor code, with 3rd silver band = X .01.

✓ Examples:

red-red-silver (22X.01) = 0.22 μ H
red-red-gold (X 0.1) = 2.2 μ H
red-red-black (X 1) = 22 μ H
red-red-brown (X 10) = 220 μ H
brown-black-red = 1000 μ H

ALL ABOUT THOSE Disc Cap Numbers!

101 = 100 pF
102 = .001 μ F
103 = .01 μ F
104 = .1 μ F

✓ Want more?

221 = 220 pF
222 = .0022 μ F
223 = .022 μ F
331 = 330 pF
332 = .0033 μ F
471 = 470 pF
472 = .0047 μ F
473 = .047 μ F
474 = ?

Cot the idea ?!?

FOR SURE!

We ALL know this . . .

$E \text{ volts} = I \text{ amps} \times R \text{ ohms}$

$R = E / I$

$I = E / R$

$P \text{ watts} = E \times I$

They used to make BULLETS

by dropping melted lead way down into cold water. That's how some folks make excellent cold solder joints . . . by melting solder with the iron so it blobs onto the board, looking like deformed buckshot.

PLEASE . . .

heat the connection itself so **IT** does all the melting, forming a shiny cone, not a dirty blob!

A super SOLDER BRIDGE

is built with that extra solder clinging to the iron's tip that we didn't need anyway. Just jiggle the soldering iron, and we can build nifty bridges across 2, 3, 4 or more PC-board soldering points, especially DIP IC's or sockets. **Don't try it: you'll hate it!**

MAKE your Antennas!

$1/4 \text{ Wavelength (in FEET)}$
= $234 \div \text{FREQ in MHz}$
*use 238 for radials

* FOR VHF, you can use 2808
to get $1/4 \lambda$ in INCHES !!!

ROKIT

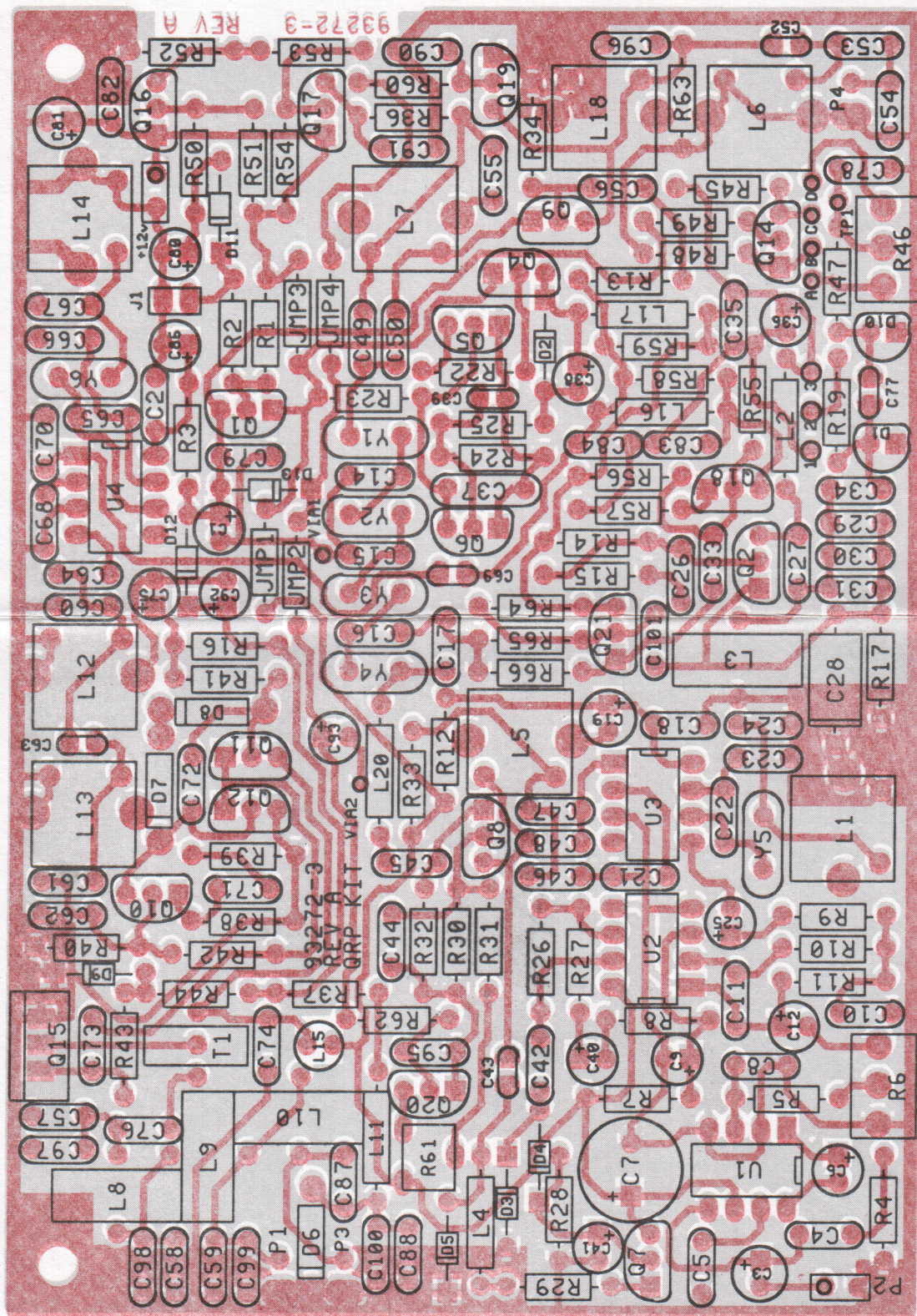
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T-KIT QRP CW Transceiver Circuit Board X-Ray View



Solder-side pads and traces



Component Side Groundplane

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T-KIT ORP CW Transceiver
Models 1320, 1330, 1340, 1380
Mechanical Assembly Details

