Elecraft XV Series Transverters

Models XV50, XV144, XV222

Rev C, February 16, 2005

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Introduction

The Elecraft XV Series high-performance transverters may be used with any transceiver or transmitter/receiver pair that covers 28 MHz. Separate transverters are offered for the following bands:

- Model XV50: 50 to 52 MHz.
- Model XV144: 144 to 146 MHz.
- Model XV222: 222 to 224 MHz

I.F. connections to the transceiver can be either single-port (single RF cable) or dual port (separate receive and transmit cables).

The transverters include an adjustable input level control that will provide full output from I.F. power levels from as low as 0.01 watts up to 8 watts continuous. Full protection against accidental high-power transmit of up to 100 watts into the I.F. port is also included.

The receiver features a very low noise figure with a PHEMT RF stage for weak-signal work. Relays are used for transmit/receive switching to avoid receive performance degradation by diode switches in the signal path.

The transmitter is conservatively rated at 20 watts output PEP SSB, CW or data modes. The RF output is displayed on the front panel with a 10-segment LED bargraph. The LED display may be switched between dot or bar modes and has two brightness levels when used with an Elecraft K2 transceiver.

The transverters are housed in attractive, low-profile enclosures that may be stacked for multi-band operation. An illuminated band label identifies the transverter in use. Several transverters may be connected to the transceiver in most cases. Internal relays select only the transverter for the band in use, avoiding the need to switch I.F. cables.

Using an Elecraft K2 as the I.F. Transceiver

While the transverters will work with nearly any HF transceiver, using them with our Elecraft K2 (or K2/100) offers additional benefits. The high-performance K2 provides:

- Low noise, single-conversion, wide dynamic range receiver
- Four adjustable I.F. crystal filter bandwidths per mode
- Automatic transverter band switching with individual menu-selected output power levels for up to three transverters.
- Direct display of the transverter operating frequency to 10 Hz, including per-band adjustable offsets of +/- 9.99 kHz
- Four RIT ranges from +/- 0.6 to +/- 4.8 kHz

We recommend that K2's with serial numbers 3445 and below be equipped with Elecraft-approved modifications that reduce spurious responses and enhance frequency stability. See *Special Notes for Elecraft K2 Owners*, page 64.

Figure 1. Three Transverters May Be Controlled by an Elecraft K2.

Transverter Kits

The XV Transverters are intermediate-to-advanced kits, yet you'll be surprised at how uncomplicated they are to build. All of the radio frequency (RF) circuits are on one printed circuit board (PCB). A second smaller PCB holds the microcontroller and front-panel LEDs. High-quality, double-sided PCBs are used, with plated-through holes for optimal RF performance. Point-to-point wiring is minimal. All components to be installed have wire leads; the few surface-mount devices required are pre-installed on the circuit board.

This kit uses just one toroidal inductor, which is easy to wind. However, if you prefer not to wind this inductor yourself, you can order one pre-wound with the leads tinned and ready to install from an Elecraft-qualified source. Ordering information is on our web site at www.elecraft.com.

Customer Service and Support

Whether you build the kit or buy a factory-built transverter, you'll find a wealth of information on our web site at www.elecraft.com. Among the materials there you'll find the latest application notes, photographs, any updates to this manual, and information on new products. We also have a popular e-mail forum, for which you can sign up from the web site. It's a great way to interact with other Elecraft owners, exchange ideas and find answers to many questions.

You can also get assistance by telephone or by sending an e-mail to support@elecraft.com. E-mail is preferable because it gives us a written record of your question. Telephone assistance is available from 9 A.M. to 5 P.M. Pacific time, Monday through Friday (except US Holidays) at 831-662-8345.

Repair Service

Contact Elecraft before returning your equipment to obtain the current information on repair fees.

To ship the unit, first seal it in a plastic bag to protect the finish. Use a sturdy packing carton with at least 3-in (8 cm) of foam or shredded paper on all sides. Seal the package with reinforced tape. (Neither Elecraft or the carrier will accept liability for damage due to improper packaging.) Ship the equipment to:

Elecraft
P.O. Box 69
Aptos, CA 95001-0069

Elecraft 1-Year Limited Warranty

If building a kit, complete the assembly, carefully following all instructions in the manual, before requesting warranty service.

What is covered: During the first year after the date of first consumer purchase, Elecraft will replace defective parts free of charge (post-paid). We will also correct any malfunction caused by defective parts and materials. You must send the unit at your expense to Elecraft. We will pay return shipping.

What is not covered: This warranty does not cover correction of assembly errors or misalignment; repair of damage caused by misuse, negligence or builder modifications; or any performance malfunctions involving non-Elecraft accessory equipment. **The use of acid-core solder or any corrosive or conductive flux or solvent will void this warranty in its entirety.** Also not covered is any reimbursement for loss of use, inconvenience, customer assembly or alignment time, or cost of unauthorized service.

Limitation of incidental or consequential damages: This warranty does not extend to non-Elecraft equipment or components used in conjunction with our products. Any such repair or replacement is the responsibility of the customer. Elecraft will not be liable for any special, indirect, incidental or consequential damages, including but not limited to any loss of businesses or profits.

Specifications

Numeric values are typical; your results will be somewhat different. Also, specifications may be affected by the options or accessories chosen. See **www.elecraft.com** for details about options and accessories currently available. Specifications are subject to change without notice.

General

Size

Cabinet:	1.3” H x 7.8” W x 8.3” D (3.3 x 19.8 x 21 cm)
Overall:	1.5 H x 7.8 W x 9.5 D incl. feet and connectors. (3.8 x 19.8 x 21 cm)

Weight: 2.5 lbs (1.1 kg)

Supply Voltage: 13.8 VDC

Current Drain:

Receive:	250 mA (typical)
Transmit[1]:	4 A (typical)

Frequency Ranges:

XV50:	50 – 52 MHz
XV144:	144 – 146 MHz
XV222:	222 – 224 MHz

T/R Switching Time: 3 ms (typical)

T/R Key Input: Ground for transmit: must pull 5 volt logic level to within 0.5 volts of ground at < 1 ma.

I.F. Overload Protection: Survives 100 watts RF input at the I.F. Port without damage with transverter un-keyed (in receive mode).

Amplifier Key Output: Ground on transmit: 200 VDC at 1 A maximum.

Connectors:

K2 Interface:	DB9
Keying Line Input:	RCA
Keying Line Output:	RCA
I.F. In/Out:	BNC
Aux (Rx-Only Ant):	BNC
Antenna:	SO-239 (UHF) on XVR 50 Type N on XVR 144 & XVR 222

Transmitter

Power Output:	20 watts into 50 ohms
Minimum Supply Voltage Recommended:	12 VDC
Operating Modes:	CW, SSB, AM, FM, PSK
I.F. Input Frequency Range:	28 – 30 MHz
I.F. Input Power Range:	0.01 mW (-20 dBm) to 8 watts (+ 39 dBm)
Harmonic Content:	< - 60 dBc at 20 watts output.

Receiver

Noise Figure:	< 1 dB
Conversion Gain:	25 dB (typical)
Image Rejection:	> 60 dB
3rd-Order Intercept:	+20 dBm (typical)

[1] Current varies with supply voltage, load impedance and power output. We recommend a minimum 5 A supply.

Preparing for Assembly

Overview of the Kit

The Elecraft XV transverters use modular construction, both physically and electrically. This concept extends to the chassis (Figure 2). Any chassis element can be removed to provide access for troubleshooting.

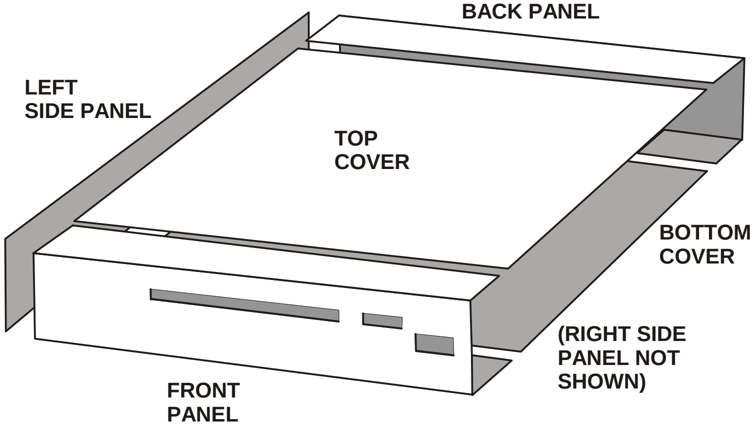


Figure 2. XV Transverter Modular Cabinet Parts.

There are two printed circuit boards (PCBs) in the transverter: the front panel board, which sits vertically behind the front panel, and the large RF board.

The boards are interconnected using board-to-board connectors which eliminates the need for a wiring harness. Gold-plated contacts are used on these connectors for reliability.

Tools Required

You will need the following tools to build this kit:

- Fine-tip temperature-controlled soldering station with 700 or 800°F tip (370-430°C). Do not use a high-wattage iron or gun with small components since this can damage pads, traces, or the parts themselves.
- IC-grade, small-diameter (.031”) solder (Kester #44 or equivalent).
- Desoldering tools and supplies are invaluable if you make any modifications or need to do any repairs. Narrow solder wick or a good vacuum desoldering tool such as the Soldapullt® model DS017LS are recommended. See *Soldering, Desoldering and Plated-Through Holes,* on page 9 for more information.

  DO NOT use acid-core solder, water-soluble flux solder, additional flux or solvents of any kind. Use of any of these will void your warranty.

- Screwdrivers: a small, #2 Phillips and a small flat-blade for slotted screws.
- Needle-nose pliers.
- Small-point diagonal cutters, preferably flush-cutting.
- Digital Multimeter (DMM) for voltage checks and confirming resistor values. A DMM with capacitance measurement capability is desirable, but not required.
- Noise generator (Elecraft N-Gen or equivalent[2]) or signal generator with output in the RF frequency range of the transverter.
- RF power meter capable of measuring RF power levels up to 25 watts at the RF frequency used by the transverter.
- 50-ohm dummy load capable of handling 25 watts, minimum.

Refer to www.elecraft.com for tool sources and solder recommendations.

[2] Check www.elecraft.com for availability.

Preventing Electro-Static Discharge Damage

Your XV transverter uses integrated circuits and transistors that can be damaged by electrostatic-static discharge (ESD). Problems caused by ESD often can be difficult to troubleshoot because components may be degraded but still operating at first rather than fail completely.

To avoid such problems, simply touch an unpainted, grounded metal surface before handling any such components and occasionally as you build, especially after moving about.

For maximum protection, we recommend you take the following anti-static precautions (listed in order of importance):

1. Leave ESD-sensitive parts in their anti-static packaging until you install them. The packaging may be a special container or conductive foam (Figure 3). Parts which are especially ESD-sensitive are identified in the parts list.
2. Ground yourself briefly before touching any sensitive parts or wear a conductive wrist strap with a series 1 megohm resistor. **DO NOT ground yourself directly as this poses a serious shock hazard.**
3. Make sure your soldering iron has a grounded tip.
4. Use an anti-static mat on your work bench.

Figure 3. A common anti-static packaging is conductive foam which keeps all of the terminals of a device at the same potential.

Unpacking and Inventory

We strongly recommend that you do an inventory of the parts before beginning to assemble the kit. Even if you don't count all the parts, an inventory is helpful to familiarize yourself with them. A complete parts list is included in the next section.

Identifying Parts

The parts list contains illustrations of the parts to help you identify them. Identifying marks on the individual parts are shown in the text in parenthesis. For example, "Transistor Q4 (PN2222)…" indicates a transistor, Q4, which may be located in the parts list that has the characters shown in parenthesis printed on it. Sometimes these letters are not obvious. They may be printed in light gray on a black body, for example. Also, there may be other marks on the device in addition to the letters listed.

Identifying Resistors

Resistors are identified by their power capacity and their resistance value. The power rating in watts determines the physical size of a resistor. The most common resistors are 1/4 watt. Higher wattage resistors are proportionately larger. The resistance value and wattage of each resistor is shown in the Parts Lists and in the individual steps of the assembly procedures. The silk screened outlines on the circuit boards indicate the relative physical size of the resistors as well.

Most resistors use a color code. The color bands are listed in the text along with the values of each resistor. For example, "R4, 100k (brn-blk-yel)…" indicates a 100k ohm resistor and the colors to look for are brown, black and yellow, starting with the band nearest the end of the resistor.

Some resistors use numbers instead of color bands. For example, an 820 ohm resistor might be stamped with the digits 821 instead of having gray, red and brown color bands. Some larger resistors have their value in ohms stamped on the body using numbers. For, example the 820 ohm resistor would be stamped with 820 instead of 821 as described above. Normally, when the value is shown in ohms it will be followed with the word "ohms" or the Greek letter omega: Ω

Reading Resistor Color Codes

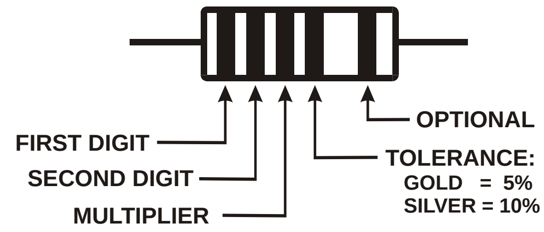
It is very helpful if you learn to read the color codes. A color-code chart showing how to read the four-color bands on resistors with a 5% or 10% tolerance is shown in Figure 4. 1% resistors are similar except that they use a fifth band to provide a way of showing another significant digit. For example, a 1,500 ohm (1.5 k-ohm) 5% resistor has the color bands brown, green and red signifying one, five and two zeros. A 1,500 ohm (1.5 k-ohm) 1% tolerance resistor has the color bands brown, green, black and brown signifying one, five, zero, and one zero.

The optional band shown in Figure 4 indicates other performance specifications for the resistor. When used, it is separated from the other color bands by a wider space.

If in doubt of a resistor's value, use a DMM. It may be difficult to see the colors on some resistors, particularly 1% tolerance resistors with a dark blue body. Do NOT be concerned with minor deviations of your DMM reading from the expected value. Typical errors in most DMMs and the tolerances of the resistors normally produce readings that are slightly different from the value indicated by the color bands.

Identifying Molded Inductors

Small molded inductors have color bands that use the same numeric values as resistors but they start near the center of the inductor and work toward the end. These colors are listed in the text after the value of the inductor, for example: 27µH (red-vio-blk). The red stripe would be near the center of the inductor and the black strip would be closer to the end. On very small chokes, the first color will be only slightly farther from one end than the last color. There may be a variety of other stripes on inductors as well, indicating their tolerance, conformance to certain specifications and other data.



COLOR	DIGIT	MULTIPLIER
Black	0	X 1
Brown	1	X 10
Red	2	X 100
Orange	3	X 10K
Yellow	4	X 10K
Green	5	X 100K
Blue	6	X 1M
Violet	7	-
Gray	8	-
White	9	-
Silver	-	X 0.01
Gold	-	X 0.1

Figure 4. Resistor Color Code.

Identifying Capacitors

Capacitors are identified by their value and the spacing of their leads.

Small-value fixed capacitors usually are marked with one, two or three digits and no decimal point. The significant digits are shown in parenthesis in the text. For example: “C2, .01 (103)”.

If one or two digits are used, that is always the value in picofarads (pF). If there are three digits, the third digit is the multiplier. For example, a capacitor marked “151” would be 150 pF (15 multiplied by 10^1). Similarly, “330” is 33 pF and “102” is 1000 pF (or .001 μF). You may think of the multiplier value as the number of zeros you need to add on to the end of the value.

Note: In rare cases, a capacitor manufacturer may use “0” as a decimal placeholder. For example, “820” might mean 820 pF rather than 82 pF. Such exceptions are usually covered in the parts lists. If possible, measure the values of all capacitor below .001 μF. Most DMMs include capacitance measurement capability.

Fixed capacitors with values of 1000 pF or higher generally use a decimal point in the value, such as .001 or .002. This is the value in microfarads (μF). Capacitors also may have a suffix after the value, such as “.001J”.

The lead spacing is noted in the Parts Lists for most capacitors. If two different types of capacitors have the same value, the lead spacing will indicate which one to use. When the lead spacing is important, both the value and the lead spacing is shown in the assembly procedure. For example, “LS 0.1” means that the Lead Spacing is 0.1 in.

Hard-to-Identify Capacitor Values

2.2 pF: These are “disc ceramic” capacitors with round, pillow-shaped bodies about 1/8” (3 mm) in diameter and a black mark on the top. The capacitor should be labeled “2.2” but the marking sometimes requires a magnifying glass to see clearly.

150 pF: These capacitors are marked “151” on one side, but the other side may be marked #21ASD. The “#21” may look like “821”.

Assembly Process

There are seven steps in the transverter assembly process:

1. Front Panel board assembly.
2. RF Board Assembly, Part I, parts common to all models.
3. RF Board Assembly, Part II, band-specific parts.
4. RF Board Assembly, Part III, installing the RF Power Module.
5. Final Assembly.
6. Interconnect cabling.
7. Test and alignment.

Follow the assembly process in the order given. Each part builds on what has been completed before it. For example, the Front Panel assembly procedure contains details about installing certain parts that are not repeated when similar parts are installed later.

Forming Component Leads

Sometimes the space provided for a component on the PC board is larger than the distance between the leads on the part itself. In such cases, you'll need to carefully bend the leads out and then down to fit the given space. Always use long-nose pliers to accomplish this task, and *bend* the leads – don't tug on them. This is especially important with capacitor leads, which are fragile.

Step-By-Step Procedures

Perform the assembly steps in each procedure in the order given, and do not skip any steps. Otherwise you may find that you've installed one component that hinders the installation of another. When groups of components are installed, they are listed in a logical order as you work around the circuit board to reduce the time needed to find where each part goes.

☑ Each step in the assembly procedures has a check box.

Some steps have more than one task. For example, you may be installing a number of components listed. When a step has a number of tasks, each task is indented with space for a check mark:

✓ Check off each task as you complete it.

Soldering, Desoldering and Plated-Through Holes

CAUTION: Solder contains lead, and its residue can be toxic. Always wash your hands after handling solder.

The printed circuit boards have circuitry on both sides ("double-sided"). Boards of this type require *plated-through holes* to complete the electrical connections between the two sides.

When you solder components on these boards the solder fills the plated holes making excellent contact. This means that you do not need to leave a large "fillet" or build-up of solder on top of the pads themselves. *A small amount of solder will do for all connections.*

Unfortunately, removing components from double-sided PC boards can be difficult. To remove a multi-pin component you'll need to get all of the solder out of every hole to free the leads. You will need to use solder wick or a vacuum desoldering tool (see *Techniques* below).

The best strategy for avoiding de-soldering is to place all components properly the first time. Double-check values, component placement and orientation. Take care to avoid ESD damage to components.

Techniques

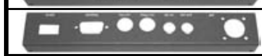
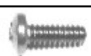
- Don't pull a lead or pin out of a hole unless the solder has been removed completely, or you are applying heat. Otherwise you can literally pull the plating out of the plated-through hole.
- Limit soldering iron contact to a few seconds at a time.
- Use small-size solder wick, about 0.1" (2.5 mm) wide. Use wick on both the top and bottom solder pads when possible. This helps get all of the solder out of the hole.
- Buy and learn to use a large hand-operated vacuum desoldering tool such as the Soldapullt® model DS017LS. Small solder suckers are not effective.
- When removing ICs and connectors, clip all of the pins at the body first, then remove each pin *one at a time*, working slowly. You may damage pads and traces by trying to remove a component intact, possibly leaving a PC board very difficult to repair.
- Invest in a PC board vise with a heavy base if possible. This makes removing parts easier because it frees up both hands.
- If in doubt about a particular repair, ask for advice from Elecraft or someone with PCB repair experience. Our e-mail reflector is an excellent source of help.

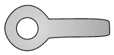
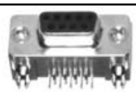
Parts Inventory

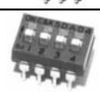
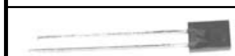
You should do a complete inventory. Contact Elecraft if you find anything missing.

Leave painted panels wrapped until they are needed during assembly. This will protect the finish.

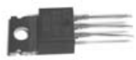
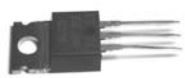
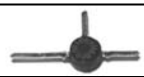
☐ **Cabinet and RF circuit board components used in all transverters.**

Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Printed Circuit Board, XV, 50,144,222 **Handle with care – ESD Sensitive.** This board is supplied with several surface mount components pre-installed. Some of these components are static-sensitive and are vulnerable until the other parts are installed on the board. There is a temporary jumper across the solder pads for L1 on the board to prevent static damage to Q3. **Do not remove this jumper until instructed to do so**.	E100169
		1	Front Panel	E100153
		1	Rear Panel	E100154
See Figure 2.		2	Side Panel	E100140
		1	Top Cover	E100146
		1	Bottom Cover	E100155
		1	Heat Spreader	E100156
		8	2D Connector	E100078
		2	Right Angle Bracket	E700073
		40	Pan Head Black Machine Screw, 3/16 inch. 4-40.	E700015
		5	Pan Head Zinc Machine Screw, 5/16 inch, 4-40	E700077
		2	Pan Head Black Machine Screw, 1/2 inch, 4-40	E700030

Picture	Ref. Designator(s)	QTY	Description	Part #
		10	Machine Screw Nut, 4--40	E700011
		14	Split Lock washer, #4 (Includes two spares)	E700004
		8	Internal Tooth Lock washer, #4	E700010
		2	Flat Washer, #4	E700044
		1	Ground Lug	E700062
		2	M-F Standoff for DB9 Connector	E700078
		4	Rubber Foot, Self Adhesive **A Bail kit is available as an optional accessory if desired.** The Bail will hold the front of the transverter up at a convenient viewing angle. See www.elecraft.com for details	E980067
		2	RCA Jack	E620057
		3	BNC Connector assy. with nut and lock washer, PC Mount	E620020
		3	Nut for BNC Connector	E700059
		3	Lock washer for BNC Connector	E700058
		1	DB9 Female Connector, PC Mount	E620058
		1	DB9 Male Cable Connector	E620049
		1	DB9 Back Shell (Shell components are normally packaged together in a transparent bag).	E620050
		4	Anderson Crimp Terminal	E620062

Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Anderson Roll Pin	E700071
		2	Anderson Power Pole, Shell, Red	E620059
		2	Anderson Power Pole, Shell, Black	E620060
	P1	1	Header Connector, 12 Pin , Right Angle	E620065
	JP5,JP6, JP9	3	Header Connector, 2 Pin	E620054
	JP1,JP2,JP3,JP4, JP5, JP6, JP9[3]	7	Header Connector, 3 Pin	E620007
		9	Header Shorting Block, 2 Pin	E620055
	S2	1	DPDT Power switch	E640006
	SW1	1	4 Pole DIP switch	E640014
		1	Key Cap, Black	E980023
	F1	1	Resettable Fuse, 5A PolySwitch (Thin, about 3/8" [9.5mm] square.)	E980065
	K1, K2, K4, K5, K6, K7, K8, K9	8	Relay, Small (G6E-134P)	E640011
	K3	1	Relay, SPDT, 12 A, 12 VDC, Large (KLT1C12DC12).	E640012
	D3	1	Diode, Zener, 6.8 volt, 1N5235B	E560011
	D5	1	Diode, SB530	E560003
	D10, D11	2	Diode, LED, Red	E570007

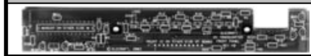
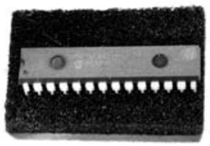
[3] JP9 comprises a three pin and a two pin header connector.

Picture	Ref. Designator(s)	QTY	Description	Part #
Pre-mounted on the PCB	Z1	1	Frequency Mixer, ADEX-10H	E600050
	U1	1	MMIC Amplifier, ERA-6	E600051
	U5	1	MMIC Amplifier, MAR-3	E600073
	U2	1	Voltage Regulator, 9 volt, LM78L09	E600054
	Q6	1	Transistor, NPN, PN2222A	E580001
	U4	1	Voltage Regulator, 5 volt, LM7805	E600024
	Q5	1	Transistor, MOSFET, 2N7000 **Handle with care – ESD Sensitive. Do not remove it from its ESD-protective packaging until you are instructed to install it.**	E580002
	Q4	1	Transistor, HEXFET, IRL620	E580018
Pre-mounted on the PCB	Q3	1	Transistor, PHEMT, ATF 34143	E580020
	Q2	1	Transistor, NPN , BFR96	E580021
	R21	1	Resistor, metal oxide, 1 watt, 5%, 820 ohm (821)	E500094
	R20, R26, R27	3	Resistor, metal oxide, 3 watt, 5%,160 ohm (160)	E500095
	R10	1	Trimmer Potentiometer, PC mount, 100K (104)	E520001
	R13, R22	2	Trimmer Potentiometer, PC mount, 100 ohm (101)	E520008
	D1, D2, D4, D13, D6, D12, D9, D14, D15, D16	10	Diode, 1N4148	E560002
	D7, D8	2	Diode, 1N5711	E560004

Picture	Ref. Designator(s)	QTY	Description	Part #
	R25	1	Resistor , 1/4 watt, 5%, 56 ohm (grn-blu-blk)	E500096
	R14	1	Resistor , 1/4 watt, 5%, 4.7 ohm (yel-vio-gld)	E500062
	R1, R7, R9, R33	4	Resistor , 1/4 watt, 5% , 10K ohm (brn-blk-org)	E500015
	R11	1	Resistor, 1/4 watt, 5%, 1K ohm (brn-blk-red)	E500013
	R18	1	Resistor, 1/4 watt, 5%, 620 ohm (blu-red-brn)	E500097
	R4, R5	2	Resistor, 1/4 watt, 5%, 5.6K ohm (grn-blu-red)	E500007
	R23, R34	2	Resistor, 1/4 watt, 5%, 100K ohm (brn-blk-yel)	E500006
	R40	1	Resistor, 1/4 watt, 5%, 22k ohm (red-red-org)	E500090
	R31	1	Resistor , Metal Film, 1/4 watt, 1%, 15.0K ohm (brn-grn-blk-red)	E500112
	R32	1	Resistor, Metal Film, 1/4 watt, 1%, 3.92K ohm (org-wht-red-brn)	E500110
	R30	1	Resistor, Metal Film, 1/4 watt, 1%, 7.50K ohm (vio-grn-blk-brn)	E500111
	R35	1	Resistor, Metal Film, 1/4 watt, 1%, 5.11K ohm (grn-brn-brn-brn)	E500109
	R16, R8	2	Resistor , 1 watt , 5%,120 ohm (brn-red-brn)	E500105
	R12, R19	2	Resistor, 1 watt, 5%, 180 ohm (brn-gry-brn)	E500113
Pre-mounted on the PCB	R15	1	Resistor 56 ohm SMD, 1206 size	E500099
	R17	1	Resistor, .02 ohm SMD, 2512 size	E500100
	C2,C57	2	Ceramic Capacitor, 100 pF (101)	E530117
	C35	1	Ceramic Capacitor, 10 pF (100)	E530118
	C55,C56	2	Ceramic Capacitor, 270 pF (271)	E530050
	C52,C54	2	Ceramic Capacitor , 150 pF (151)	E530049
	C53	1	Ceramic Capacitor, 18 pF (180) or (18), LS 0.2	E530088
	C3, C17, C15, C7, C39	5	Ceramic Capacitor, .001µF (102), LS 0.1	E530129
Capacitors shown are typical. Different styles may be supplied.	C8, C9, C10, C27, C16, C19, C23, C20, C34, C38, C37, C36, C63, C22, C40, C6, C61, C62, C64, C67, C71	21	Ceramic Capacitor, .01µF (103), LS 0.1	E530130
	C65, C68, C29	3	Ceramic Capacitor, .047 µF (473), LS 0.1	E530131
	C30	1	Ceramic Capacitor, .22 µF (224), LS 0.1	E530132
	C18	1	Ceramic Capacitor, 2.2 pF (2.2), LS 0.1	E530047
Pre-mounted on the PCB	C70	1	Ceramic SMD Capacitor, 27 pF	E530121
	C72	1	Ceramic SMD Capacitor, 4.7 pF	E530125
	C25, C21, C24, C41, C32 C66, C31, C4, C84, C85	10	Ceramic SMD Capacitor, .047 µF, 50 V	E530120

Picture	Ref. Designator(s)	QTY	Description	Part #
	C26, C60	2	Electrolytic Capacitor, 22 µF, 25 volt	E530012
	L9	1	Molded Inductor, .47 µH (yel-vio-silver)	E690020
	L8	1	Molded Inductor, 15 µH (brn-grn-blk)	E690012
	L15,L16,L17	3	Variable Inductor, .243-.297 µH, shielded, grey plastic insert.	E690025
	L7	2	Ferrite Bead	E980029
	T1	1	Toroid Core, FT37-43	E680003
		12 in. (30 cm)	Solid Insulated Wire, #24	E760005
		12 in. (30 cm)	Red magnet wire, , #26	E760002
		12 in. (30 cm)	Green magnet wire, #26	E760004
		3 in. (7.5 cm)	Bare copper wire, , #14	E760023
		5 ft. (1.5 m)	Red/Black 2-conductor wire, #12 stranded (for DC power wiring)	E760017
		3 ft. (91 cm)	4-conductor shielded cable (serial I/O cable)	E760009
		1	Heat sink gasket, large	E100170
		1	Heat sink gasket, small	E100171
		1	5” Hex Tuning Tool	E980068

☐ **Front panel circuit board components.**

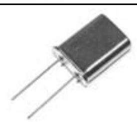
Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Printed Circuit Board	E100168
		2	Screw, Fillister Head, 1/8 inch, 2-56	E700023
	U1	1	Microcontroller PIC16F872, Programmed (packaged in foam) **Handle with care – ESD Sensitive. Do not remove it from its conductive foam until you are instructed to install it.**	E610014
		1	IC Socket, 28 pin (packaged in foam)	E620011
	J1	1	Header Socket, 12 Pin	E620008
	D1, D2	2	Rectangular LED, Red	E570007
	D3	1	Rectangular LED, Yellow	E570009
	D4, D5, D6, D7, D8, D9, D10,	7	Rectangular LED, Green	E570008
	R6, R7, R8, R9, R10, R11, R12, R13,R14, R15, R16, R21, R22, R23	14	Resistor, Metal Film, 1/4 watt 120 ohm (brn-red-brn)	E500022
	R1	1	Resistor, Metal Film 1/4 watt, 5%, 220 ohm (red-red-brn)	E500002
	R2	1	Resistor, Metal Film 1/4 watt, 5%, 470 ohm (yel-vio-brn)	E500003
	R3	1	Resistor, Metal Film 1/4 watt, 5%, 10K ohm (brn-blk-orn)	E500015
	R4, R17	2	Resistor, Metal Film 1/4 watt, 5%, 100K ohm (brn-blk-yel)	E500006
	R25	1	Resistor, Metal Film 1/4 watt, 5%, 270K ohm (red-vio-yel)	E500101
	R18, R19, R20,R24	4	Resistor, Metal Film 1/4 watt, 5%, 2.2K ohm (red-red-red)	E500104
	R5	1	Resistor, Metal Film 1/4 watt, 5%, 1 megohm (brn-blk-grn)	E500024
	C4	1	Capacitor, Monolithic, .001 μF, (102), LS 0.1	E530129
	C2, C3	2	Capacitor, Monolithic, .01 μF, (103), LS 0.1	E530130
	C1	1	Capacitor, Monolithic, .047 μF (473), LS 0.1	E530131
	D11	1	LED Light Bar, Yellow (packaged in foam)	E570011

Picture	Ref. Designator(s)	QTY	Description	Part #
	Q1,Q2,Q3,Q4,Q5,Q6	6	Transistor, NPN, PN2222	E580001
	Z1	1	Ceramic Resonator, 4 MHz	E660001
	JP1	1	Header Connector, 2 pin	E620054
		1	Header Shorting block, 2 pin	E620055

The remainder of the parts in your kit depend upon the band of operation. Check only the list that corresponds to your transverter.

☐ **XV50:** The following parts are included only in the XV50 transverter.

Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Front Panel Label, XV50	E980059
Pre-mounted on the PCB	U6	1	SGA7489, Sirenza Gain Block Amplifier (Three-lead device with tab. Two leads and tab are soldered to the board. Center lead is not connected)	E600055
	U3	1	Voltage Regulator, 9-volt, LM78L09	E600054
	Q1	1	Transistor, NPN, MPS918	E580022
	U7	1	RF Power Module, M57735	E600056
	J1	1	SO-239 Chassis Mount Connector	E620064
	R24	1	Resistor, Metal Oxide, 2 watt, 5%, 56 ohm (56J)	E500102
	Z4	1	Resistor, 1/4 watt, 5%, 56 ohm (grn-blu-blk)	E500096
	R6	1	Resistor, 1/4 watt, 5%, 330 ohm (org-org-brn)	E500103
	C69	1	Ceramic Capacitor, LS 0.1, 10 pF (100)	E530118
	C14, C58, C59	3	Ceramic Capacitor, LS 0.1, 390 pF (391)	E530051
	C12	1	Ceramic Capacitor LS 0.1, 100 pF (101)	E530117
Pre-Mounted on the PCB.	C42,C43	2	Ceramic Capacitor, SMD, 50 V, 82 pF	E530133
	C44	1	Ceramic Capacitor, SMD, 50 V, 150 pF	E530134
	C5,C49,C50	3	Ceramic Capacitor, SMD, 50 V, 2.2 pF	E530123
	C48,C51	2	Ceramic Capacitor, SMD, 50 V, 10 pF	E530135
	C28	1	Ceramic Capacitor, SMD, 50 V, 15 pF	E520127
	C45,C47	2	Ceramic Capacitor, SMD, 50 V, 22 pF	E530136
	C46	1	Ceramic Capacitor, SMD, 50 V, 27 pF	E530121
	C1, C33	2	Ceramic Trimmer Cap, 5-30 pF	E540001

Picture	Ref. Designator(s)	QTY	Description	Part #
	Z3	1	Molded Inductor, .15 μH (brn-grn-silver)	E690022
	L2, L3	2	Molded Inductor, .22 μH (red-red-silver)	E690028
	L10,L11	2	Variable Inductor, .198-.240 μH, Blue	E690032
	L1	1	Variable Inductor, .333-.407 μH, Grey	E690033
	L12,L13,L14	3	Variable Inductor, .243-.297 μH, Shielded, Grey Plastic Insert.	E690025
	L3	2	Ferrite Bead	E980029
	Y1	1	Crystal, 22 MHz Fundamental (22.00)	E660004

XV144: The following parts are included only in the XV144 transverter.

Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Front Panel Label, XV144	E980060
Pre-mounted on the PCB	U6	1	Amplifier, MMIC, ERA-5 (Four-lead device with no tab. All four leads soldered to board)	E600052
	U3	1	Voltage Regulator, 5-volt, LM78L05	E600029
	Q1	1	Transistor, NPN, MPS918	E580022
	U7	1	RF Power Module, RA30H1317M	E600058
	R39	1	Pot, PC mount, 1K ohm (102)	E520010
	Z4, R29	2	Resistor, 1/4 watt, 56 ohm (grn-blu-blk)	E500096
	R24	1	Resistor, 1 watt, 120 ohm (brn-red-brn)	E500105
	R28	1	Resistor, 1/4 watt, 1K ohm (brn-blk-red)	E500013
	R6	1	Resistor, 1/4 watt, 470 ohm (yel-vio-brn)	E500003
	C14	1	Ceramic Capacitor, 0.1 LS, 33 pF (330)	E530116
	C12	1	Ceramic Capacitor, 0.1 LS, 10 pF (100)	E530118
	C13	1	Ceramic Capacitor, 0.1 LS, .047 µF (473)	E530131
Pre-mounted on the PCB	C42,C43	2	Ceramic Capacitor, SMD, 50 V , 27 pF	E530121
	C44	1	Ceramic Capacitor, SMD, 50 V , 47 pF	E530122
	C5	1	Ceramic Capacitor, SMD, 50 V, 2.2 pF	E530123
	C48,C51, C28	3	Ceramic Capacitor, SMD, 50 V, 4.7 pF	E530125
	C45,C47	2	Ceramic Capacitor, SMD, 50 V, 12 pF	E530126
	C46	1	Ceramic Capacitor, SMD, 50 V, 15 pF	E530127
	C49,C50	2	Ceramic Capacitor, SMD, 50 V, 1 pF	E530128
	C1	1	Ceramic Trimmer Capacitor, 4-15 pF (Has a blue dot for identification)	E540003

Picture	Ref. Designator(s)	QTY	Description	Part #
	L2, Z3	2	Molded Inductor, .1 µH (brn-blk-silver)	E690021
	L4	1	Molded Inductor, .15 µH (brn-grn-silver)	E690022
	L10,L11	2	Variable Inductor, .085-0.1µH, Orange	E690023
	L1	1	Variable Inductor, .108-.132 µH, Orange	E690024
	L12,L13,L14	3	Variable Inductor, .059-070 µH, Red Plastic Insert.	E690027
	Y1	1	Crystal, 116 MHz, 5th Overtone Series Resonant (116.000)	E660016
	J1	1	Type “N” Chassis Mount Female Connector	E620069
			Teflon Tubing	E980075

☐ **XV222:** The following parts are included only in the XV222 transverter.

Picture	Ref. Designator(s)	QTY	Description	Part #
		1	Front Panel Label, XV222	E980061
Pre-Mounted on the PCB	U6	1	SGA7489, Sirenza Gain Block Amplifier (Three-lead device with tab. Two leads and tab are soldered to the board. Center lead is not connected)	E600055
	U3	1	Voltage Regulator, 5-volt, LM78L05	E600029
	Q1	1	Transistor, NPN, MPS918	E580022
	U7	1	RF Power Module, RA30H2125M or RA30H2127M	E600057
	R28	1	Resistor, 1/4 watt, 5%, 1K ohm (brn-blk-red)	E500013
	R6	1	Resistor, 1/4 watt, 5%, 220 ohm (red-red-brn)	E500002
	R24	1	Resistor, 2 watt, 5%, 56 ohm (grn-blu-blk)	E500102
	R29, Z4	2	Resistor, 1/4 watt, 5%, 56 ohm (grn-blu-blk)	E500096
	C14	1	Ceramic Capacitor, LS 0.1, 22 pF (220)	E530139
	C12	1	Ceramic Capacitor, LS 0.1, 10 pF (100)	E530118
	C13	1	Ceramic Capacitor LS 0.1, .047 µF (473)	E530131
	R39	1	Trimmer Potentiometer, PC mount, 1K ohm (102)	E520010
Pre-mounted on the PCB	C42, C43, C44, C44A, C45, C47	6	Ceramic Capacitor, SMD, 50 V, 10 pF	E530135
	C5,	1	Ceramic Capacitor, SMD, 50 V, 2.2 pF	E530123
	C48,C51	2	Ceramic Capacitor, SMD, 50 V, 3.3 pF	E530124
	C46	1	Ceramic Capacitor, SMD, 50 V 12 pF	E530126
	C49, C50, C45A, C46A, C47A	5	Ceramic Capacitor, SMD, 50 V, 1 pF	E530128
	C28	1	Ceramic Capacitor, SMD, 50 V, 4.7 pF	E530125
	C1	1	Ceramic Trimmer Capacitor, 4-15 pF (Has a blue dot for identification)	E540003
	L2, Z3	2	Molded Inductor, .1 µH (brn-blk-silver)	E690021

Picture	Ref. Designator(s)	QTY	Description	Part #
	L10, L11, L4A, L19	4	Variable Inductor, .064-.080 µH, Red	E690029
	L1	1	Variable Inductor, .041-.044 µH, Brown	E690034
	L12, L13, L14	3	Variable Inductor, Shielded, .038-.040 µH, Brown Plastic Insert	E690031
	Y1	1	Crystal, 194 MHz 7th Overtone Series Resonant (194.000)	E660017
	J1	1	Type "N" Chassis Mount Female Connector	E620069
		1 in	Teflon Tubing	E980075

Front Panel Board Assembly

☐ Place the front panel board on top of the heat spreader with the silk screened side down as shown in Figure 5. Temporarily attach the board to the heat spreader with a single 3/16” (4.8 mm) pan-head screw.

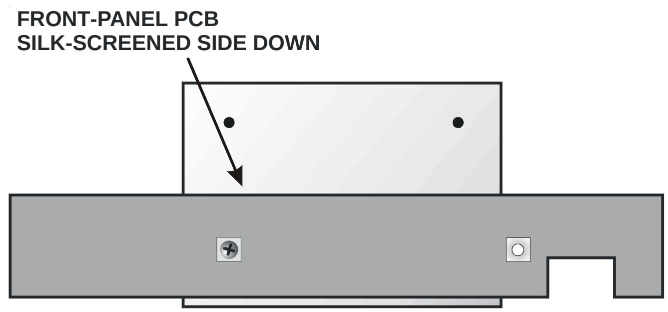


Figure 5. Preparing Front Panel to Install Light Bar.

☐ Prepare the leads of the yellow light bar for mounting on the board by bending them as shown in Figure 6. Press the leads against a smooth, hard surface and roll the roll the light bar until they are at about a 45 degree angle to the side of the light bar.

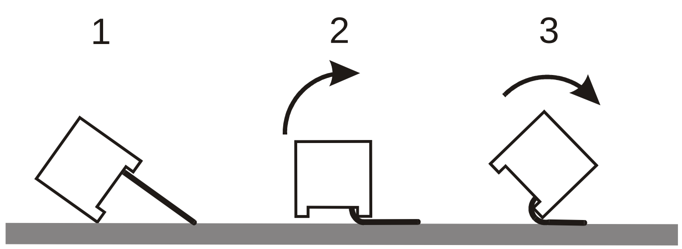


Figure 6. Preparing Light Bar Leads.

☐ Position the light bar in the cutout of the board as shown in Figure 7. Adjust the leads as necessary so they line up with the six solder pads at the edge of the cutout. The leads will NOT pass through the solder pads. The tips of the leads will rest just inside the top of each solder pad.

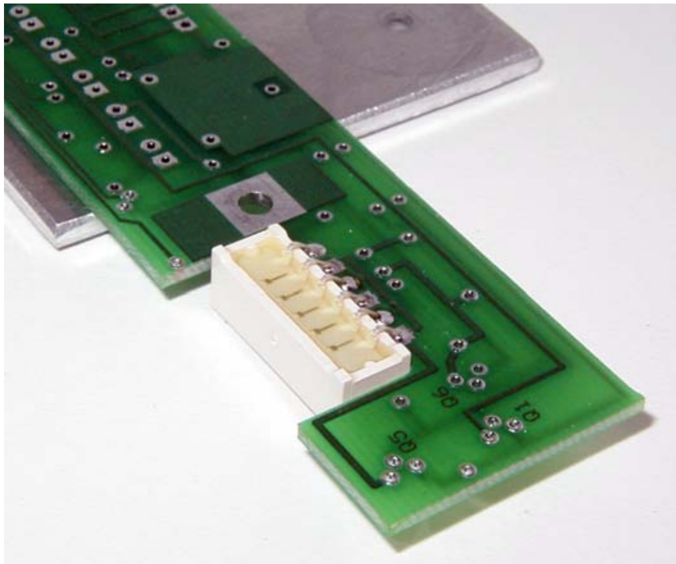


Figure 7. Installing Light Bar.

☐ Solder the six terminals to the circuit board pads.

☐ Remove the front panel board from the heat spreader.

The front panel board has parts on BOTH sides of the board. Follow the instructions carefully. If parts are placed on the wrong side of the board, it will not mate with the RF board properly or it will not fit inside the enclosure when construction is finished. Parts that go on the back (not silk screened) side of the board are identified by asterisks on the silk screening.

☐ Place the 28 pin IC socket in the holes provided on the front panel board at the end opposite the light bar you just installed. The socket goes on the BACK of the board (the side opposite the silk screened outline). Orient the socket so the notch in the end is facing away from the end of the board, as shown on the outline.

☐ While holding the IC socket against the board, wet the tip of your soldering iron with a very small amount of solder and then touch it a pin and solder pad at one end of the socket to tack-solder it in place.

☐ Tack-solder a second pin at the opposite end of the socket.

☐ Check the IC socket carefully to ensure:

- __ The socket is on the side of the board that is NOT silk-screened.
- __ The notched end of the socket is on the end farthest from the end of the board (as shown on the silk-screened outline).
- __ The socket is against the board at both ends. If necessary, heat the tack-soldered joints and adjust the socket so it is flush.

☐ Solder all 28 pins of the IC socket and trim the leads. Be sure to solder properly the two pins you tack-soldered above.

If your solder joints are not clean and shiny, your iron may not be hot enough, or you may be using the wrong type of solder. <u>These "cold" solder joints will likely result in poor performance, reliability problems, or component failure.</u> You may wish to consult our web site for additional soldering instructions and tool recommendations.

☐ Locate the silk screened outline for Q5 near the yellow light bar. Install a PN2222 transistor on the BACK side of the board (the side that is not silk screened). The transistor's leads should protrude through the board on the silk screened side.

Note: The wide, flat side of the transistor must line up with the flat side of the silk screened outline on the board (See Figure 9). The part number may be on either side of the transistor.

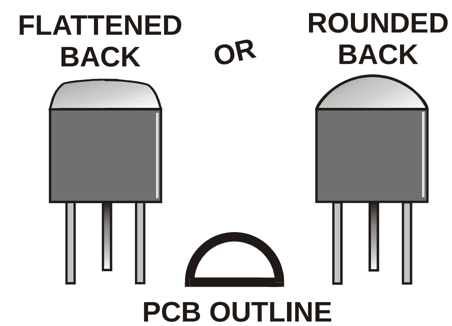


Figure 8. Transistor Orientation Guide.

☐ Position the transistor on the board as shown in Figure 9 and bend the leads to hold it in place. Solder and trim the leads as short as possible.

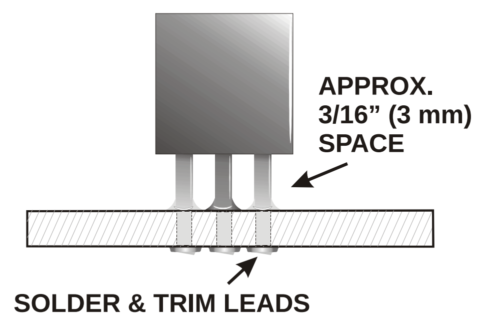


Figure 9. Installing Transistors.

In the steps that follow, you'll be installing groups of components. When working from a long list, install all of the items on one line before moving on to the next. Arrows (⇒) appear in the list to remind you of this order. Components may be soldered one at a time or in groups. Leads can be trimmed either before or after soldering. After trimming, leads should be 1/16" (1.5 mm) or less in length.

☐ Install six additional PN2222 transistors on the BACK side of the board (the side that is NOT silk screened) just as you did Q5. Align the flat side of each transistor with the outline shown on the silk screening.

__ Q6 ⇒ __ Q1 __ Q7
__ Q2 ⇒ __ Q3 __ Q4

☐ Install capacitor C1, .047 µF (473) on the BACK side of the board (the side that is NOT silk screened). Position the capacitor as shown in Figure 10 .

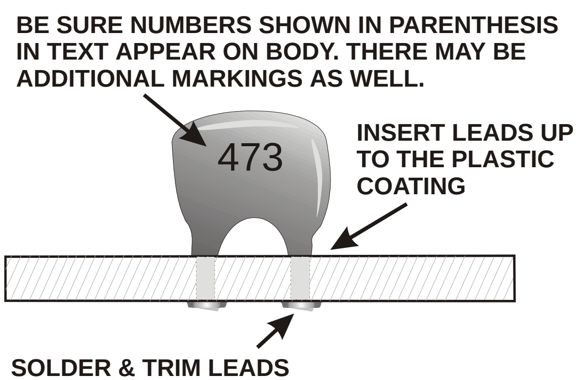


Figure 10. Installing Capacitors.

☐ Install capacitor C4, .001 µF (102) on the BACK side of the board (the side that is NOT silk screened).

☐ Install ceramic resonator Z1 (4.0 MG) on the BACK side of the board (the side that is NOT silk screened). This part may be inserted in either direction. Like the capacitors, insert the resonator as far as the plastic coating on the leads will allow.

☐ Install JP1, a two-pin header connector on the BACK side of the board (the side that is NOT silk screened) as shown in Figure 11 . Temporarily place a shorting block on the pins to provide a finger rest while soldering. **Do not hold the solder iron on the pins more than 1 or 2 seconds. Excessive heat will melt the plastic part of the header.**

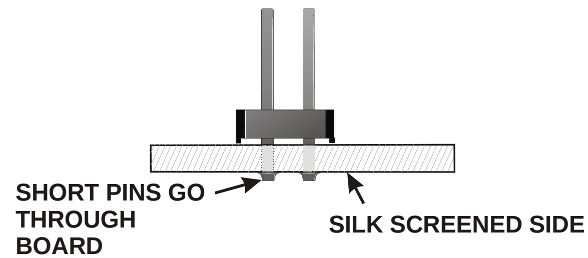


Figure 11. Installing Header Connectors.

☐ Check to ensure that:

- All of the above parts were installed in the BACK of the BOARD (the side with NO silk-screening).
- All parts are soldered.
- All leads are trimmed to 1/16” (1.5 mm) or less.

The remaining parts will be installed on the FRONT of the circuit board

Follow the LED installation instructions carefully to preserve the appearance of your transverter's front panel. When finished, the LEDs should be perpendicular to the board and in a straight line (See Figure 12).

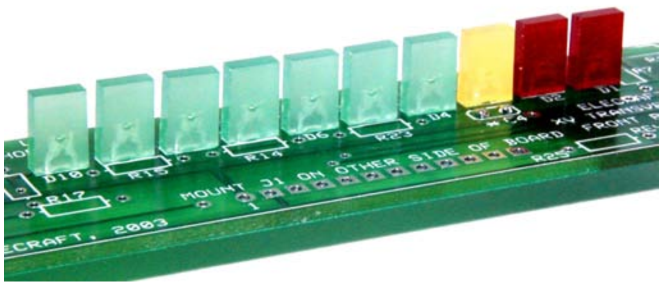


Figure 12. Power LEDs Installed on Front Panel Board.

☐ Sort the rectangular LEDs into groups according to color.

Note that one lead of each LED is longer than the other. This is the anode lead. It must be inserted in the right hand hole for each LED as shown on the front panel board. The right hand holes have square PCB pads to help identify them. The LEDs will not illuminate if the leads are reversed.

☐ Insert the leads of a **green** LED through the holes provided for D10 on the silk screened side of the front panel board. Be sure the long lead is in the right-hand hole (with the square pad). **Do not solder yet**.

☐ Hold the LED with the back of the plastic housing flat against the board (not tilted). Bend the leads outward on the bottom side to hold it in place.

☐ Solder one lead of the LED, keeping soldering time to 1 to 2 sec.

☐ If the LED is tilted or is not flat against the board, re-heat the lead while pressing the LED down.

☐ Once the LED is correctly positioned, solder the other lead, again keeping soldering time to 1 or 2 seconds. Then trim both leads.

☐ Install a **green** LED at D9. **Make sure the long lead is to the right as shown on the board.** Before soldering, adjust the LED's position as with D10.

☐ Install **green** LEDs at D8, D7, D6, D5, and D4. Make sure the long lead is to the **right** for these and all remaining LEDs.

☐ Install a **yellow** LED at D3.

☐ Install **red** LEDs at D2 and D1.

☐ Sort all of the resistors by value. If the color bands are difficult to read, use a DMM (digital multimeter) to verify their values. Tape them to a piece of paper with the values labeled.

☐ Install the resistors below on the front (silk screened) side of the board. Align each resistor to rest against the board inside the silk screened outline (See Figure 13). Start with R1 near the light bar end of the board.

__R1, 220 ohm (red-red-brn)	⇒	__R16, 120 ohm (brn-red-brn)
__R22, 120 ohm (brn-red-brn)		__R21, 120 ohm (brn-red-brn)
__R24, 2.2k (red-red-red)		__R2, 470 ohm (yel-vio-brn)
__R25, 270k (red-vio-yel)		__R23, 120 ohm (brn-red-brn)
__R14, 120 ohm (brn-red-brn)		__R15, 120 ohm (brn-red-brn)
__R13, 120 ohm (brn-red-brn)		__R5, 1 meg (brn-blk-grn)
__R3, 10k (brn-blk-org)		__R18, 2.2k (red-red-red)
__R20, 2.2k (red-red-red)		__R4, 100k (brn-blk-yel)
__R17, 100k (brn-blk-yel)		__R19, 2.2k (red-red-red)
__R12, 120 ohm (brn-red-brn)		__R11, 120 ohm (brn-red-brn)
__R10, 120 ohm (brn-red-brn)		__R9, 120 ohm (brn-red-brn)
__R8, 120 ohm (brn-red-brn)		__R7, 120 ohm (brn-red-brn)
__R6, 120 ohm (brn-red-brn)		

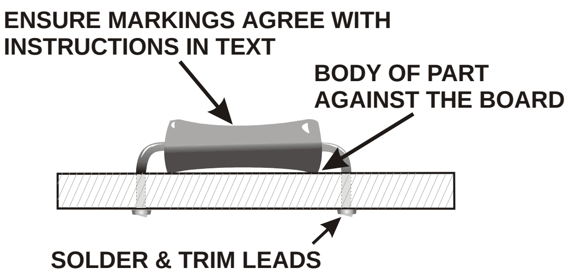


Figure 13. Installing Resistors.

☐ Install the two capacitors listed below on the front (silk screened) side of the board, near the outline of the 28-pin IC socket. **Check each capacitor's labeling carefully (shown in parentheses).**

__C2, .01µF (103)   __C3, .01 µF (103)

☐ Inspect the board carefully for the following:

_ All connections soldered.

_ No solder bridges between pads (use a magnifier as needed).

_ All leads clipped to no more than 1/16” (2 mm) long.

Uninstalled Components

☐ Verify that all component locations on the front panel board are filled, except the following:

_ U1 (controller 16F872) should not be installed in its socket yet.

_ J1 at the bottom center of the board. This will be installed in the next section.

You’ve finished the Front Panel Board Assembly Procedure. Go to the *RF Board Assembly – Part I* on the next page to continue.

RF Board Assembly – Part I

RF circuit assembly is divided into three parts:

Part 1: DC, control circuits and RF components common to all of the transverters.

Part 2: Additional RF components unique to each band.

Part 3: Installation of the RF power module.

Handle the RF board carefully. Some surface-mounted components are used in the RF circuits for optimum transverter performance. The RF circuit board is supplied with these components pre-mounted. Take care not to damage them.

Do NOT remove the temporary wire jumper across the solder pads for L1 until instructed to do so. This jumper protects U1 from static damage until the circuits are completed.

☐ Locate the two small L-brackets. Identify the *shorter* side of the "L", which will be attached to the RF board.

☐ On the RF board, locate the hole at either end of the silk screened lettering: P1 MOUNTS ON OTHER SIDE OF BOARD. These are the holes where “L” brackets will be installed.

☐ Secure the shorter leg of an L-bracket loosely to the RF board in each hole using a 4-40 x 3/16” (4.8 mm) black screw. A lock washer is not required at this time.

☐ Locate the 12-pin female connector (J1) and the 12-pin male connector (P5). Normally J1 is included with the Front Panel board parts and P5 is with the RF Board parts.

☐ Slide the 12-pin female connector (J1) onto the pins of the 12-pin male connector (P1). There should be no gap between them.

☐ Insert P1's right-angle pins into the holes on the bottom of the RF board near the letters: P1 MOUNTS ON THIS SIDE OF BOARD. **Do not solder yet**.

☐ Position the Front Panel board as shown in Figure 14. The pins of J1 should be inserted into the holes in the Front Panel board, and the two L-brackets should be aligned with their outlines on the back of the Front Panel board.

☐ Secure the L-brackets loosely to the Front Panel using two 4-40 x 3/16" (4.8 mm) screws (black). It is not necessary to use lock washers at this time.

☐ Adjust the L-bracket positions so the Front Panel board is aligned with the RF board If the gap between the Front Panel board and the RF board is wider at one end than the other, you probably have one of the brackets in backwards. Be certain the shorter legs are attached to the RF board.

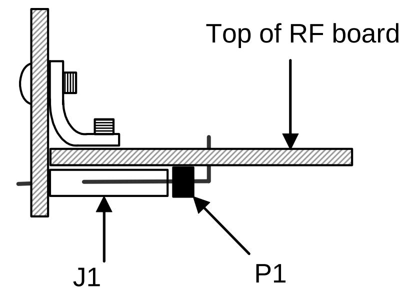


Figure 14. Installing J1 and P1.

☐ Tighten all four L-bracket screws.

☐ Solder all pins of J1 and P1.

☐ Remove the two screws holding the Front Panel board to the brackets. Unplug the Front Panel board and set it aside in a safe place.

☐ Remove the brackets and screws from the RF Board and set them aside.

☐ Sort the fixed resistors by wattage and value as follows:

__ Divide the resistors by wattage: 3-watt (physically largest), 1-watt and 1/4 watt (smallest).

__ Among the 1/4 watt resistors, separate the four 1% tolerance resistors. These resistors have five color bands: four color bands show the value plus a brown color band at one end that is wider than the others. The wide band indicates that it is a 1% tolerance resistor.

__ Sort the remaining 1/4 watt resistors by value. If the color bands are difficult to read, use a DMM (digital multimeter) to verify their values. Tape them to a piece of paper with the values labeled.

☐ Place the circuit board with the silk screened side up and the cutout to your left. The lettering in the center of the board will read right side up. All of the remaining parts will be installed on the top, silk screened side of the board.

Save the longer clipped leads from the following resistors. You will use several of them to make jumpers and test points later.

☐ Install the 1-watt resistors listed below. Space each resistor about 1/16" (1.5 mm) above the board by placing the long end of one of the right-angle brackets between the resistor and circuit board until the resistor is soldered in place (See Figure 15). The objective is to leave space for air to flow around the resistor. These resistors that should be spaced above the board are shown by a double silk screen outline.

__ R12, 180 ohm (brn-gry-brn), near U1 in the upper left area of the board.

__ R16, 120 ohm (brn-red-brn) next to R12.

__ R21, 820 ohms (821), 1 watt next to Q6.

__ R19, 180 ohm (brn-gry-brn), near U5 at the center of the board.

__ R8, 120 ohm (brn-red-brn) near Z1 in the lower right area of the board.

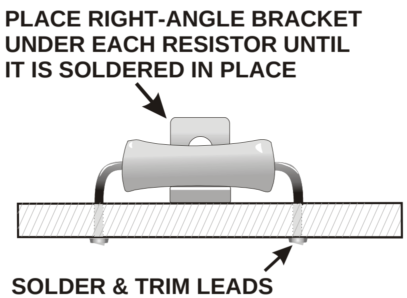


Figure 15. Spacing the 1-watt and 3-watt Resistors above the PCB.

☐ Install the following 3-watt resistors above R21 near the center of the board. Space each resistor about 1/16" (1.5 mm) above the board just like you did for the 1-watt resistors.

__R20, 160 ohm (160) ⇒ __R26, 160 ohm (160)
__R27, 160 ohm (160)

☐ Install the 1/4-watt 1% tolerance resistors listed below in the lower left area of the circuit board. Place these and all of the rest of the resistors directly against the circuit board.

__ R35, 5.11k (grn-brn-brn-brn)

__ R31, 15.0k (brn-grn-blk-red)

__ R30, 7.5k (vio-grn-blk-brn)

__ R32, 3.92k (or-wht-red-brn)

☐ Install the 1/4 watt resistors listed below. Start with R1, which is on the left side just above the cutout in board. The locations follow the perimeter of the board going clockwise.

__R1, 10k (brn-blk-org)	⇒	__R11, 1k (brn-blk-red)
__R14, 4.7 ohm (yel-vio-gld)		__R23, 100k (brn-blk-yel)

☐ Install the 1/4 watt resistors listed below. Start with R4, which is on the lower right above Z1. The locations follow the perimeter of the board going clockwise.

__R4, 5.6k (grn-blu-red)	⇒	__R25, 56 ohm (grn-blu-blk)
__R5, 5.6K (grn-blu-red)		__R7, 10k (brn-blk-org)
__R34 (on the right edge of the board),		100k (brn-blk-yel)
__R9, 10k (brn-blk-org)		__R33, 10k (brn-blk-org)

☐ Install the following 1/4 watt resistors next to Q6 at the center of the board:

- __ R18, 620 ohm (blu-red-brn)
- __ R40, 22k (red-red-org)

☐ Locate the silk screened space for D5 on the board near R23 in the upper right area of the board.

Diodes must be oriented correctly. A black band around the diode indicates the cathode end. Install each diode so the cathode end goes to the square solder pad and the band is oriented to match the silk screened outline (see Figure 16 below). If a diode has more than one band, the widest band indicates the cathode end.

Figure 16. Circuit Board Diode Orientation Guides. The cathode always goes to the square solder pad on the board.

☐ Install D5 (SB530) so it is against the board and the banded end of the diode is aligned with the banded end of the PC board outline. Save the excess leads when you clip them.

☐ Put the clipped leads from D5 in a safe place. Keep them separate from the other clipped leads you are saving for test points and jumpers. You will use the leads from D5 when you install antenna connector J1 later.

☐ Sort the small glass diodes by type. If necessary use a strong magnifier to read the tiny numbers printed on the glass body. Tape each group to a piece of paper marked by the type number.

- __ 1 ea. 1N5235
- __ 2 ea. 1N5711
- __ 10 ea. 1N4148

☐ Install zener diode D3 (1N5235) in the upper left quadrant of the board near R12. Position it against the board with the banded end aligned with the banded end of the PC board outline.

☐ Install the two 1N5711 diodes in the lower right quadrant of the board. Place each diode against the board with the cathode band oriented as you did in the previous steps.

__D7 __D8

☐ Install the 1N4148 diodes listed below. Start with D1, which is near resistor R1 in the upper left portion of the board and work clockwise around the board.

__D1 ⇒ __D12 __D6 __D9 __D13
__D14 __D15 __D16 (In lower right quadrant),
__D2 __D4

In the following steps you will install molded inductors. These inductors look much like 1-watt resistors but the color codes read differently. The color codes on the inductors read from the center to the end instead of from the end towards the center like resistors.

☐ Install molded inductor L8, 15µH (brn-grn-blk) in the upper right quadrant of the board.

☐ Install molded inductor L9, 0.47 µH (yel-vio-silver) about half way up the board about 2 inches (5 cm) from the right-hand edge.

☐ Install transistor Q6 (PN2222) next to R21 near the center of the board. Orient the transistor as shown by the silk-screened outline on the board.

☐ Prepare transistor Q2 (BFR96) for installation as follows:

- _ Place the transistor over the outline on the board with the lettered side up and note the lead lengths required to match the three solder pad areas on the board. Trim the leads to match these pads.
- _ Gently bend the leads down so they make solid contact with the board starting close to the body of the transistor. This is easily done by pressing down on the lead with a small flat-blade screwdriver (see Figure 17).

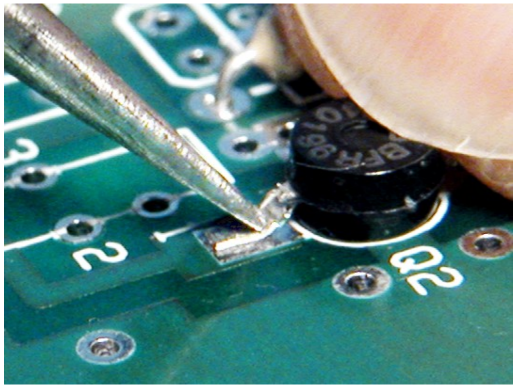


Figure 17. Installing Transistor Q2. Use gentle pressure with a small screwdriver blade to form the leads.

☐ Solder Q2 in place as follows:

- Wet your soldering iron with a small amount of solder and touch it to one lead of Q2 tack-solder it in place.
- Check alignment of the other two leads to be sure they are over the solder pads. If necessary reheat the tack-soldered lead and adjust the position of the transistor.
- Solder all three leads properly, soldering the tack-soldered lead last. Keep your soldering time as short as possible to avoid over-heating the transistor. Do not hold the iron on the leads more than two seconds.

Check each capacitor's labeling carefully to ensure the values agree with the numbers shown in parenthesis.

☐ Install the monolithic capacitors listed below near U3 and Q6 at the center of the board.

__C68, .047 µF(473)	⇒	__C67, .01 µF (103)	__C64, .01µF (103)
__C65, .047µF (473)		__C10, .01 µF (103)	__C9, .01 µF (103)

☐ Install the monolithic capacitors listed below. With the board oriented with the cutout to the left, start with C62 near the lower left and work around the board clockwise to the upper right quadrant.

__C62, .01 µF (103)	⇒	__C40, .01 µF (103)	__C7, .001 µF (102)
__C8, .01 µF (103)		__C3, .001 µF (102)	__C63, .01µF (103)
__C6, .01 µF (103)		__C22, .01 µF (103)	__C61, .01 µF (103)
__C2, 100 pF (101)		__C23, .01 µF (103)	__C38, .01 µF (103)
__C27, .01 µF (103)		__C29, .047 µF(473)	__C37, .01 µF (103)
__C35, 10 pF (100)		__C36, µF .01 (103)	__C34, .01 µF (103)
__C39, .001 µF (102)			

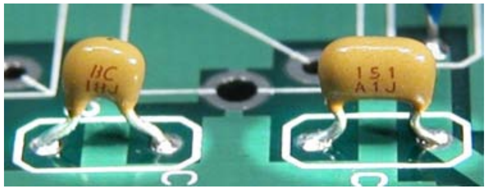
☐ Install the monolithic capacitors listed below. Start with C71 on the edge of the board in the lower quadrant and work from right to left across the lower part of the board.

__C71,.01 µF (103)	⇒	__C15, .001 µF (102)	__C16, .01 µF (103)
__C20, .01 µF (103)		__C30, 0.22 µF (224)	__C17, .001 µF (102)
__C19, .01 µF (103)		__C57, 100 pF (101)	

☐ Install disc ceramic capacitor C18 (2.2) next to C17 in the lower right area of the board.

☐ Install the capacitors listed below in the area near the center of the board marked 28 MHZ IF BANDPASS FILTER. The lead spacing of these capacitors may be narrower than the hole spacing on the board. If necessary, form the leads to avoid stress on the capacitor when they are inserted in the board. **Do not force the capacitors down against the board.** The capacitors may sit about 1/16" (1.5 mm) above the board as shown in Figure 18 .

__C55, 270 (271)	⇒	__C54, 150 (151)	__C53, 18 (180) or (18)
__C52, 150 (151)		__C56, 270 (271)	



The capacitors shown are typical.
Other styles may be supplied.

Figure 18. Installing I.F. Filter Capacitors.

☐ Use a discarded lead to create test point TP3. Two holes for TP3 are directly below R17 in the upper right quadrant of the board. Bend the lead in a "U" shape and insert it in the holes indicated with a line between them on the board. The loop formed should rise about 1/4" (4 mm) above the board. Solder the leads.

☐ Use a discarded lead to create TP4 next to TP3, following the procedure described above. Solder the leads.

☐ Make two ground test points just like you did for TP3 and TP4. The places on the board are indicated by ground symbols. One is directly below the "Elecraft" label and the other is in the lower left quadrant below U6. Solder the leads.

☐ Remove the eight small relays (G6E-134P) from the carrier tube. If any of the pins are bent, straighten them carefully using long-nose pliers.

Most likely you'll want to use a single antenna for both transmitting and receiving with your transverter. However, some operators use separate transmitting and receiving antennas and separate feed lines. See *Using an External Receive Preamplifier* on page 73 for more information. The following step provides special instructions to follow ONLY if you are building your transverter for use with SEPARATE transmit and receive antennas.

☐ If you are building your transceiver for separate (split-path) transmit and receive antenna connections, do the following:

- In the next step, cross out relay "K1". It will not be installed. Remove K1 from your parts and set it aside in a safe place. You may want it later if you decide to re-wire your transverter for single antenna operation.
- Use discarded leads to form jumpers across W2 and W3 near the outline for K1 as shown in Figure 19.

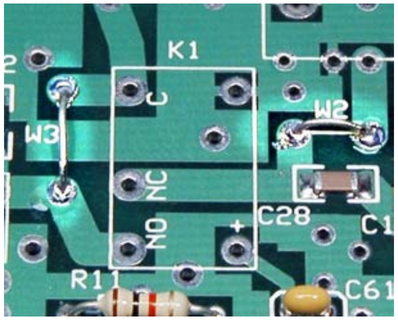


Figure 19. Installing W2 and W3 for split path (separate transmit and receive antenna) operation. Do NOT Install Relay K1

☐ Working around the board clockwise from the upper left quadrant, place the relays at the following locations. They can only be installed one way. **Do not solder the relays yet and do not clip or bend the relay leads.**

__K1	⇒	__K8	__K9	__K7
__K4		__K5	__K6	__K2

☐ Using a thin, hardcover book to hold the relays in place, flip the board and book over together.

☐ Solder just two diagonally opposite corner pins on each relay.

☐ Turn the book back over and check each relay. If any relay is not flat against the board, re-heat its corner pins while pressing it down against the board.

☐ Once all the relays are properly seated, solder the remaining pins. Take care to locate and solder all five pins on every relay. **Do not trim the relay pins**. Trimming the pins can cause mechanical stress which may reduce the life of the relay.

Note that W2 and W3 are used ONLY when separate transmit and receive antennas are used and K1 is NOT installed.

☐ Install resettable fuse F1 in the space provided next to relay K9. F1 may be oriented either way. Solder and trim the leads.

☐ Check the pins on the large relay (KLT1C12DC12). If any pins are bent, straighten them carefully using long-nose pliers.

☐ Install the main power relay (KLT1C12DC12) next to F1 and solder two diagonally opposite corner pins. Check the relay to ensure it is flush against the circuit board. If necessary, reheat the solder while pressing down on the relay.

☐ Solder all five pins on the main power relay. **Do not trim the relay pins**. Trimming the pins can cause mechanical stress which may reduce the life of the relay.

☐ Install a 3-terminal header at JP1 adjacent to relay K8. Put a shorting block over two pins of the header to provide a surface where you can place your finger to keep it straight and against the board. While holding the assembly, touch one of the pins on the bottom of the board with a soldering iron to tack-solder it in place. Check to ensure that the header is sitting vertically on the board (see Figure 11). Reheat and adjust as necessary, then solder all three pins. **Do not hold the solder iron on the pins more than 1 or 2 seconds. Excessive heat will melt the plastic part of the header.**

☐ Remove the shorting block from JP1.

☐ Install the following 3-terminal headers:

- __ JP2 next to relay K8.
- __ JP3 next to relay K8.
- __ JP4 near resistor R21.
- __ JP5 near relay K6.
- __ JP6 near relay K6.

☐ Install JP9 next to K4 and K5. JP9 requires one 2-terminal header and one 3-terminal header.

☐ Install the 100 k-ohm (104) potentiometer R10 (Power Cal) in the upper left area of the board. The center lead goes toward the beveled end of the silk screen outline (see Figure 20).The shoulders on the leads should touch the top of the board.

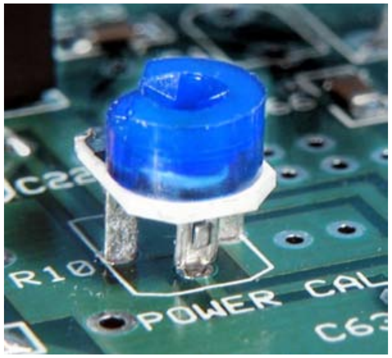


Figure 20. Installing PC Board Pots. Orient the center pin toward the beveled end of the silk screened outline.

☐ Spread the leads on R10 to hold it in place, then solder and trim the leads.

☐ Install the two 100 ohm PC board potentiometers just as you did R10:

- __ R13 (101) in the upper left quadrant of the board near D3.
- __ R22 (101) below the three 160-ohm 3-watt resistors near the center of the board.
- __ Verify that all three terminals on each pot are soldered.

☐ Install 4-pole DIP switch SW1 in the space provided in the lower left quadrant of the board. The DIP switch may not have a notch at one end to line up with the silk screened outline. Orient the switch so that the ON positions are on the side with the silk screened numbers. If you aren't sure, use your DMM to check the orientation of the switch assembly so there is continuity through each switch when the toggle is toward the silk screened number on the circuit board.

☐ Bend the leads of voltage regulator U4 (UA78M05C) to fit on the board as shown in Figure 21. Bend the leads around the shaft of a small screwdriver to create smooth rather than sharp bends.

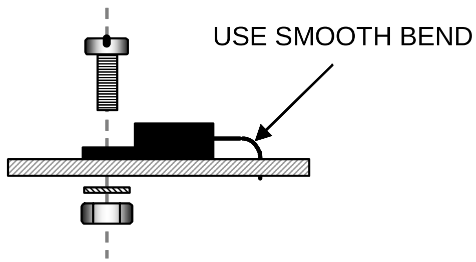


Figure 21. Installing Voltage Regulator U4.

☐ Insert U4's leads into the holes. Secure it with a zinc 4-40 x 5/16" (8 mm) screw, #4 lock washer and 4-40 nut as shown. The metal tab on the transistor sits directly against the metal foil on the circuit board.

☐ Solder all three leads to U4 on the bottom side of the board and trim them short.

☐ Install two 22 µF, 25 VDC electrolytic capacitors near the notch on the left side of the board. **Be sure to observe polarity. The longer positive lead goes in the square solder pad with a + silk screened next to it.**

__C26 __C60

☐ Locate diodes D10 and D11. They are square, red LEDs identical to the ones you installed on the front panel board.

☐ Locate the positions for D10 and D11 on the board, near the center on the right hand side. Note that the square solder pad for D10 is to the left and the square solder pad for D11 is to the right. The diodes *must* be installed turned 180 degrees with respect to each other.

☐ Position diode D10 on the board with the long lead through the square pad on the left and the short lead through the round pad. Position the body of the LED directly against the board within the silk screen outline and spread the leads under the board to hold the diode in place.

☐ Solder one lead on the bottom of the board. Check to be sure the LED is still positioned directly against the board. Reheat and adjust the LED as necessary, then solder and trim both leads.

☐ Position diode D11 on the board with the long lead through the square pad on the right, opposite the orientation of D10. Solder and trim the leads as you did for D10.

☐ Locate the inductors provided for L15, L16 and L17 in the I.F. Bandpass filter. They will have grey plastic forms visible inside the shields. Prepare the inductors for installation as follows:

- __ Use the inductor alignment tool to exercise the core in each inductor. If the alignment tool fits tightly, insert it from the bottom to avoid pushing the inductor out of the shield. Run the core up and down through the coil to ensure it runs smoothly (some inductors are very stiff at first) then position the core near the top of the coil.
- __ Check the two leads and the two tabs on the case of each inductor. If they are bent, straighten them carefully using long nose pliers.

☐ Position each inductor on the board so that its tabs and pins protrude through on the bottom. The inductors can be positioned either way. Ensure that the shoulders of the tabs are against the top of the board, and then bend the tabs toward each other until they are flat on the board to hold the inductor in place.

__L16 ⇒ __L15 __L17

☐ Solder the two tabs and the two pins on all three inductors.

☐ Install voltage regulator U2 (78L09) in the space provided near L17. Be sure to align the body with the silk screen outline on the board.

☐ Install transistor Q4 (IRF 620) in the space provided near diodes D7 and D8 as shown in Figure 19. **Be sure the leads are inserted until their shoulders are against the top of the board. If the leads are not inserted far enough, the tab on the top of the transistor may short against the top cover when the cabinet is assembled.** Trim the leads as short as possible on the bottom of the board.

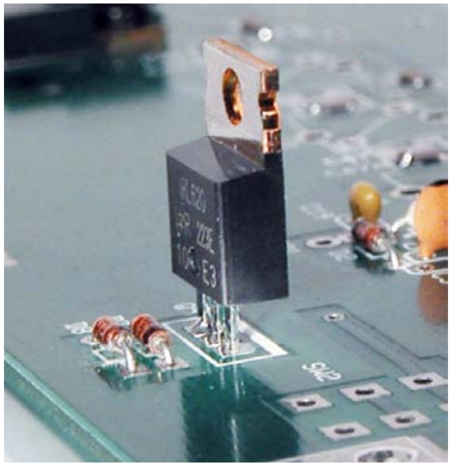


Figure 22. Installing Transistor Q4.

The following transistor is particularly sensitive to electro-static discharge (ESD) damage. If you are not wearing a grounded anti-static wrist strap, touch an unpainted, grounded object before handling Q5.

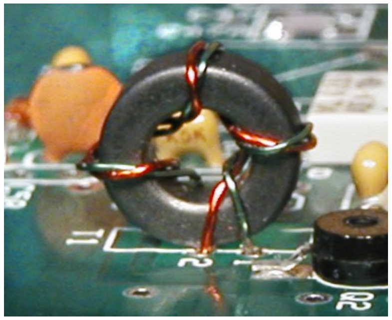
☐ Install transistor Q5 (2N7000) in the space provided on the right edge of the board.

☐ Install two 2-pin header connectors next to Q5.

__JP8 __JP7

☐ Wind toroidal transformer T1 on the FT37-43 toroid core as follows[4]. T1 uses a *bi-filar* winding, which means that two wires are wound on the core together. The wires will be twisted together loosely before they're wound onto the core.

- Twist the red and green enameled wires together over their entire length. The wires should cross over each other 2 to 4 times per inch (1 to 2 times per cm).
- Wind 4 turns of the twisted pair on the FT37-43 toroid core as shown in **Figure 23**. Each time the wire passes through the core counts as one turn, so verify that the wires pass through the toroid four times. Spread the turns around the core as shown in the figure.
- Separate the leads and trim them to a length of about 1" (2.5 cm).



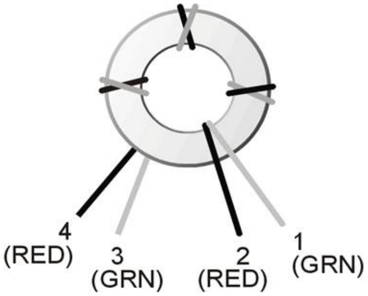


Figure 23. Installing T1.

In the next step the toroid leads will be stripped and tinned. The leads must be prepared correctly to provide good electrical contact when installed.

☐ Strip the insulation and tin the leads using ***one*** of the following techniques:

1. Heat Stripping:
   a. Place a small amount of solder (a.k.a. a "blob" of solder) on your soldering iron.
   b. Insert the clipped end of the wire into the hot solder. If the iron is hot enough, you should see the insulation bubble and vaporize after 4 to 6 seconds.
   c. Add more solder and feed more wire into the solder as the enamel melts. Continue tinning the wire up to the edge of the core, and then slowly pull the wire out of the solder.
   d. If any enamel remains on the lead, scrape it away using your thumbnail or sharp tool.
2. Burning: The insulation can be burned off by heating it with a butane lighter for a few seconds. Use sandpaper to remove the residue, then tin the bare wires.
3. Scraping: Use a sharp tool to scrape the insulation away. Work carefully and gently: ***do not nick the wire***. Work around the entire circumference of the wire to remove all of the enamel and tin the bare wires.

[4] A pre-wound toroid is available from an Elecraft-approved source. See page 4.

☐ Insert the tinned leads in the holes on the board and position the toroid as shown in **Figure 23**. Be sure the correct lead goes to each hole. Use a magnifier to check the following:

- __ Bare, tinned wire should be visible where the wire enters the hole at the top of the board. If necessary remove the toroid and strip the wire further to ensure the wire going through the hole is free of enamel and tinned.
- __ Check carefully for shorts between the wires. The toroid core is **not** a conductor. Bare wire may touch the core. Be sure that the tined wires do not touch each other.

☐ Solder the wires on the bottom of the board and trim the leads as short as possible.

☐ Locate the solder pads for choke L7 on the left side of the board next to the notch (see Figure 24) Choke L7 consists of a bare wire passing through two ferrite beads as shown.

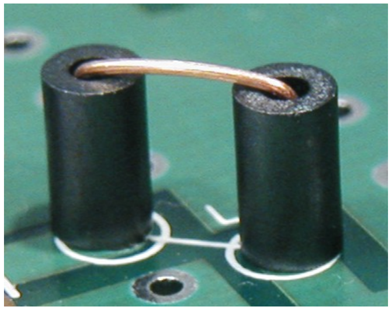


Figure 24. Installing L7.

☐ Strip the insulation from 3" (7.5 cm) of the #24 solid insulated wire provided.

☐ Bend the wire into a U shape to match the spacing of the holes on the board. Place a bead on either side of the bend.

☐ Thread the ends of the wires through the solder pads for L7. Make sure the beads are sitting vertically on the board over each hole and bend the leads on the bottom of the board to hold the assembly in place.

☐ Solder both leads and trim them as short as possible.

☐ Install the DPDT power switch at SW2 in the lower right corner of the board. Orient the switch so the pushbutton shaft extends out over the edge of the board. Be sure the two feet on the bottom of the switch are resting against the board before soldering.

☐ Install two RCA jacks at the top of the board. Solder one pin first then check to be sure the jack is sitting flat against the board. If necessary, re-heat the solder while pressing down on the jack. Solder the second pin then trim the leads.

__J5 __J4

J8, installed in the next step, is not required if you are building your transverter to use a common transmit and receive antenna. J8 is needed only if you plan to use separate (split-path) transmit and receive antennas. It won't hurt to install it in any case.

☐ Install three BNC jacks at the top of the board. Line up the two supports and the two small conductor pins with the holes and gently press the connectors down until the four plastic pins on the jack rest directly against the board. Solder one of the large pins, then check the position. If necessary, reheat the solder while pressing down on the jack. After soldering all four pins, trim off the excess length of the small pins.

__J8 __J2 __J3

☐ Install the DB-9 connector at J6 and solder the pins including the two larger mounting pins.

☐ The Anderson power connector is held in place by two heavy copper wires soldered to the circuit board (See Figure 25). Prepare and install the connector as described in the following steps.

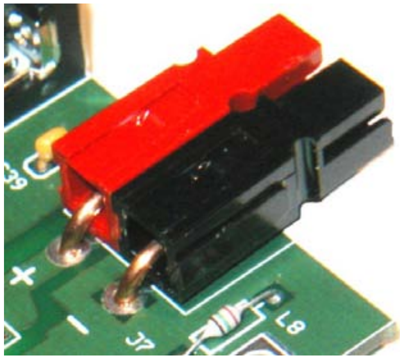


Figure 25. Installing J7.

☐ Cut the length of #14 copper wire provided in half.

☐ Solder each length of the #14 copper wire into an Anderson crimp terminal. **Solder, do not rely on a crimp connection. Take care to keep solder off of the terminal.**

☐ Orient each crimp terminal as shown in Figure 26 and slide it into a shell until it "clicks" in place. Tug on the wire to be sure it is locked in place. If the terminal comes out, you probably have it in upside down.

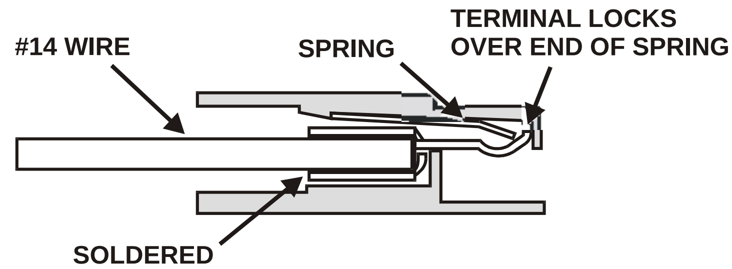
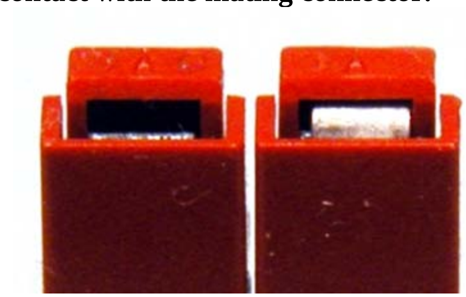


Figure 26. Inserting Terminal into Anderson Connector Shell.

☐ Inspect the end of each connector. You should see the terminal pressing up against the end as shown in Figure 27. If necessary, press the terminal in until it reaches the end. **If you don't get the terminal pushed all the way in so it locks over the end of the spring, it will not make reliable contact with the mating connector.**



WRONG

RIGHT
Terminal reaches end of the shell.

Figure 27. Verify Terminal is Fully Inserted.

☐ Orient the shells with dimpled side up so that the red and black shells are over the colors marked on the circuit board exactly as shown in Figure 28. **Be sure the shells are oriented as shown. If they are upside down they will not mate to the connectors on the power cord.**

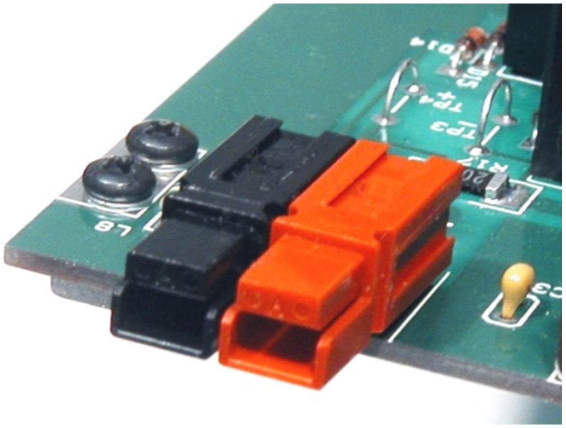


Figure 28. Orienting J7 on the RF Board.

☐ Look closely at the sides of the shells. Each has a small tongue on one side and a groove on the other. Slide the two shells together engaging the tongue in the groove. Be sure they are fully meshed. No locking pin is needed.

☐ Bend the copper wire at right angles to the shells so that when it is placed in the holes on the circuit board, the shells lie against the board within their outline as shown in Figure 28. **Be sure the red shell is on the + side and the shells are oriented as shown.**

☐ Solder the wires in place and cut them as close to the board as possible.

You've finished Part I of the RF Board Assembly Procedure. Go to the *RF Board Assembly – Part II* to continue the RF board assembly.

RF Board Assembly – Part II

In the following steps you will install components unique to each band on the RF Board. These components are provided in the XV50, XV144 or XV222 band completion kit package. Perform only the assembly procedure for the transverter you are building.

XV50 – 50 MHz Transverter

Perform the following steps on the RF board **ONLY** if you are building the XV50 transverter.

☐ Install resistor R24, 56 ohm (56J), **2 watt**, in the lower left quadrant near U6. Space this resistor about 1/16" (1.5 mm) above the board like you did the 1-watt and 3 watt resistors earlier (See Figure 15).

☐ Install resistor R6, 330 ohm (org-org-brn), 1/4 watt, above Q2 and U2. Place this resistor directly against the circuit board.

☐ Install Z4, a 56 ohm (grn-blu-blk), 1/4 watt resistor near U2.

☐ Install transistor Q1 (MPS918) near U2.

☐ Install the molded inductors listed below:

- __ L2, .22 µH (red-red-silver) near U1 in the upper left area of the board.
- __ Z3, .15 µH (brn-grn-silver) near U6 in the lower left area of the board.
- __ L3, .22 µH (red-red-silver) near frequency mixer Z1 in the lower right area of the board.

☐ Install the following capacitors near transistor Q1:

__C12, 100 pF (101)   __C14, 390 pF (391)

☐ Install the following capacitors near frequency mixer Z1:

__C58, 390 pF (391)   __C59, 390 pF (391)

☐ Install capacitor C69, 10 pF (100) near L15 and L16.

☐ Install the two 4-15 pF trimmer capacitors as follows:

- __ C33, near L17 on the right lower quadrant of the board. (On some boards C33 may be marked C64).
- __ C1, to the right relay K1 in the upper left part of the board.

☐ Install crystal Y1 where indicated by the silk screened outline inside circle OV1. The crystal may be oriented either way. Be sure the crystal case is sitting directly on the board. **Do not hold your soldering iron on the leads more than 2 or 3 seconds maximum. Excessive heat may damage the crystal.**

☐ If you purchased the optional crystal oven with your transverter (Elecraft part number E980076) install it now as follows:

- __ Position the oven down over the crystal so the three leads on the oven pass through the +, - and NC holes in the circuit board. The oven will only go on the crystal one way.
- __ Bend the leads over on the bottom of the RF board to hold the oven in place, then tack-solder one lead.
- __ Check to be sure the oven fully seated down over the crystal and against the board. If necessary, re-heat the soldered lead and adjust its position.
- __ Solder and trim all three leads.

☐ Install a jumper across the solder pads for L4A near C13 on the right side of the board.

☐ Install voltage regulator U3 (78L09) to the left of relay K6 at the center of the board.

☐ Install jumpers across the solder pads of R29 and R39 in the center of the board (See Figure 29). The PCB's green coating is a good insulator, but it is best to leave clearance under the jumper for R29 to avoid the possibility of a short.

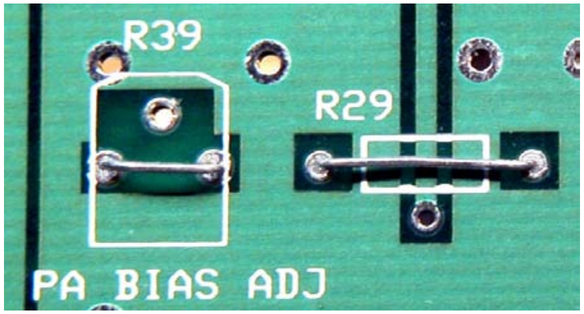


Figure 29. R29 and R39 Jumpers.

If you are not wearing a grounded anti-static wrist strap, touch an unpainted, grounded object before performing the next step. Once the temporary jumper across L1 is removed, Q3 is particularly sensitive to electro-static discharge (ESD) damage until inductor L1 is soldered in place.

☐ Remove the temporary jumper and install L1, the larger gray variable inductor in the space next to trimmer capacitor C1.

☐ Unscrew and remove the tuning slug from L1. The tuning slug will not be used.

☐ Install the two blue variable inductors near the upper left corner of the board:

__L10 __L11

☐ Unscrew and remove the tuning slugs from L10 and L11. They will not be used.

☐ Locate the shielded inductors with gray inserts provided for L12, L13 and L14 in the R.F. Bandpass filter. Prepare the inductors for installation as follows:

- _ Use the inductor alignment tool to exercise the core in each inductor. If the alignment tool fits tightly, insert it from the bottom to avoid pushing the inductor out of the shield. Run the core up and down through the coil to ensure it runs smoothly (some inductors are very stiff at first) then position the core near the top of the coil.
- _ Check the two leads and the two tabs on the case of each inductor. If they are bent, straighten them carefully using long nose pliers.

☐ Install the RF Bandpass Filter inductors in the spaces provided between relay K2 and frequency mixer Z1:

__L12 __L13 __L14

☐ Prepare and install choke L18 using two ferrite beads and 3” (7.5 cm) of #24 wire just as you did for L7.

☐ Verify that there are **no** components installed in the following locations. These components are not used in XV50 transverter:

- ___ Jumper W1 near L18.
- ___ SMD capacitor C44A in the upper left near L10 and L11.
- ___ SMD capacitors C45A, C46A and C47A in the RF Bandpass Filter.

☐ Carefully inspect the bottom of the circuit board for the following:

- ___ All component leads are soldered. Be especially careful when checking relays and other components with several leads to ensure that all the leads are soldered.
- ___ All component leads are clipped at least as short as the relay pins. **Do not cut the relay pins**.

This finishes Part II of the RF Board Assembly. **Proceed directly to RF Board Assembly Part III.**

XV144 –144 MHz Transverter

Perform the following steps on the RF board **ONLY** if you are building the XV144 transverter.

☐ Install the resistors listed below.

- __ R24, 120 ohm (brn-red-brn), **1 watt** in the lower left quadrant near U6. Space this resistor about 1/16” (1.5 mm) above the board like you did the 1-watt and 3 watt resistors earlier (See Figure 15).
- __ R28, 1k (brn-blk-red), 1/4 watt, near L7 on the middle left. Place this resistor directly against the board.
- __ R29, 56 ohm (grn-blu-blk), 1/4 watt, in center of board.
- __ R6, 470 ohm (yel-vio-brn), 1/4 watt, above Q2 and U2.

☐ Install Z4, a 56 ohm (grn-blu-blk), 1/4 watt resistor near U2.

☐ Install the following capacitors near the circular outline for OV1 in the lower right quadrant:

__C13, .047 (473) ⇒ __C12, 10 pF (100)
__C14, 33 pF (330)

☐ Install a jumper wire across the solder pads for C69 (near L15 and L16).

☐ Install a jumper wire across the solder pads for L3 to the left of torodial transformer T1.

☐ Install the molded inductors listed below:

- __ L2, .1 µH (brn-blk-silver) near U1 in the upper left area of the board.
- __ Z3, .1 µH (brn-blk-silver) near U6 in the lower left area of the board.
- __ L4, .15 µH (brn-grn-silver) near R6 on the right side of the board.

☐ Cut the Teflon tubing to a length of 3/8” (8 mm).

☐ Slide the 3/8” (8mm) length of Teflon tubing over the center lead of transistor Q1 (MPS918).

☐ Install transistor Q1 (MPS918) near U2 so that the Teflon tubing acts as a spacer to hold the transistor above the board. One end of the tubing should contact the bottom of Q1’s case and the other end should rest against the top of the circuit board (see Figure 30).

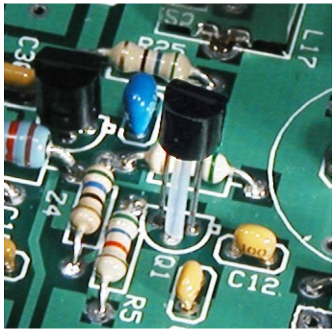


Figure 30. Installing Q1 with Teflon Spacer.

☐ Install crystal Y1 where indicated by the silk screened outline inside circle OV1. The crystal may be oriented either way. Be sure the crystal case is sitting directly on the board. **Do not hold your soldering iron on the leads more than 2 or 3 seconds maximum. Excessive heat may damage the crystal.**

☐ If you purchased the optional crystal oven with your transverter (Elecraft part number E980076) install it now as follows:

- __ Position the oven down over the crystal so the three leads on the oven pass through the +, -, and NC holes in the circuit board. The oven will only go on the crystal one way.
- __ Bend the leads over on the bottom of the RF board to hold the oven in place, then tack-solder one lead.
- __ Check to be sure the oven fully seated down over the crystal and against the board. If necessary, re-heat the soldered lead and adjust its position.
- __ Solder and trim all three leads.

☐ Install voltage regulator U3 (78L05) to the left of relay K6 at the center of the board.

☐ Install PC trimmer potentiometer R39, 1 K ohm (102) near the center of the board.

☐ Install trimmer capacitor C1, 4-15 pF, to the right of relay K1 at the upper left part of the board. This capacitor has a blue dot to identify it.

While installing L1 in the next step and similar inductors in the following steps, be sure the body of the inductor is pressed down against the board so it is not being supported by its leads.

If you are not wearing a grounded anti-static wrist strap, touch an unpainted, grounded object before performing the next step. Once the temporary jumper across L1 is removed, Q3 is particularly sensitive to electro-static discharge (ESD) damage until inductor L1 is soldered in place.

☐ Remove the temporary jumper and install L1, the larger orange variable inductor in the space next to trimmer capacitor C1.

☐ Unscrew and remove the tuning slug from L1. The tuning slug will not be used.

☐ Install the two smaller orange variable inductors near the upper left corner of the board:

__L10 __L11

☐ Unscrew and remove the tuning slugs from L10 and L11. The tuning slugs will not be used.

☐ Locate the shielded inductors with red inserts provided for L12, L13 and L14 in the R.F. Bandpass filter. Prepare the inductors for installation as follows:

- __ Use the inductor alignment tool to exercise the core in each inductor. If the alignment tool fits tightly, insert it from the bottom to avoid pushing the inductor out of the shield. Run the core up and down through the coil to ensure it runs smoothly (some inductors are very stiff at first) then position the core near the top of the coil.
- __ Check the two leads and the two tabs on the case of each inductor. If they are bent, straighten them carefully using long nose pliers.

☐ Install the RF Bandpass Filter inductors in the spaces provided between relay K2 and frequency mixer Z1:

__L12 __L13 __L14

☐ Install a jumper across the solder pads at W1 near the notch and L7 on the left side of the board.

☐ Verify that there are **no** components installed in the following locations. These components are not used in XV144 transverter:

- __ Choke L18 near the notch on the left.
- __ SMD capacitor C44A in the upper left near L10 and L11.
- __ L19 near crystal Y1.
- __ Inductor L4A near crystal Y1.
- __ Capacitor C59 next to T1.
- __ Capacitor C58 next to T1.
- __ Molded inductor L3 next to T1 (replaced by a jumper).
- __ SMD capacitors C45A, C46A and C47A in the RF Bandpass Filter.
- __ SMD capacitor C32 on the left next to the notch.

☐ Carefully inspect the bottom of the circuit board for the following:

- __ All component leads are soldered. Be especially careful when checking relays and other components with several leads to ensure that all the leads are soldered.
- __ All component leads are clipped at least as short as the relay leads. **Do not cut the relay pins**.

This finishes Part II of the RF Board Assembly. **Proceed directly to RF Board Assembly Part III.**

XV222 – 222 MHz Transverter

Perform the following steps on the RF board **ONLY** if you are building the XV222 transverter.

☐ Install the resistors listed below.

- __ R24, 56 ohm (grn-blu-blk), **2 watt**, in the lower left quadrant near U6. Space this resistor about 1/16" (1.5 mm) above the board like you did the 1-watt and 3 watt resistors earlier (See Figure 15).
- __ R28, 1k (brn-blk-red), 1/4 watt, near L7 on the middle left. Place this resistor directly against the board.
- __ R29, 56 ohm (grn-blu-blk), 1/4 watt, in center of board.
- __ R6, 220 ohm (red-red-brn), 1/4 watt, above Q2 and U2.

☐ Install Z4, a 56 ohm (grn-blu-blk) 1/4 watt resistor, in the lower right quadrant of the board.

☐ Install a jumper wire across the solder pads for L3 to the left of torodial transformer T1.

☐ Install two .1 µH (brn-blk-silver) molded inductors:

- __ L2, near U1 in the upper left quadrant of the board.
- __ Z3, near U6 in the lower left quadrant of the board.

☐ Install the following capacitors near the circular outline for OV1 in the lower right quadrant:

__C13, .047 (473) ⇒ __C12, 10 pF (100)
__C14, 22 pF (220)

☐ Cut the Teflon tubing to a length of 3/8" (8mm).

☐ Slide the 3/8" (8mm) length of Teflon tubing over the center lead of transistor Q1 (MPS918).

☐ Install transistor Q1 (MPS918) near U2 so that the Teflon tubing acts as a spacer to hold the transistor above the board. One end of the tubing should contact the bottom of Q1's case and the other end should rest against the top of the circuit board (see Figure 31).

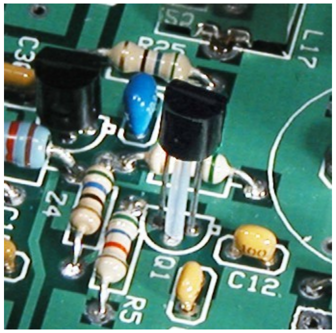


Figure 31. Installing Q1 with Teflon Spacer.

☐ Install voltage regulator U3 (78L05) to the left of relay K6 at the center of the board.

☐ Install crystal Y1 where indicated by the silk screened outline inside circle OV1. The crystal may be oriented either way. Be sure the crystal case is sitting directly on the board. **Do not hold your soldering iron on the leads more than 2 or 3 seconds maximum. Excessive heat may damage the crystal.**

☐ If you purchased the optional crystal oven with your transverter (Elecraft part number E980076) install it now as follows:

- __ Position the oven down over the crystal so the three leads on the oven pass through the +, - and NC holes in the circuit board. The oven will only go on the crystal one way.
- __ Bend the leads over on the bottom of the RF board to hold the oven in place, then tack-solder one lead.
- __ Check to be sure the oven fully seated down over the crystal and against the board. If necessary, re-heat the soldered lead and adjust its position.
- __ Solder and trim all three leads.

☐ Install pc pot R39, 1 K ohm (102) near the center of the board.

☐ Install trimmer capacitor C1, 4-15 pF, to the right of relay K1 at the upper left part of the board. This capacitor has a blue dot to identify it.

While installing L4A in the next step and similar inductors in the following steps, be sure the body of the inductor is pressed down against the board so it is not being supported by its leads.

☐ Install red inductor L4A near crystal Y1 on the right side of the board.

☐ Adjust the slug in L4A so it is flush with the top of the coil form.

☐ Install red inductor at L19 near crystal Y1 on the right side of the board. Unscrew and remove the tuning slug from the inductor. The tuning slug will not be used.

If you are not wearing a grounded anti-static wrist strap, touch an unpainted, grounded object before performing the next step. Once the temporary jumper across L1 is removed, Q3 is particularly sensitive to electro-static discharge (ESD) damage until inductor L1 is soldered in place.

☐ Remove the temporary jumper and install L1, the larger brown variable inductor in the space next to trimmer capacitor C1.

☐ Unscrew and remove the tuning slug from L1. The tuning slug will not be used.

☐ Install the two red variable inductors near the upper left corner of the board:

__L10 __L11

☐ Unscrew and remove the tuning slugs from L10 and L11. The tuning slugs will not be used.

☐ Locate the shielded inductors with brown inserts provided for L12, L13 and L14 in the R.F. Bandpass filter. Prepare the inductors for installation as follows:

- __ Use the inductor alignment tool to exercise the core in each inductor. If the alignment tool fits tightly, insert it from the bottom to avoid pushing the inductor out of the shield. Run the core up and down through the coil to ensure it runs smoothly (some inductors are very stiff at first) then position the core near the top of the coil.
- __ Check the two leads and the two tabs on the case of each inductor. If they are bent, straighten them carefully using long nose pliers.

☐ Install the RF Bandpass Filter inductors in the spaces provided between relay K2 and frequency mixer Z1:

__L12 __L13 __L14

☐ Install a jumper across the solder pads at W1 on the left side of the board near the notch and electrolytic capacitor C60.

☐ Verify that there are **no** components installed in the following locations. These components are not used in XV222 transverter:

- __ Choke L18 near the notch on the left side of the board.
- __ Molded inductor L4 near crystal Y1.
- __ Capacitor C59 next to torodial inductor T1.
- __ Capacitor C58 next to torodial inductor T1.
- __ Capacitor C69 next to the OV1 circle on the board.
- __ Molded inductor L3 (replaced by a jumper) to the left of torodial inductor T1.
- __ SMD capacitor C32 on the left next to the notch. (C32 may be incorrectly labeled C58 on your PC board).

☐ Carefully inspect the bottom of the circuit board for the following:

- __ All component leads are soldered. Be especially careful when checking relays and other components with several leads to ensure that all the leads are soldered.
- __ All component leads are clipped at least as short as the relay leads. **Do not cut the relay pins**.

This finishes Part II of the RF Board Assembly. **Proceed directly to RF Board Assembly Part III**

RF Board Assembly – Part III

In the following steps you will install the RF Power module. The procedure is the same for all three transverter models.

☐ If you purchased the optional feet and bail for your transverter (see page 79), install them on the bottom cover now.

☐ You will need the following small hardware:

- __ 14 pan head black screws, 3/16” (4.8 mm) 4-40 thread.
- __ 2 pan head black screws, 1/2” (12.7 mm) 4-40 thread.
- __ 2 nuts, 4-40 thread.
- __ 4 2-D connectors.
- __ 2 flat washers, #4.
- __ 2 inside tooth lock washers, #4.
- __ 8 split lock washers, #4.

☐ Install four 2-D connectors on the bottom corners of the RF Board. Line up the offset holes of each 2-D connector so the side of the connector is flush with the edge of the circuit board (see Figure 32). Secure each connector to the circuit board with two black 3/16” (4.8 mm) pan head screws and split lock washers.

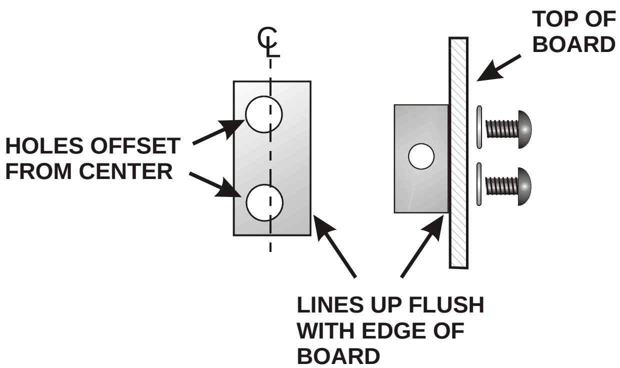


Figure 32. 2-D Connectors.

In the following steps you will install the hardware that attaches the RF power module to the bottom cover. Follow the steps carefully to ensure the module makes good thermal contact with the bottom cover and the leads line up properly with the RF board. The completed hardware assembly is shown in Figure 36 .

☐ On the inside surface of the bottom cover, locate the area with four holes along one side that matches the holes in the heat spreader. Test-fit the larger of the two thermal conduction pads so that the holes in the pad line up with the holes in the cover. Orient the pad so it does not hang over the edge of the bottom cover.

☐ Lift the thermal conduction pad and clean the surface of the bottom cover under the pad using the sandpaper supplied, a sharp knife or other tool. The pad should rest against clean metal.

☐ Clean the paint off of the inside surface of the bottom cover around the screw holes in the four corners where the 2D connectors will attach it to the RF board (See Figure 35).

☐ Inspect the edges of the heat spreader and remove any burrs with the edge of a flat-blade screwdriver, knife or small file.

☐ Replace the larger of the two thermal conduction pads over the clean metal area on inside of the bottom cover so that the holes line in the pad line up with the holes in the cover. Be sure the pad does not hang over the edge of the bottom cover.

☐ Place the heat spreader on the thermal conduction pad on so the screw holes line up. Put a 1/2” (12.7 mm) pan head screw through each unthreaded hole with the head on the bottom cover. Place a nut on each screw and finger tighten.

☐ Insert two black 3/16” (4.8 mm) pan head screws through the bottom cover into the threaded holes in the head spreader. Tighten the screws.

☐ Lay the bottom cover on a clean, smooth surface with the heat spreader facing up.

☐ Remove the nuts from the long screws but do not remove the screws. If you have installed feet on the bottom cover, place a small book that fits between the feet under the cover so the long screws do not fall out.

☐ Place the smaller thermal conduction pad over the screws. Orient the pad so it does not hang over the edge of the heat spreader.

☐ Position the RF power module on the two screws as shown in Figure 33. Be sure the thermal conduction pad on the heat spreader is resting directly against the bottom of the RF power module.

☐ Place a flat washer on each screw as shown in Figure 33.

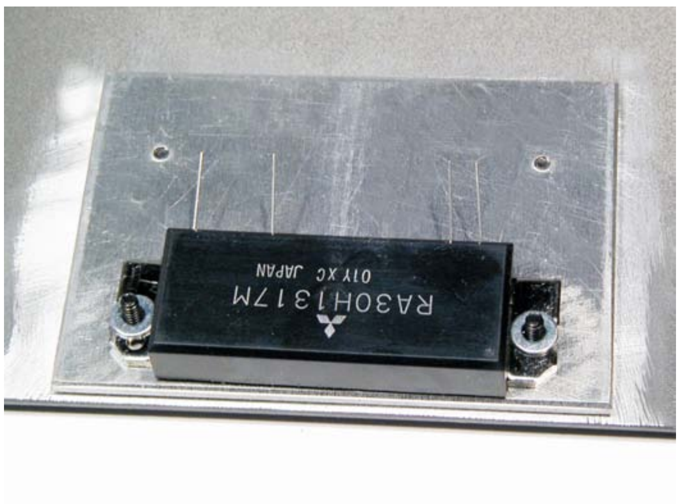


Figure 33. RF Power Module and Flat Washers in Place on the Heat Spreader.

☐ Slide the circuit board under the leads on the RF power module and over the screws until they pass through the holes in the board (see Figure 34). You can rock the RF Power Module slightly on the screws and bend the leads up as needed to slip the board under them and over the tops of the mounting screws.

☐ Place an internal tooth lock washer and nut on each screw and tighten them finger tight.

Figure 34. RF Board attached to the RF Power Module Screws.

☐ Pick up the entire assembly and secure the four 2-D fasteners to the bottom cover. Each corner is attached with one 3/16” (4.8 mm) black screw (see Figure 35). The other two screw holes in each 2-D fastener will secure the front, rear and side covers in later steps.

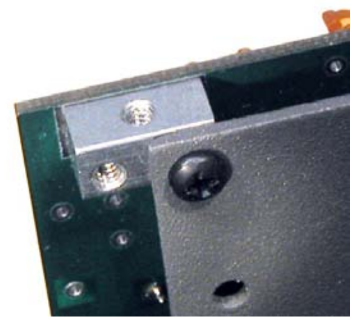


Figure 35. Bottom Cover Attached to 2-D Fastener.

☐ Inspect the RF Power module to be sure you have the module and hardware installed exactly as shown in Figure 36.

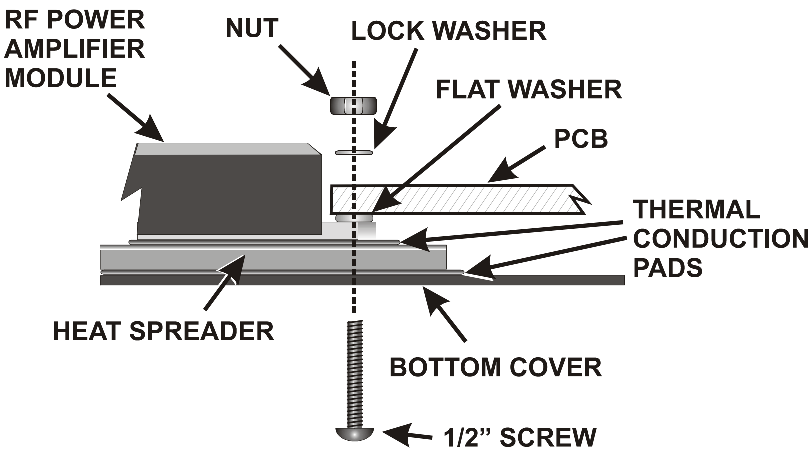


Figure 36. RF Amplifier Module Mounting Hardware.

☐ Adjust the position of the RF Power module to provide the best alignment of the leads with the solder pads on the circuit board. If necessary, loosen the nuts slightly to allow the module to move within the limits of its screw holes. **Note:** There are four leads on the RF power modules for the XV144 and XV222 and five leads on the module for the XV50.

☐ Hold the RF Power module in place and tighten both screws and nuts to secure it.

Be sure the four screws holding the RF Power module and head spreader are tightened securely to ensure good heat transfer. Otherwise the RF Power module may overheat and fail.

☐ Solder the RF power module leads to their corresponding pads on the circuit board. Before soldering, trim the leads as needed so they do not extend beyond the solder pads.

This finishes Part III of the RF Board Assembly. **Proceed directly to Final Assembly.**

Final Assembly

In the following steps you'll finish assembling the transverter.

☐ Remove paint overspray from around the screw holes on the inside surface of the cabinet back panel where the 2D connectors will be attached (see Figure 42). The 2D connectors should make good electrical contact with the back panel.

Good electrical contact between all of the chassis parts is essential for optimum shielding and system noise figure.

☐ Mount antenna connector J1 on the cabinet back panel using four 5/16" 4-40 pan head zinc screws, lock washers, nuts and one ground lug as shown in Figure 37. Be sure the ground lug is on the lower screw nearest the end of the back panel and faces upward as shown. The antenna connector is an S0-239 (UHF) connector on the XV50 transverter, and a type "N" connector on the XV144 and XV222 transverters.

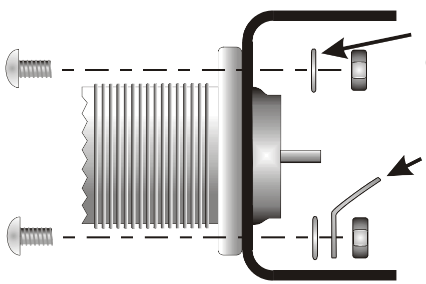


Figure 37. Mounting the Antenna Connector J1 on the Back Panel.

☐ Solder the two clipped leads you saved when you installed D5 (Page 31) to the J1 solder pads on the RF board. The J1 pads are near K1 (see Figure 38).

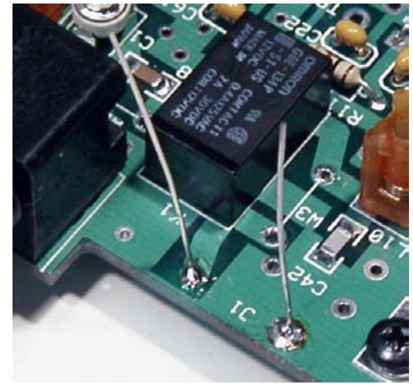


Figure 38. J1 Solder Pads on RF Board.

☐ Position the cabinet back panel on the rear of the RF circuit board so the 12 VDC, Control, TXn/IF1, RXout/IF2, Key In and Key Out jacks project through the holes in the cover. Attach the cover to the 2-D connectors at the rear of the RF Board using two 3/16" (4.8 mm) black pan head screws.

☐ Attach the two DB-9 male-female standoffs to the Control connector. Use a #4 inside tooth lock washer between each standoff and the rear cover. **Note: Do not force the threads**. When assembling the modular chassis, screw holes will sometimes not align perfectly. Loosen the other screws holding the panel so it can move as needed to align the holes so all the screws can start easily, then tighten all hardware.

☐ Slip the finish lock washers and nuts over the BNC connectors and tighten them.

☐ Connect J1 to the leads already soldered to the RF Board as follows (See Figure 39):

- Solder the lead that is farthest from the edge to the center pin on the antenna connector. This is the lead that goes to the circuit trace on the board. Keep the lead as short as possible.
- Solder the lead attached to the RF board at J1 that is closest to the corner to the ground lug on the antenna connector. This is the lead that goes to the ground plane on the board. Bend the ground lug up as needed to reach it. Keep the lead as short as possible.

Figure 39. Installing J1.

☐ Mount the two right-angle brackets on the edge of the RF board (see Figure 14. Installing J1 and P1. Place the shorter side of each bracket against the top of the RF board and secure it with a 3/16” (4.8 mm) screw and split lock washer.

Either wear a grounded anti-static wrist strap or touch an unpainted, grounded object before handling the processor (U1) in the next steps, or at any time you handle the front panel board unplugged from the RF board with processor U1 installed.

☐ Remove processor U1 from its conductive foam packing and inspect the pins. The two rows of pins must be straight and parallel to each other to establish the proper pin spacing for insertion into the socket. To straighten the pins, rest one entire row of pins against a hard, flat surface. Press down gently on the other row of pins and rock the IC forward to bend the pins into position as shown in Figure 40.

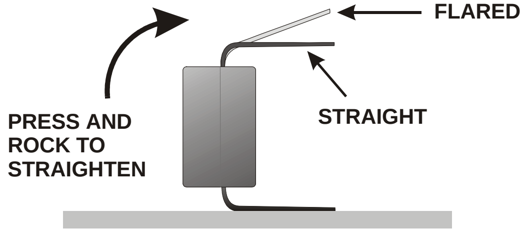


Figure 40. Straightening IC Pins.

☐ Identify the end of the IC where Pin 1 is located. It will have a notch, a dimple or both at this end (see Figure 41).

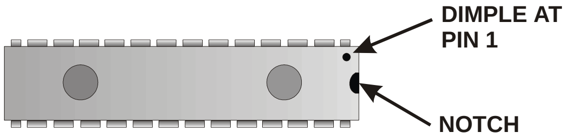


Figure 41. IC Orientation.

When U1 is pressed into its socket, you must be careful to avoid jamming its pins. Make sure all the pins are lined up with the associated holes before pressing down on the IC. Watch the pins on both rows as you press down to be sure each pin goes straight down into its socket hole and does not bend in under the IC or outward alongside the socket. Realign each pin individually with its socket hole, if necessary.

☐ Insert processor U1 in its socket with pin 1 or the notched end lined up with the notched end of the socket (the end farthest from the edge of the front panel board). Be careful while pressing U6 into its socket not to bend or damage the power indicator LEDs on the front side of the board.

☐ Insert plug P1 on the front panel board into J1 on the bottom of the RF board, and then secure the front panel board to the two right angle brackets with 3/16" (4.8 mm) screws and split lock washers.

☐ Place the cabinet front panel face up on your work surface and attach the label with two 2-56 screws. Orient the label with the lighter side upward so that the band identification reads correctly when viewed from the front.

☐ Fit the front panel over the power pushbutton and power LEDs. Attach the front panel to the 2-D connectors on the bottom of the RF board with two 3/16" (4.8 mm) screws.

☐ Press the key cap onto the On/Off switch shaft until it clicks in place.

☐ Attach a 2-D connector to the each screw hole at the top corners of the front and rear chassis end panels with 3/16" (4.8 mm) screws. Be sure the widest side of each 2-D connector is facing toward the end of the panel so the edge lines up flush with the edge of the panel as shown.

Figure 42. Attaching 2-D Connectors to Cabinet End Covers.

☐ Attach the side panels using four 3/16" (4.8 mm) screws in each panel. You many need to loosen the other screws holding the end covers temporarily to line up the screw holes properly.

In the following step be sure to orient the Anderson power connector shells exactly as shown. Otherwise, the connector will not mate with the connector on the transverter.

☐ Locate the two Anderson power connector shells. Orient them as shown in Figure 43 and slide them together so the tongue on one side fully engages the groove on the other half.

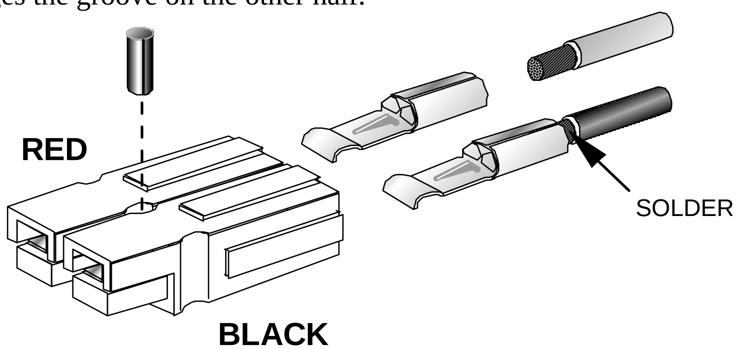


Figure 43. Power Cable Connector Assembly.

Use only the supplied 12 AWG, 2-conductor stranded wire (red/black) for the DC power cable.

☐ Separate the two conductors at one end of the 12 AWG, 2-conductor cable. Remove 5/16" (8 mm) of insulation from the red and black wires at one end. Do not nick or cut off any of the strands.

☐ Insert the wires into the terminals as shown above. Solder the wires to the crimp terminals, using enough solder to completely surround the wire and fill the interior of the terminal. (This may take as long as 10 seconds if you're using a small iron.) Be careful not to get solder on the tongue that extends from the front of the terminal.

☐ Insert the terminals into the housings exactly as shown in Figure 43. The terminals should snap securely in place. Pull on the wires individually and make sure they cannot be pulled out (if so, the terminals are probably inserted upside down).

☐ **Optional:** The supplied spring pin may be inserted as shown in the figure above to keep the red and black housing from slipping apart. The manufacturer of the connectors recommends securing the pin with a drop of super-glue.

☐ Prepare the opposite end of the 2-conductor stranded wire and attach the red wire to your power supply positive (+) terminal and the black wire to the power supply negative (-) terminal.

☐ Locate the top cover and the four 3/16" (4.8 mm) screws provided to attach it to the 2D connectors on the top of the transverter.

☐ Clean any paint from the areas where the inside surface of the top cover will contact the 2D connectors when it is installed. You may leave the top cover off at this time if desired. You will need the top open to complete the installation and alignment procedures.

☐ Locate and set aside the nine, 2-pin header shorting blocks. They will be used in the Installation section to configure your transceiver to work with your station equipment.

Skip the next step if you have installed the optional feet and bail assembly.

☐ Attach the self-stick rubber feet to the bottom of your transverter. Use the pre-drilled holes for the optional feet as a guide.

_ Place the rear feet over the screw holes.

_ There are two screw holes provided for each front foot. Position each front foot between the holes.

This completes the assembly of your transverter. Go to the Alignment and Test section next.

Alignment and Test

You will need the following equipment to perform the following procedures:

- __ 28 MHz transceiver or transmitter and receiver to use as the I.F. system, with interconnecting cables.
- __ Power supply capable of providing 13.8 VDC at 5 A, minimum.
- __ Digital Multimeter (DMM).
- __ Noise Generator (Elecraft N-Gen or equivalent) or signal generator with output in the RF frequency range of the transverter.
- __ RF Wattmeter capable of measuring 20 watts with good accuracy.
- __ RF dummy load, 20 watts minimum
- __ Adjustment tool for the inductors in the transceiver (supplied with kit).

In addition, you will need **one** of the following to adjust the frequency of the local oscillator in an XV50 transverter.

- __ A frequency counter capable of measuring signals in the 22 or 50 MHz range, or
- __ A calibrated signal generator capable of producing output with good frequency accuracy in the 50 MHz Amateur band (an H.F. transmitter with a well-calibrated VFO that covers the 12 meter Amateur band may be used).

Initial Setup

☐ Pre-set the potentiometers on the RF board as follows:

- __ R10 (Power Cal) at mid-range.
- __ R13 (LNA Bias) full CCW (counter clockwise).
- __ R22 (Input Atten Adjust) full CCW.
- __ R39 (PA Bias) full CCW.

ⓘ **In the next step you will use the alignment tool supplied with your kit to preset inductor slugs a certain number of turns down from the top of the coil. You may find it easier to count the turns if you place a readily-visible mark on the alignment tool.**

☐ Pre-set the inductors in the transverter as follows. Turns are measured down from the point where the slug is flush with the top of the coil.

COIL	XV50	XV 144	XV222
L12	0	6	6
L13	3	6	6
L14	1.5	6	6
L15	2	2	2
L16	2	2	2
L17	2	2	2

☐ Verify that the tuning slugs have been removed from the following inductors. If not, remove the cores and discard them. These slugs will not be used:

__ L1 __ L10 __ L11

☐ If you are aligning an XV222, set the slug in inductor L4A even with the top of the form. This slug will not be adjusted in the following procedure. L4A is used only in the XV222 transverter.

☐ Connect an RF power meter and dummy load to the transverter ANT connector.

☐ Verify that the transverter Power switch is Off (button out).

☐ Turn to the Installation section (Page 64) and hook up your transverter to your 28 MHz rig following one of the *Quick-Start Installation* procedures.

Alignment Procedure Part I – All Transverters

☐ Attach a 50 ohm dummy load to the transverter ANT connector.

☐ Adjust your 28 MHz rig output for the level chosen to drive your transverter to full output (normally 1 milliwatt 251 milliwatts or 5 watts)

☐ Apply power to your 28 MHz rig and verify that the transverter power control operates as follows:

- If you are using a non-Elecraft 28 MHz rig, press the transverter Power pushbutton in. Verify that the band label lights.
- If you are using an Elecraft K2, confirm that the transverter band label lights when you select the band assigned to the transverter on the K2, and that the band label goes off when you select any other band. The transverter Power pushbutton should be inoperative.

☐ Attach your DMM ground probe to one of the ground test points on the RF board. One is near the Elecraft label near the center of the board and another is near the Band Select switch in the lower left corner.

You may notice that some of the 1-watt resistors are quite warm to the touch while power is applied when driving the transverter with 5 watts from your 28 MHz rig. This is normal. They are operating well within their design ratings. These resistors were mounted above the circuit board to promote good cooling air circulation around them.

☐ Check the local oscillator level at TP1 as follows. TP1 is in the lower right area of the RF board. **If you find no reading, make sure you have a 2-pin shorting block on JP9 pins 1 and 2.** The local oscillator is disabled until this jumper is installed.

- **XV50**: 0.8 to 1.2 VDC.
- **XV144:** 1.2 to 1.8 VDC.
- **XV222:** 1.0 to 1.5 VDC

☐ Measure the voltage at TP2 near L1 and rear-panel jacks J4 and J5 in the upper left area of the RF board. This is the low-noise amplifier (LNA) bias level. Adjust R13 for between 200 and 275 mV (250 mV nominal).

☐ Perform the following adjustment **only** on XV144 or XV222 transverters. If you are aligning an XV50, go directly to the next step.

- Connect your DMM between TP3 (-) and TP4 (+) near J7 in the upper right corner of the RF board.
- Disconnect the 28 MHz rig from the transverter and connect it to a suitable dummy load.
- Key the 28MHz rig to put the transverter into transmit mode with no RF input. Adjust R39 for a reading of 20 mV on your DMM. This sets the quiescent bias level for the RF power module.
- Reconnect your 28 MHz rig to the transverter I.F. input.

☐ Connect your DMM between a ground test point and TP5, in the upper left area of the RF board near Power Cal pot R10.

☐ Verify that your 28 MHz rig is set for the output power that you want to correspond to 20 watts output from the transverter.

☐ Set the H.F. rig frequency to transmit at 51 MHz, 145 MHz or 223 MHz. If you are using an Elecraft K2 in transverter mode, the frequency display will show the actual transmit frequency. Other H.F rigs must be set to 29 MHz.

☐ Key the 28 MHz rig to provide transmit RF to the transverter and advance R22 (Input Atten Adjust) until a reading anywhere between 0.1 and 10 volts is obtained on the DMM.

While performing this alignment, take care not to overheat your 28 MHz I.F. rig by holding the key down too long.

☐ With the 28 MHz rig keyed to provide transmit RF, adjust L12, L13, L14, L15, L16 and L17 for maximum voltage at TP5. The adjustment of L17 is very broad. If the voltage exceeds 10 volts, turn R22 (Input Atten Adjust) CCW to reduce the voltage. **Note:** the front panel Power Output LEDs may begin lighting as you peak the inductors.

☐ Repeat peaking L12, L13, L14, L15, L16 and L17 for maximum voltage at TP5 several times, turning R22 CCW as needed to keep the voltage below 10 volts. Some of the adjustments interact.

☐ Set your 28 MHz rig for the maximum transmit signal level you configured the I.F. power level jumpers for in the Installation procedure (1 milliwatt or 5 watts).

Do not exceed the recommended maximum transmit power from your 28 MHz rig, depending upon how you configured the transverter jumpers. Exceeding the maximum level may damage the transverter.

☐ Set your 28 MHz rig transmit frequency to 29.5 MHz. If you are using an Elecraft K2 in transverter mode, the frequency displayed will be 51.5, 145.5, or 223.5 MHz.

☐ Key the 28 MHz rig to provide a transmit signal and adjust R22 (Input Atten Adjust) for 20 watts indicated on your external wattmeter. When finished, do NOT change the output power from your 28 MHz rig before performing the next step.

☐ Key the 28 MHz rig to provide a transmit signal. With the external wattmeter indicating 20 watts, adjust pot R10 (Power Cal) in the upper left area of the RF Board so that the yellow (20 watt) LED on the transverter front panel just lights.

Accidentally transmitting while performing the following steps could destroy your noise generator.

☐ On your 28 MHz rig:

- If possible, turn the AGC Off.
- Set the receive frequency to 29.0 MHz. If you are using an Elecraft K2 in transverter mode, the frequency display will be 51, 145 or 223 MHz.

☐ Place your DMM in AC volts mode and connect it across the phone or speaker output of your 28 MHz rig to measure the audio level.

☐ Connect your noise generator to the transverter antenna input. Normally this will be the ANT connector unless you wired your transverter for separate transmit and receive connections (see page 34). In that case there will be a BNC connector marked AUX installed next to the ANT connector. If present, connect your signal generator to the AUX connector.

☐ Turn On your noise generator. You should note an increase in the AC voltage reading on your DMM.

☐ Adjust trimmer capacitor C1 near L1 in the upper left area of the transverter RF board for maximum voltage shown on the DMM. You may need to reduce the input from the noise generator to see the peak clearly.

ⓘ **Adjusting C1 for maximum conversion gain will normally result in a receive noise figure of less than 1 dB. However, the adjustment for maximum gain and minimum noise figure do not coincide exactly because the optimum impedance for lowest noise figure differs from an exact conjugate match. With the filter design used in the transverter, adjusting C1 for maximum gain 1 MHz above the lower band limit as described above produces very nearly the optimum noise figure at the bottom of the band. It may be possible to achieve an 0.1 to 0.2 dB improvement in noise figure by adjusting C1 with a calibrated Noise Figure Meter.**

Alignment Procedure Part II – XV50 Only

The XV50 local oscillator frequency is adjustable over a narrow range. Adjust the frequency as follows to provide the best frequency calibration for both transmit and receive on the 28 MHz I.F. rig. Although the local oscillators in the XV144 and XV222 are not adjustable, the firmware in the K2 transceiver allows you to compensate for frequency errors using the menu commands. Once the proper compensation is entered, the K2 frequency display will show the actual transmit and receive frequencies accurately. The same menu commands may be used to correct for small errors in the XV50 frequency as well. See the instructions that accompany the Revision 2 and up K2 firmware for details.

You can calibrate the local oscillator several ways:

- Use a counter to measure the local oscillator frequency at 22 MHz.
- Use a counter to measure the output frequency of the transverter at 50 MHz.
- Use a received signal produced by a calibrated signal generator, transmitter or other known source. The second harmonic from an H.F. transmitter that covers the 12 meter Amateur band also may be used as a signal source.

Using a Counter to Measure the Local Oscillator Frequency

☐ Turn on power to the transceiver and allow the transverter to stabilize for at least 5 minutes at room temperature (approx. 20 – 25º C).

ⓘ **In the next step you will connect the frequency counter to a circuit that has a DC voltage. If your counter does not provide protection against DC voltages, or you aren't sure, place a capacitor in series with the counter input. Any value from 100 pF to .01 µF is suitable.**

☐ Attach the frequency counter to either end of molded inductor L3 (near T1 on the RF board).

☐ Adjust trimmer capacitor Z6 near crystal Y1 for a reading as close to 22.00000 MHz as possible on the frequency counter.

Using a Counter to Measure the Transverter Output Frequency

☐ Turn on power to the transceiver and allow the transverter to stabilize for at least 5 minutes at room temperature (approx. 20 – 25º C).

☐ Attach a dummy load to the transverter output.

ⓘ **In the next step you will connect your frequency counter to the output of your transverter.**

☐ Connect the frequency counter to sample the RF output from the transverter. **Do NOT connect your counter directly to the antenna output without a suitable attenuator to protect the counter input.** If you do not have a suitable attenuator, arrange an insulated wire connected to the counter input that lies near inductors L10, L11 or antenna relay K1 on the RF board. You may need to experiment with the position of the wire to pick up enough RF to operate the counter. Do NOT wrap the wire around L10 or L11. That would detune the output filter and could damage the RF power module.

☐ Set the 28-MHz rig to transmit at 28.0000 MHz. If you are using an Elecraft K2 for the I.F. and have the transverter menu enabled, set the K2 to display a frequency of 50000.00 kHz and ensure that the Menu OFS (Frequency Offset) command is set to 0.00. (Refer to your Rev. 2 and up Firmware instructions for detailed procedure). Be sure that SPLIT and RIT are turned off.

☐ Key the rig to produce a steady carrier and set trimmer capacitor Z6 near crystal Y1 for a reading as close to 50.00000 MHz as possible.

Using a Received Signal

☐ Turn on power to the transceiver and allow the transverter to stabilize for at least 5 minutes at room temperature (approx. 20 – 25º C).

☐ Set up your external signal source to produce an audible signal in the receiver. If you are using an H.F rig, set it to transmit into a dummy load at 25.000 MHz to produce a second harmonic at 50.000 MHz. If it won't transmit outside the 12 meter Amateur band, set it for 24.990 MHz to produce a second harmonic at 49.980 MHz.

☐ Set the I.F rig to the frequency of the test signal. The signal may not be audible if the local frequency oscillator is too far off.

☐ Adjust trimmer capacitor Z6 near crystal Y1 to bring the received signal into the center of the I.F. receiver band pass. If you are comfortable zero beating CW signals, you can listen in CW mode and zero beat the signal against the sidetone.

Overload Circuit Test

This test verifies that the transverter will protect itself in the event a transmit signal is applied while the transverter is still in receive mode.

Do not perform this test if you are using a low-level (1 milliwatt) output from your 28 MHz rig. The overload circuit will not respond to a low-level transmit signal.

☐ Disconnect the noise generator from the transverter Antenna output and reconnect the dummy load.

☐ If you are using an Elecraft K2, temporarily change the XV configuration as follows, otherwise skip this step:

- _ Remove the jumper header from JP8 on the RF Board (near the front corner on the right side).
- _ Write down the DIP switch positions in the spaces provided:

SWITCH	POSITION (On / Off)
1	
2	
3	
4	

- _ Switch all four DIP switches Off.

☐ Disconnect the transmit/receive control from the I.F rig as follows:

- If you are using a non-Elecraft rig for the I.F., disconnect the Key In connector
- If you are using an Elecraft K2, disconnect the interface cable at the Control connector.

☐ Momentarily key the transmitter. Verify that all of the Power LEDS begin flashing and keep flashing even after the transmit signal is removed. This is the Overload warning indicating that a transmit signal was applied to the transverter while the transverter was still in receive mode.

☐ Turn the transverter Power Off, the On again to clear the overload display.

☐ If you are using an Elecraft K2:

- Replace the jumper shorting block on JP8.
- Switch all four DIP switches Off, then reset the switches as they were before performing this test.

☐ Reconnect the Key In or Control line to the transverter.

This completes the alignment and test procedures and the basic installation of your transverter.

For operating information , go to *Using Your Transverter* on page 74.

Installation

Your transverter is designed to integrate closely with the Elecraft K2 transceiver. Also, it will perform well with a variety of 28 MHz rigs and connection setups.

Quick-Start Installation

Choose the setup you wish to use from the following list and go directly to that procedure. If you aren't sure, check the drawings associated with each of the following procedures to see which matches the 28 MHz rig you are using with your transverter.

1. Elecraft K2 with K60XV Adapter. Go to page 65.
2. Elecraft K2 With No K60XV. Go to page 66.
3. Non-Elecraft 28 MHz Rig – Separate Transmit and Receive RF Connections. Go to page 67.
4. Non-Elecraft 28 MHz Rig – Single Transmit and Receive RF Connection. Go to page 68.

Installation Options

We recommend that you use the appropriate Quick-Start Installation and complete the Alignment procedures to verify that your transverter is operating as expected. Once that has been done, the following optional setup configurations may help you better integrate the transverter into your station:

1. *Daisy-Chaining Multiple Transverters.* Using multiple transverters without swapping cables. See page 72.
2. *Using an External Receive Preamplifier*. Using the transverter with an antenna-mounted preamplifier to optimize noise figure with long feed lines. See page 73.
3. *Using an External Power Amplifier*. Controlling an external power amplifier from the transverter. See page 73.

Special Notes for Elecraft K2 Owners

Your K2 must be equipped with:

- **KIO2 Interface.** Either the stand-alone KIO2 interface for the QRP version of the K2 or the KIO2 interface built into the KPA100 amplifier is suitable.
- **Revision 2 Firmware.** Hold any front-panel button while turning on the power to your K2 to see the current firmware version. Upgraded firmware is available from Elecraft.

K2's with serial numbers 3445 and earlier should be equipped with the following Elecraft-approved modifications.

- **10 Meter Bandpass Filter and VFO/ALC modification**, applicable to all K2's S/N 2999 and down. This modification reduces spurious signals. It is very strongly recommended.
- **K2 BFO Toroid & PLL Ref Osc Xtal Upgrade,** applicable to K2's S/N 2999 and down. This modification substantially reduces the K2's reference oscillator and BFO frequency drift.
- **Temperature-Compensated PLL Reference Upgrade**, applicable to K2's S/N 3445 and down. This modification further reduces the K2's reference oscillator frequency drift.

The Elecraft K60XV 60-M and Transverter Adapter is highly recommended for use with the transverters. This adapter provides separate (split) receive and low-level (1 milliwatt) transmit drive to the transverter. It eliminates the need to switch between the transverter and an external antenna when using the K2 as both the transverter I.F. and as an H.F. rig.

Elecraft K2 With K60XV Adapter

This setup uses the low-level transmit and separate receiver connections provided by the K60XV module. This leaves the K2 or K2/100's antenna connection free for use on the HF bands. The K2 must be equipped with an auxiliary input/output either through a KIO2 interface or the one built into the KPA100 amplifier.

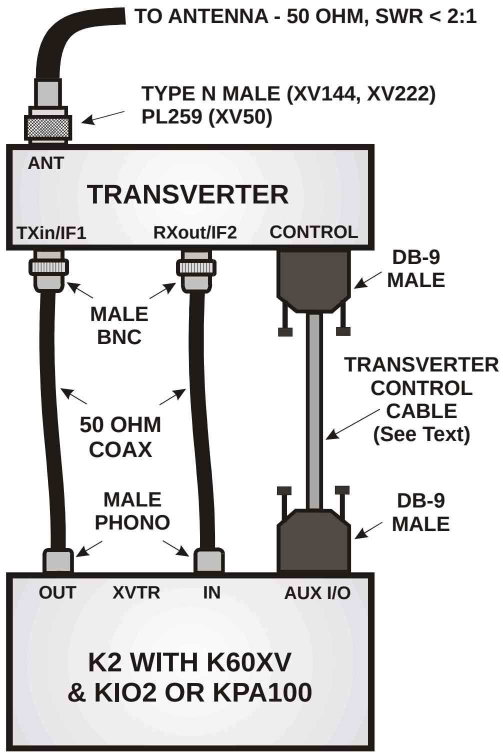


Figure 44. Connecting the Transverter to an Elecraft K2 With a K60XV Interface.

☐ Refer to the *Transverter Operation* section of the *Elecraft K60XV 60-M and Transverter Adapter Assembly and Operating Instructions* and use the K2's MENU commands to configure the K60XV for operation with the transverter:

_ Note the TRN number you have set up for the transceiver.
_ Set the maximum output to: Out L 1.00 (1.00 milliwatts).

☐ Refer to the following table and set the dip switch on the RF board for the TRN number you assigned.

TRN	DIP SWITCH POSITIONS			
	1	2	3	4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	ON
5	OFF	ON	ON	OFF
6	OFF	ON	OFF	ON
7	OFF	OFF	ON	ON
8	OFF	ON	ON	ON

☐ Place 2-pin shorting blocks on transverter RF board jumpers shown below:

_ JP1: 1-2 _ JP2: 2-3 _ JP3: 1-2
_ JP4: 1-2 _ JP5: 2-3 _ JP6: 2-3
_ JP9: 1-2

☐ Place a shorting block on 2-pin jumper JP8 (near the ON/OFF switch on the RF board).

☐ Refer to *Transverter Control Cable for Elecraft K2 or K2/100* on page 69 to make up a new transverter control cable or to add connections for the transverter to your existing Aux I/O cable.

☐ Connect the cables as shown in Figure 44.

☐ Connect a 13.8 vdc, 5 ampere power supply to the transverter using the cable with the Anderson connector described in *Final Assembly*, page 57.

This completes your basic installation. If you are hooking up your transverter to perform the alignment and test procedures, go to *Alignment Procedure Part I – All Transverters*, page 59.

Elecraft K2 With No K60XV

This setup uses the K2's antenna port for both the transmit and receive signal path to the transverter. The K2 must be equipped with an auxiliary input/output either through a KIO2 interface or the one built into the KPA100 amplifier.

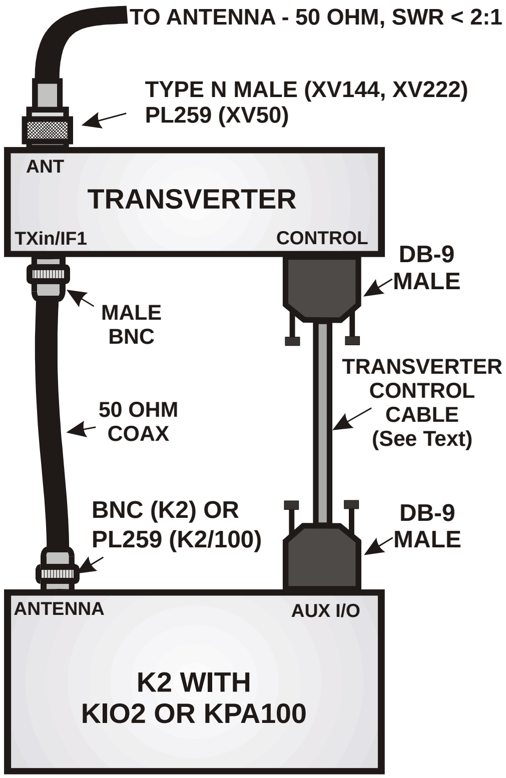


Figure 45. Connecting the transverter to an Elecraft K2 without a K60XV interface

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☐ Refer to your K2 Operating Manual and use the K2's MENU commands to do the following. Refer to the instructions that came with your current firmware.

_ Note the TRN number you have set up for the transceiver.

_ If using a K2/100, set the MENU command for PA OFF.

☐ Refer to the following table and set the dip switch on the RF board for the TRN number you assigned.

TRN	DIP SWITCH POSITIONS			
	1	2	3	4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	ON
5	OFF	ON	ON	OFF
6	OFF	ON	OFF	ON
7	OFF	OFF	ON	ON
8	OFF	ON	ON	ON

☐ Place 2-pin shorting blocks on transverter RF board jumpers shown below:

_ JP1: 2-3 _ JP4: 2-3

_ JP2: 1-2 _ JP5: 1-2

_ JP3: 2-3 _ JP6: 1-2

_ JP9: 1-2

☐ Place a shorting block on 2-pin jumper JP8 (near the ON/OFF switch on the RF board).

☐ Refer to *Transverter Control Cable for Elecraft K2 or K2/100* on page 69 to make up a new transverter control cable or to add connections for the transverter to your existing Aux I/O cable.

☐ Connect the cables as shown in Figure 45.

☐ Connect a 13.8 vdc, 5 ampere power supply to the transverter using the cable with the Anderson connector described in *Final Assembly*, page 57.

This completes your basic installation. If you are hooking up your transverter to perform the alignment and test procedures, go to *Alignment Procedure Part I – All Transverters*, page 59.

Non-Elecraft 28 MHz Rig – Separate Transmit and Receive RF Connections.

This setup is for any 28 MHz rig capable of providing separate transmit and receive connections. The transmitter must be capable of providing a variable RF output of up to 1 milliwatt, 251 milliwatts or 5 watts, and provide a key line that will ground a 5 volt logic level on transmit.

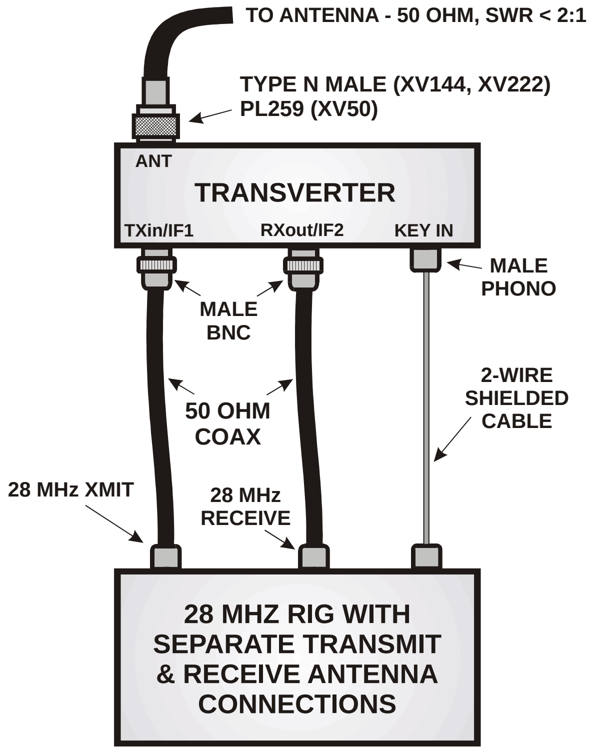

Figure 46. Connecting the Transverter to a Non-Elecraft 28-MHz Rig with Separate Transmit and Receive RF Paths.

☐ On the transverter RF board, set all four dip switches to OFF.

☐ Place 2-pin shorting blocks on transverter RF board jumpers shown below:

_ JP1: 1-2 _ JP2: 2-3 _ JP9: 1-2

☐ From the options below, choose the power output from your 28 MHz rig that will drive the transverter to full output. Place 2-pin shorting blocks on the corresponding RF board jumpers as shown:

Max. 28 MHz Drive Level	JP3	JP4	JP5	JP6
1 milliwatt	1-2	1-2	2-3	2-3
251 milliwatts	1-2	1-2	1-2	1-2
5 watts	2-3	2-3	1-2	1-2

Take care not to exceed the maximum power level you set up the transverter for in the previous step. Doing so may result in damage to the transverter.

☐ Place a shorting block on 2-pin jumper JP7 (near the ON/OFF switch on the RF board).

☐ Locate front panel board 2-pin jumper, JP1, between the end of the socket-mounted controller IC and the side of the transverter. Place a shorting block on JP1 (Do not confuse this JP1 with three pin jumper JP1 on the RF board.)

☐ Connect the cables as shown in Figure 46.

☐ Connect a 13.8 vdc, 5 ampere power supply to the transverter using the cable with the Anderson connector described in *Final Assembly*, page 57.

This completes your basic installation. If you are hooking up your transverter to perform the alignment and test procedures, go to *Alignment Procedure Part I – All Transverters*, page 59.

Non-Elecraft 28 MHz Rig – Single Transmit and Receive RF Connection.

This setup is for any 28 MHz rig with a single RF port for transmit and receive. The transmitter must be capable of providing a variable RF power output of up to 1 milliwatt, 251 milliwatts or 5 watts, and provide a key line that will ground a 5 volt logic level on transmit.

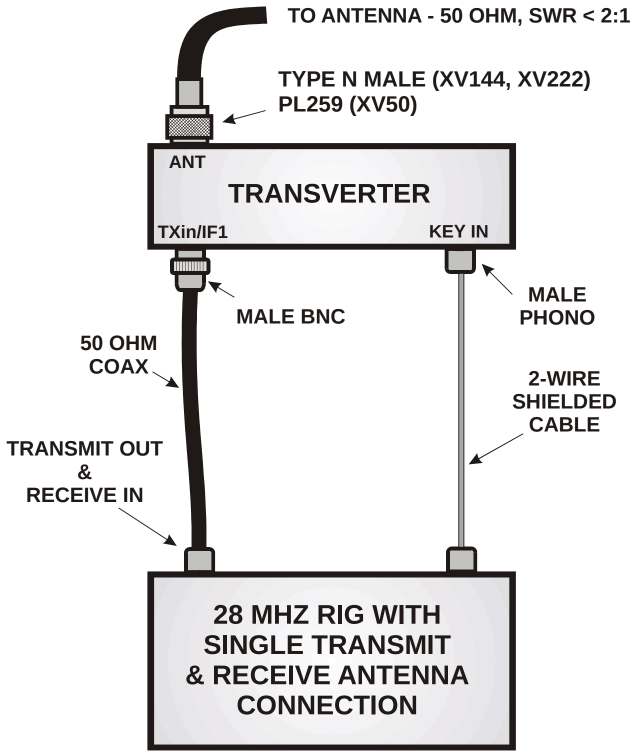

Figure 47. Connecting the Transverter to a Non-Elecraft 28-MHz Rig with a Single Transmit and Receive RF Path.

☐ On the transverter RF board, set all four dip switches to OFF.

☐ Place 2-pin shorting blocks on transverter RF board jumpers shown below:

_ JP1: 2-3 _ JP2: 1-2 _ JP9: 1-2

☐ From the options below, choose the power output from your 28 MHz rig that will drive the transverter to full output. Place 2-pin shorting blocks on the corresponding RF board jumpers as shown:

Max. 28 MHz Drive Level	JP3	JP4	JP5	JP6
1 milliwatt	1-2	1-2	2-3	2-3
251 milliwatts	1-2	1-2	1-2	1-2
5 watts	2-3	2-3	1-2	1-2

Take care not to exceed the maximum power level you set up the transverter for in the previous step. Doing so may result in damage to the transverter.

☐ Place a shorting block on 2-pin jumper JP7 (near the ON/OFF switch on the RF board).

☐ Locate front panel board 2-pin jumper, JP1, between the end of the socket-mounted controller IC and the side of the transverter. Place a shorting block on JP1 (Do not confuse this JP1 with three pin jumper JP1 on the RF board.)

☐ Connect the cables as shown in Figure 47.

☐ Connect a 13.8 vdc, 5 ampere power supply to the transverter using the cable with the Anderson connector described in *Final Assembly*, page 57.

This completes your basic installation. If you are hooking up your transverter to perform the alignment and test procedures, go to *Alignment Procedure Part I – All Transverters*, page 59.

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Transverter Control Cable for Elecraft K2 or K2/100

Your transverter was supplied with a DB-9 cable connector and a length of multi-conductor wire for making up the transverter control interface cable for use with an Elecraft K2 or K2/100. You will need the DB-9 connector that came with your KIO1 or KPA100 to complete the cable. Follow the procedure below to make up your control cable.

If you are already using the K2 Aux I/O port to control a KPA100 ATU or to communicate with your personal computer, you may add the transverter control cable to the existing cable at the DB-9 connector so you won't need to switch connectors when using the transceiver (see Figure 50 on page 71).

☐ Cut a length of the 4-conductor cable to suit the needs of your station layout. **Note:** Keep the cable length as short as practical. A length of 2' (60 cm) is recommended. Longer lengths may be used, but a longer length will have to be tested to ensure that it is not subject to RF interference. A more heavily-shielded cable may be required.

☐ If you are integrating two or more transverters into the station at this time, cut a length of cable as needed to reach from the first transverter to the second transverter in a daisy-chain arrangement (see Figure 50).

☐ Remove 1/2" (12 mm) of the jacket from the cable at each end. Be very careful not to nick the individual wires.

☐ Peel back and cut away the foil shield. Be sure that you do **not** cut the bare ground wire.

☐ Strip of 3/16" (5 mm) of insulation from each insulated wire.

☐ Twist the strands of each wire together. If you are daisy-chaining cables, twist the ends of leads with like colors together. Tin lightly with solder.

☐ Solder the wires to the male DB-9 connector supplied with your transverter as shown in Figure 48.

Follow the color codes shown below when wiring the connector. The same color code is used in the control interface cables for other Elecraft equipment. Keeping a consistent color code will help avoid assembly mistakes and make troubleshooting easier.

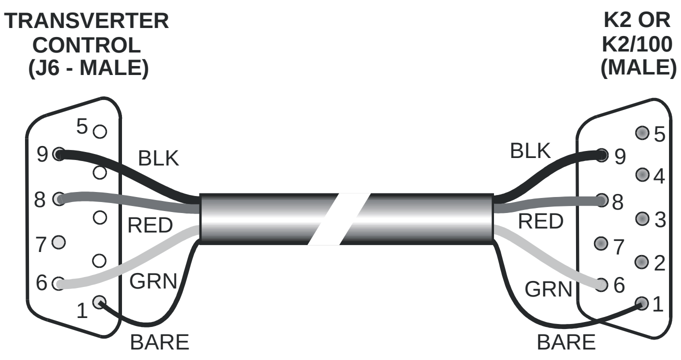


Figure 48. K2 Control Cable Wiring.

☐ If you have not built an RS-232 or control cable to connect other equipment to your K2, you should have an unused DB-9 male connector that was supplied with the KI02 or KPA100 kit. In that case, wire the connector as shown in Figure 48. If you have wired the cable for the K2 and other accessories already, add the transverter extension(s) to it as shown in Figure 50.

☐ Attach the connector housing to the transverter connector(s) as shown in Figure 49. The cable clamp has enough capacity to handle up to three cables. Before closing the housing, be sure that:

- The clamp holds the cables securely, so that strain cannot be placed on the soldered joints.
- The jack screws are positioned between the stops so the threaded ends cannot extend more than about 1/8" (3 mm) beyond the housing. If the jack screws extend too far they will prevent the connectors from mating fully, resulting in intermittent or open electrical connections.

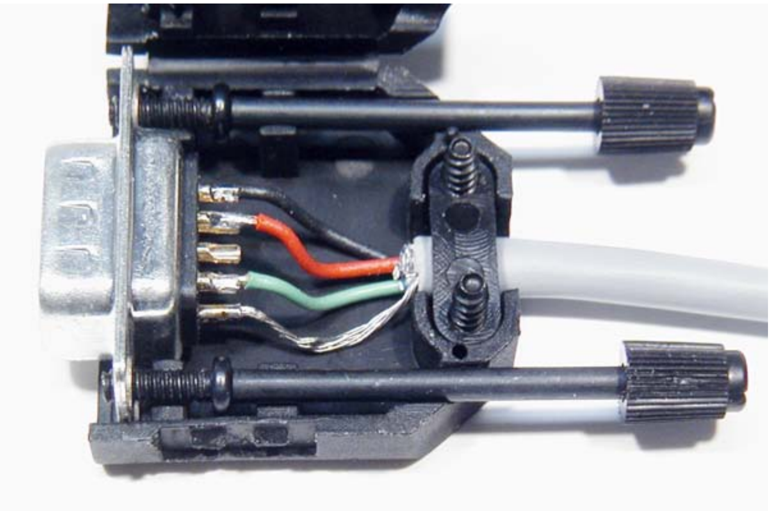


Figure 49. Installing DB-9 Connector Housing.

This completes your transverter control cable. If, in the future, you chose to add more transverters, add a KAT100 ATU interface to your H.F. station, or connect your K2 to a personal computer, you can parallel the connections needed to your existing cable as shown in Figure 50.

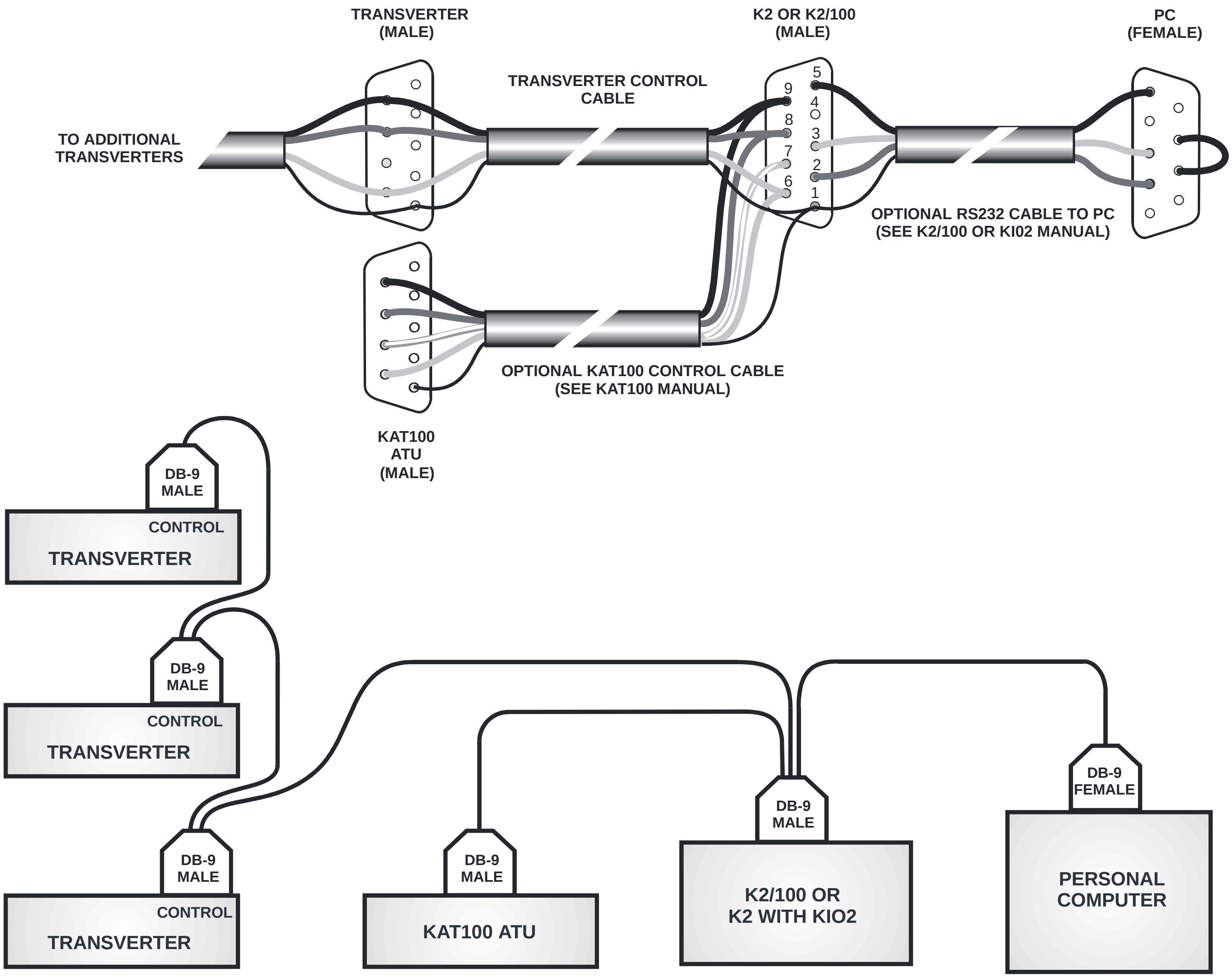


Figure 50. K2 Extended Control Cabling Hookup Diagram.

Daisy-Chaining Multiple Transverters

You can “daisy chain” several transverters together as shown in Figure 51 to avoid swapping cables when switching between them.

When using an Elecraft K2 for the 28 MHz I.F. rig, a multi-wire control cable is required. See Figure 50 for information on paralleling several cables. The control cable connects between the AUX I/O DB-9 connector on the K2 and the CONTROL DB-9 connector on each transverter.

When using a non-Elecraft rig, the two-wire key line is connected in parallel to the KEY IN phono connector on each transverter.

Relays inside the transverters disconnect the transverters not in use so the RF lines are not loaded by inactive transverters in the daisy chain.

The transverter in use is selected as follows:

- When using an Elecraft K2, the active transverter is selected by the BAND switches on the K2.
- When using a non-Elecraft rig for the 28 MHz I.F., the desired transverter is selected by its front panel ON/OFF switch.

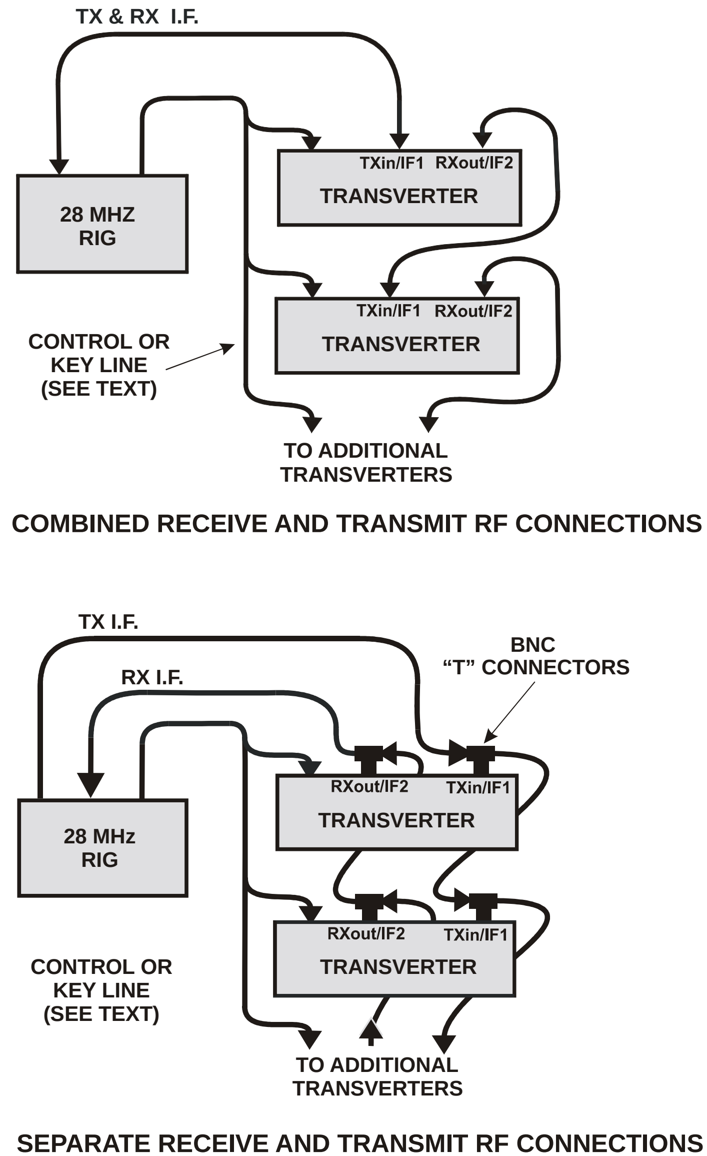


Figure 51. Daisy-Chaining Transverters.

Using an External Receive Preamplifier

An external receiver preamplifier is sometimes mounted at the antenna to offset transmission line losses and provide the best possible system noise figure.

When using an external receive preamplifier, you may want to reduce the transverter receive gain to maintain the best possible system dynamic range. A procedure for reducing the transverter receive gain without adversely affecting the noise figure is described in *Reducing Receive Gain to Preserve System Dynamic Range* on page 79.

If the external preamplifier does not provide a bypass switch when transmitting, separate transmit and receive antennas and transmission lines are required as shown in Figure 52.

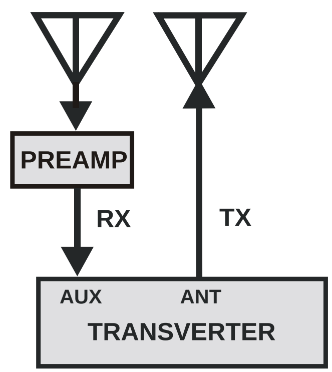


Figure 52. Using an External Receive Preamplifier Without Transmit Bypass Capability.

If you haven't already done so, the transverter needs to be wired for separate transmit and receive antenna connections as described in *Changing Between Split and Common Antennas* on page 77.

Using an External Power Amplifier

The transverter may be used to drive an external power amplifier as shown in Figure 53.

- The external power amplifier must present an SWR of less than 2:1 to the transverter output.
- The external power amplifier must key with a closure to ground and present less than +200 volts to the transverter KEY OUT during receive.

See *Changing Between Split and Common Antennas* on page 77 for instructions on rewiring the transverter RF outputs as needed.

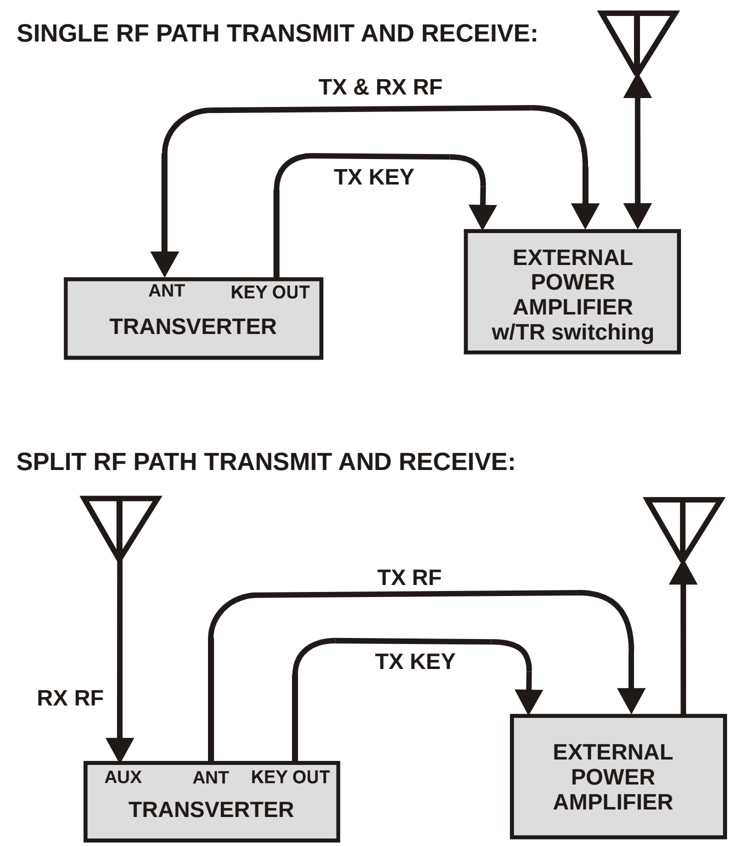


Figure 53. Using an External Power Amplifier.

Using Your Transverter

Once your transverter is hooked up to your antenna system and other equipment as described in the Installation (page 64), operation consists of turning on the transverter and setting the output power.

Cautions to Avoid Spurious Emissions From Your Station

Do not use an antenna relay to switch the 28 MHz rig output between an antenna and the transverter unless it has adequate isolation to ensure that no RF energy leaks to the antenna when it is not selected. Most normal coaxial relays do not have adequate attenuation

When using a K2, do not use the 2nd antenna position. The K60XV Adapter will provide a provide a will isolated transverter interface what does allow you to have an HF antenna connected to the K2 without concern for spurious radiation when using the transverter.

Turning the Transverter On

If an Elecraft K2 is being used for the I.F., the transverter power is turned on automatically when the band assigned to the transverter is selected at the K2 with the **BAND+** or **BAND-**.buttons. The light behind front-panel band label on the transverter will turn on indicating that power is applied and the transverter is operating.

When a rig other than the Elecraft K2 is used for the I.F., the transverter is made active by pressing the front panel switch to turn the transverter On. The light behind the front-panel band label on the transverter will light.

Power Output Control

Set the output power on your 28 MHz rig for the transverter power output desired. Do not exceed 20 watts output from the transverter, either carrier level on CW/FM or peaks on SSB or data modes. On the transverter front panel, a yellow LED indicates 20 watts. Green LEDs indicate levels below 20 watts and red LEDs indicate levels above 20 watts.

Local Oscillator Power Control

To minimize frequency drift you may want to have the local oscillator running at all times, even when the transverter is inactive. However, in some installations it is possible that a harmonic of the local oscillator may produce unwanted birdies when operating on other bands.

In the Installation section you set up the local oscillator to switch On and Off with the transverter power.

The behavior of the local oscillator may be selected by a 2-terminal shorting block at JP9 as follows:

- JP9, 1-2: Default: The local oscillator power goes off whenever the power is turned off or, when used with an Elecraft K2, the transverter is deselected by changing bands.
- JP9, 2-3: The local oscillator power is on whenever the transverter power is on or, when used with an Elecraft K2, the K2's power is on even though the transverter band may not be selected.
- JP9, 4-5: The local oscillator power is on whenever 12 volts is applied at J7 on the back panel regardless of the state of the power or band switches. This is the recommended jumper setting if you have installed the optional crystal oven so that the oven will remain at operating temperature.

Regardless which jumper setting you choose, power to the receive circuits (other than the local oscillator) is turned off except during receive mode. This avoids the possibility of strong signals leaking into the I.F system when several transverters are used with the same H.F. rig and a different band is in use.

I.F. Overload Condition

If a high-level transmit I.F. signal is applied to the transverter when it is in receive mode, a protective circuit will disable the transverter. All of the front panel power display LEDs will flash in unison to alert you that an Overload condition has occurred. To clear this condition, turn the transverter power Off, then On again. (If you're using the transverter with an Elecraft K2, turn the K2 power Off, then On again since the transverter power is controlled by the K2's power switch).

When you key the 28 MHz rig, the transverter automatically switches to transmit mode when the transmit enable signal is received. When used with an Elecraft K2, this signal is supplied through the DB-9 connector. When used with other 28 MHz rigs, this signal is supplied to the KEY IN phono jack on the transverter. An I.F. Overload condition usually means that one of these signals is not connected to the transverter. It must be corrected before the transverter will operate.

Front Panel Display Control

When used with an Elecraft K2, the front panel LEDs are controlled by the K2 through the Menu commands. The Menu LCD DAY command provides full brightness and the LCD NIGHT command dims the LCDs. The GRPH Menu command controls the behavior of the K2 bargraph and the Power Output LEDs on the transverter as follows:

DOT: Just one LED representing the power output will illuminate.

BAR: All LEDs to the left of the current LED will illuminate, resulting in a more visible display.

OFF: The LEDs operate in DOT mode.

When used with other 28 MHz rigs, the brightness of all the front panel LEDs are fixed.

Transmit-Receive Switching Delay

When the transverter is used with rigs other than an Elecraft K2, the transmit-receive switching is controlled by the signal furnished by the 28-MHz rig to the TX KEY transverter input. If the 28 MHz rig switches the TX KEY line to receive before it stops transmitting, it will trigger in I.F. Overload condition in the transverter when using a high-level RF drive from the 28 MHz rig (see page 75 for details). In the Installation section, you set up the transverter for a 200 millisecond delay to avoid problems. If your 28 MHz rig can provide the switching speed needed, you can reduce the delay time to 50 ms by removing the shorting block on jumper JP1. JP1 is located on the back of the front panel board between the left side panel and socket-mounted processor U1.

JP1 Open – 50 ms delay.

JP1 Shorted – 200 ms delay (Default).

Options and Modifications

The transverter is designed for the greatest flexibility possible in integrating it with other equipment in a high-performance station.

It is Elecraft's policy to encourage owners to experiment with their own (careful) modifications. You can build in your own accessories and make changes to the circuitry if desired. However, this policy has one firm limitation: If you make a modification, other than those described below, that damages or alters normal operation, it may not be repairable by Elecraft if you have difficulty.

Any personal modifications that you create should be installed in such a way that they can be easily disabled (turned off, unplugged, etc.). This will allow us to test and repair your kit if it becomes necessary. Repair charges will be higher if our technician has to *un*-modify your modification for any reason. Of course, any Elecraft-approved modification, such as those described below, may be left in place should you need to send in your transverter for repair. There will be no additional charges caused by the transverter having any of these modifications and they will not be removed by the Elecraft technician.

In addition to the options and modifications described here, check the Elecraft web site at www.elecraft.com for the latest information about using your transverter with the latest systems and station equipment.

- **Optional Crystal Oven.** Improves the stability of the local oscillator by maintaining the crystal at a constant temperature.
- **Changing Between Split and Common Antennas.** This modification allows you to use your transverter with separate transmit and receive antennas.
- **Reducing Receive Gain to Preserve System Dynamic Range.** This modification describes how to reduce the gain of the transverter receive system to help preserve the system dynamic range when an external preamplifier is used.
- **Optional Feet and Bail.** Elevates the front of the transverter to a convenient viewing angle.

Optional Crystal Oven

The crystal oven elevates the temperature of the local oscillator crystal and keeps it constant so long as power is applied. The oven greatly reduces frequency drift due to changes in the ambient temperature that affect the crystal. Contact Elecraft or visit the web site at www.electraft.com to order the crystal oven. Install the oven as follows:

ⓘ **The optional crystal oven does not include the crystal. It fits over the existing crystal. Be sure the local oscillator crystal is installed before installing the oven.**

☐ Remove the four screws and the top cover to gain access to the top of the RF board.

☐ Remove the 4-40 nut and lock washer on either end of the RF power module. Do NOT allow the screws to fall out of the bottom of the transceiver when the nuts are removed.

☐ Invert the transceiver so the bottom side is up. Place it on a clean surface to avoid scratching the paint.

☐ Remove the four corner screws holding the bottom cover.

☐ Carefully lift the bottom cover off of the transverter. The two long screws that secure the RF power module should come out with the bottom cover. Be careful not to disturb the flat washers between the RF amplifier module and the circuit board. If one does slip out of place, reposition it.

☐ Remove the two long screws from the bottom cover and replace them through the holes at each end of the RF power module. Replace the nuts finger-tight to keep the washers and module in place while you work on the RF board.

☐ Position the oven over the circle on the top of the RF board, OV1. The crystal will fit into a space on the bottom of the oven. The three leads on the oven fit into the +, - and NC pads on the board.

☐ Bend the leads over on the bottom of the RF board to hold the oven in place, then tack-solder one lead.

☐ Check to be sure the oven is fully seated down over the crystal and against the board. If necessary, re-heat the soldered lead and adjust the oven's position.

☐ Solder and trim all three leads.

☐ Remove the two screws you replaced at each end of the RF amplifier module. Be sure the flat washers are in place between the module and the circuit board. If necessary adjust their position so the screws will drop through them when the bottom cover is replaced.

☐ Set the bottom cover in place and drop the two long screws back through their holes. Replace the lock washers and nuts on the top of the board to hold the screws and hardware in place. Do not tighten the nuts yet.

☐ Replace the four black screws at the corners of the bottom cover and tighten them.

☐ Tighten the nuts at each end of the RF module. Inspect the RF module to ensure that both flat washers are between the module and bottom of the circuit board. Remove the cabinet side panel, if necessary, to get a clear view of the RF module mounting hardware.

☐ Configure the local oscillator power jumper, JP9, as desired (see page 74 for details). Normally you will want to place the jumper on JP9, pins 4-5. This will supply power to the oven whenever there is +12 volts at the rear panel connector, even if the transverter power if off. This will keep the oven and crystal warm and ready for operation at any time.

☐ Replace the top cover and tighten the four corner screws to secure it.

Changing Between Split and Common Antennas

Your transverter may be configured to work with either a common transmit and receive antenna or with separate transmit and receive antennas. The procedure requires removing or installing a relay and two jumpers. The relay and jumpers are located in the upper left corner of the RF board, near ANT connector J1. Make the change as follows:

☐ Remove the four screws and the top cover to gain access to the top of the RF board.

☐ Remove the 4-40 nut and lock washer on either end of the RF power module. Do NOT allow the screws to fall out of the bottom of the transceiver when the nuts are removed.

☐ Invert the transceiver so the bottom side is up. Place it on a clean surface to avoid scratching the paint.

☐ Remove the four corner screws holding the bottom cover.

☐ Carefully lift the bottom cover off of the transverter. The two long screws that secure the RF power module should come out with the bottom cover. Be careful not to disturb the flat washers between the RF amplifier module and the circuit board. If one does slip out of place, reposition it.

☐ Remove the two long screws from the bottom cover and replace them through the holes at each end of the RF power module. Replace the nuts finger-tight to keep the washers and module in place while you work on the RF board.

☐ If you are switching from a common antenna to split transmit and receive antennas, do the following:

- Desolder and remove relay K1.
- Install jumper W2. It is shown on the silkscreen on the top of the RF board next to the outline for K2 directly behind connector J8 (AUX).
- Install jumper W3 between the solder pads shown in the space where relay K1 was sitting. Be sure to elevate W3 off of the board enough to avoid shorting to the solder pad underneath it.
- Trim the excess wire for both jumpers on the bottom of the board.
- Store the relay in a safe place in case you want to reinstall it at some future time.

☐ If you are switching from split transmit and receive antennas to a common antenna, do the following:

- Remove jumper W2. W2 is next to the outline for K2 directly behind connector J8 (AUX) in the upper left corner of the RF board.
- Remove jumper W3. W3 is also near relay K1.
- Install relay K1. Be sure it is sitting solidly against the board when you solder it. Solder all five pins. **Note: Do NOT trim the relay pins on the bottom side of the board.**

☐ Remove the two screws you replaced at each end of the RF amplifier module. Be sure the flat washers are in place between the module and the circuit board. If necessary adjust their position so the screws will drop through them when the bottom cover is replaced.

☐ Set the bottom cover in place and drop the two long screws back through their holes. Replace the lock washers and nuts on the top of the board to hold the screws and hardware in place. Do not tighten the nuts yet.

☐ Replace the four black screws at the corners of the bottom cover and tighten them.

☐ Tighten the nuts at each end of the RF module. Inspect the RF module to ensure that both flat washers are between the module and bottom of the circuit board. Remove the cabinet side panel, if necessary, to get a clear view of the RF module mounting hardware.

☐ Replace the top cover and tighten the four corner screws to secure it.

☐ If you have configured your transverter for a common transmit and receive antenna, connect it to the ANT connector (J1). If you have configured your transverter for separate transmit and receive antennas:

- Connect the transmit antenna to the ANT connector (J1).
- Connect the receive antenna to the AUX connector (J8).

Reducing Receive Gain to Preserve System Dynamic Range

Although your Elecraft transverter has a very low noise figure, it can be improved by using an external pre-amplifier at the antenna to overcome the losses in your transmission line.

If you use an external preamplifier, you may want to reduce the overall gain to preserve the dynamic range of the receive system. You can reduce the receive gain about 12 dB by removing an amplifier stage in the transverter.

The following procedure will destroy one of the amplifier MMICs in the transverter. If you decide to restore the transverter to its original configuration, you will need to order a replacement MMIC from Elecraft. See the parts list for the Elecraft part number.

☐ Remove the four screws at the corners of the top cover and remove the cover to gain access to the top of the RF board.

☐ Locate MMIC U1 on the RF board. It is to the right of the Power Cal circuit board potentiometer between C72 and C23.

☐ Use sharp diagonal cutters to clip off the leads to U1 and remove it.

☐ Inspect the board to be sure the solder pads for U1 are not shorted. If necessary use a desoldering tool to remove the remnants of the leads and excess solder to be sure there are not solder bridges between the pads.

☐ Install a jumper across the pads joining C72 and C3. Be sure the jumper is not shorted to any other pads.

☐ Replace the top cover and tighten the screws.

Optional Feet and Bail Attachment

A special set of feet and a bail that elevates the front of the transverter to a convenient viewing angle is available as an optional accessory from Elecraft.

Contact Elecraft or visit www.elecraft.com to order the feet and bail.

Circuit Description

The circuits of the transverter for each band are similar. Below the signal flow is described at a block diagram level. This is followed by details of the circuits based on the schematic diagrams.

Signal Flow

Refer to the block diagram on the following page. Many of the circuits in the signal path are used for both receive and transmit. Switching between receive and transmit is done by relays to preserve the low noise figure of the receiver. The relays are shown in their de-energized state which puts them in receive mode position.

In receive mode, signals from the antenna are routed by relay K1 to RF amplifiers Q3 and U1. The signal from the RF amplifier is routed to mixer Z1 through a band-pass filter.

The local oscillator input for the mixer is provided by Q1 and Q2. The local oscillator frequency is 28 MHz below the signal frequency. The 28 MHz intermediate frequency (I.F.) is selected by the filter at the mixer output.

Relays K6 and K7 route the 28 MHz I.F. signal to the port selection circuits. The I.F. port selector allows the transverter to be used with a variety of 28 MHz rigs in addition to an Elecraft K2. The external rig can use a single connection for both transmit and receive, or it can use separate transmitter and receiver connections.

In transmit mode, the 28 MHz I.F. signal from the external rig is applied to the TXin/IF1 connector. Relay K7 routes the 28 MHz I.F. signal through the I.F. level control. The I.F. level control is adjustable to provide the correct drive to the mixer from a wide range of input levels.

Relay K6 routes the 28 MHz I.F. signal from the attenuator to the IF filter and limiter. The limiter is part of a protective circuit described below.

Z1 mixes the 28 MHz I.F. signal with the local oscillator signal to produce an output at the desired transmit frequency. The RF band-pass filter selects this frequency and attenuates the other mixing products.

Relay K2 routes the RF signal to transmit driver U6. RF power module U7 produces up to 20 watts output in CW or PEP SSB.

RF from U7 is routed through a low-pass filter and relay K1 to the antenna output.

The power monitor samples the signal level at the output of RF power module U7 and returns an analog signal to controller U1. Controller U1 generates signals that illuminate the power level LED’s on the Front Panel indicating the RF output power.

A DB-9 connector is provided for connection to an Elecraft K2 transceiver. This connection includes all of the signals needed for the transverter to work with an Elecraft K2, other than the 28 MHz I.F. signal connection to the TXin/IF1 connector.

The KEY IN line is provided so the transverter can be used with rigs other than an Elecraft K2. The KEY IN line is grounded by the external transmitter to switch the transverter from receive mode to transmit mode. When the transverter is used with an Elecraft K2, this command is furnished via the DB-9 connector and the KEY IN line is not used.

When controller U1 switches the transverter from receive mode to transmit mode, Q4 grounds the KEY OUT line to enable an external power amplifier, if used.

The overload detector protects the transverter in the event a high-level 28 MHz I.F. signal is applied to the TXin/IF1 connector while the transverter is still in receive mode. The overload detector commands controller U1 to disconnect the transverter from the 28 MHz I.F. input by opening relays in the I.F. port selector. Also, controller U1 will flash the Front Panel LEDs in unison to alert the operator. Once an overload condition occurs, the transverter must be reset by turning it Off, then On again. When used with an Elecraft K2, the K2 must be turned Off, then On again to reset the detector since the transverter power is controlled by the K2.

Since the attenuator is switched out of the signal path in receive mode, the mixer I.F. port is vulnerable to damage from a high-level 28 MHz I.F. signal. The limiter keeps the signal at a safe level while the controller reacts to an overload condition.

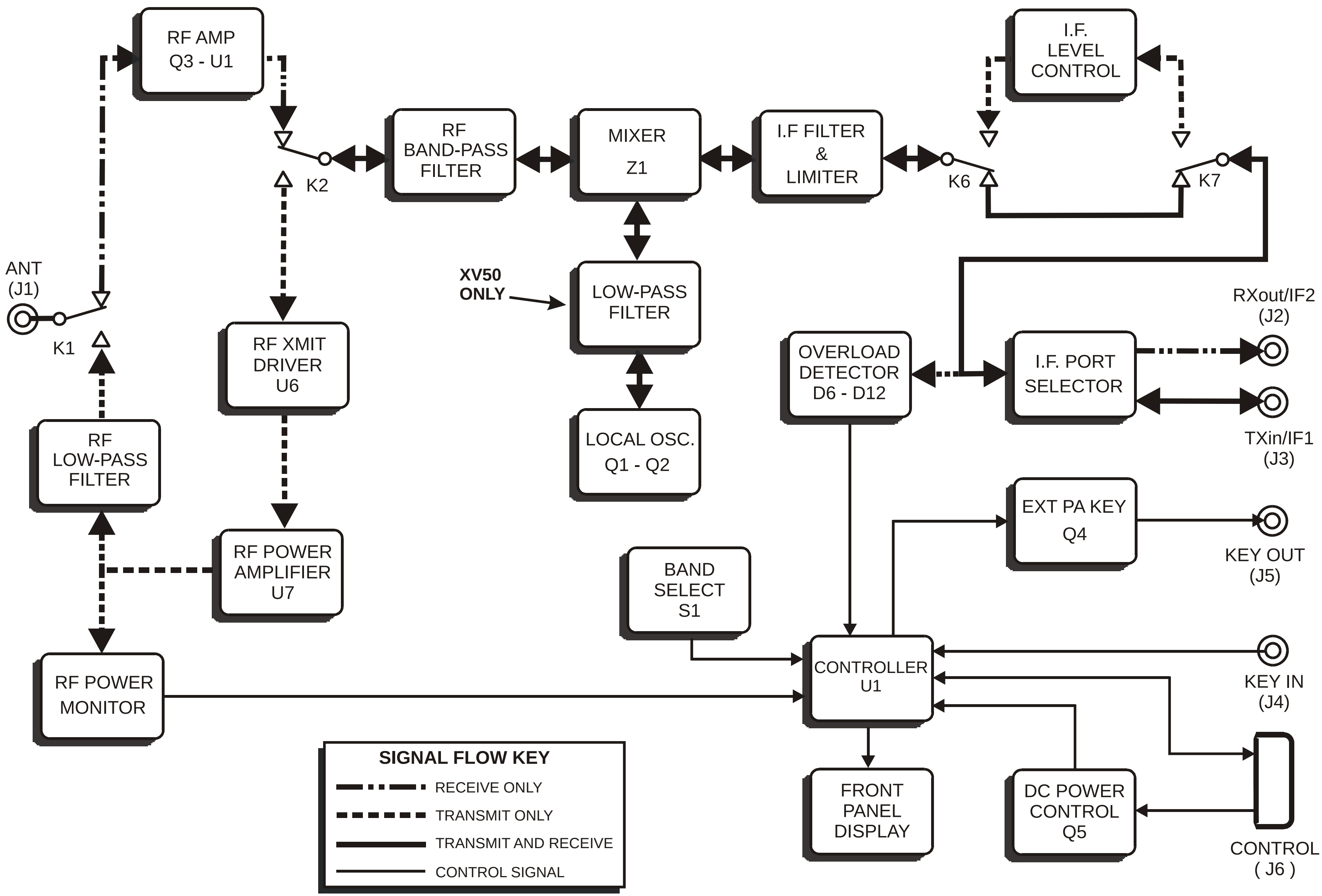


Figure 54. Transverter Block Diagram.

Circuit Details

Separate schematic diagrams are provided for the 50 MHz, 144 MHz and 220 MHz transverter RF boards in Appendix A. The location of the circuits on the schematic diagrams is similar to the block diagram except for the control logic. Controller U1, the display LEDs and associated drivers are on the Front Panel board shown on a separate schematic diagram. The same Front Panel board is used on all of the transverters.

Receive Circuits

The first active device in the receiver is Q3, a low noise PHEMT that provides an exceptionally low noise figure. The current through Q3 is set for optimum performance by potentiometer R13. R13 is adjusted for the proper voltage drop across R14 as measured at TP2.

U1 further amplifies the incoming signal which then is passed on to mixer Z1 through an RF band-pass filter.

The local oscillator signal is generated by crystal oscillator, Q1, and amplified by Q2. The local oscillator signal is 28 MHz below the RF signal frequency: 194 MHz in the 220 MHz transverter, 116 MHz in the 144 MHz transverter and 22 MHz in the 50 MHz transverter.

In the 50 MHz transverter, the second harmonic of the local oscillator at 44 MHz is very close to the 50 MHz pass band, so a low-pass filter is used between amplifier Q2 and mixer Z1 to attenuate the 44 MHz signal. This filter is not used in the 144 and 220 MHz transverters.

The intermediate frequency (I.F.) output of mixer Z1 passes through another band-pass filter that includes a diplexer formed by C57, L17 and R25. C57 and L17 are series resonant at 28 MHz, so the I.F. signal passes through to the band-pass filter section. C57 and L17 present a high impedance to frequencies removed from the 28 MHz I.F. These signals are terminated by R25.

LEDs D10 and D11 are used as limiters to protect the mixer during transmit as described below. Inductor L9 resonates with the capacitance of the LEDs at 28 MHz to avoid attenuating the I.F. signal.

The 28 MHz I.F. signal is routed around the transmit signal attenuator to the I.F. port selector circuits by relays K6 and K7. Relays K8 and K9 disconnect the I.F. RX and TX/RX ports whenever the transverter is not in use as described below. This permits several transverters to be connected the same external rig without loading the signal lines.

If a separate transmit and receive connections are used for the 28 MHz I.F., the receive line is connected to J2. A jumper is placed across JP1 pins 1 and 2 and across JP2 pins 2 and 3. JP1 routes the receiver signal through relay K9 to K6. JP2 routes the transmit signal through the attenuator.

If the external rig uses a single connection for both transmit and receive, jumpers are placed across JP1 pins 1 and 2 and across JP2 pins 1 and 2. In receive mode, relay K7 routes the I.F. signal to the RXout/IF2 output at J3. In transmit mode relay K7 routes the 28 MHz I.F. signal coming in at J3 to the attenuator.

When the external rig uses a common I.F. connection for both transmit and receive, a cable connected to J2 will carry the transmit and receive I.F. signals to another transverter.

Transmit Circuits

In transmit mode, the 28 MHz I.F. signal at J3 is routed through the I.F. port selector circuits to the I.F. level control. The I.F. level control either amplifies or attenuates the I.F. signal to the proper level for the mixer. The I.F. level control can handle signal levels of from -20 dBm to +39 dBm from the external rig. For low-level I.F. input levels amplifier Q6 may be switched into the circuit by jumpers JP5 and JP6 For higher level I.F. input levels, jumpers JP3 and JP4 permit adding or bypassing a fixed 30 dB attenuator as needed. Potentiometer R22 permits continuous adjustment of the attenuation.

Mixer Z1 uses the local oscillator signal to produce an RF output at the desired transmit frequency. Unwanted mixer products are attenuated by the RF band-pass filter.

Relay K2 routes the transmit RF signal to RF driver U6, which amplifies the signal to drive RF power module U7. A different RF power module is required for each band. The RF power modules for the 144 MHz and 220 MHz bands require a bias adjustment to set the amplifier current at the proper level. The bias is adjusted by R39, which is set for the proper total current drain on the 12 volt line. The current drain is measured by connecting a DMM to TP3 and TP4.

RF from power module U7 passes through the low-pass filter and relay K1 to the antenna connector.

Control Circuits

Power Control: The DC power control circuit is configured with jumpers to allow it to work as desired with an Elecraft K2 or any other suitable rig.

When used with a rig other than an Elecraft K2, a jumper is placed at JP5 to bypass Q5 and D16. The transverter power is then controlled by Front Panel power switch S2. Closing S2 enables relay K3, applying +12 volts to the transverter circuits.

When the transverter is used with an Elecraft K2, the control circuit automatically turns the transverter power Off whenever the K2 is turned Off. No jumper is used at JP7. As long as the K2 power is On, +12 V is supplied via pin 9 of the DB-9 connector to Q5, which grounds the return side of power switch S2 through D19. When the K2 power is turned Off, Q5 will turn the transverter off automatically.

Of course, power switch S2 on the transverter must be On. If desired, a jumper may be placed at JP8 to disable the transverter power switch. The transverter power then is controlled only by the K2.

Controller U1 on the Front Panel board enables the three-diode light bar D11 through Q6 whenever the transverter is active. If the transverter is used with an Elecraft K2, it is active whenever DC power is applied at J2 and it is selected by a K2 as described below. If the transverter is not used with a K2, light bar D11 is enabled whenever DC power is applied at J2 and power switch S2 is On.

Transmit-Receive Switching: Switching between receive mode and transmit mode is by a ground at the KEY IN connector or, if an Elecraft K2 is used, when the 8R signal at pin 6 of the DB-9 interface goes to a logic low.

When used with an Elecraft K2, the transverter is enabled automatically by the BAND switch on the K2. The K2 identifies the transverters as TRN1, TRN2 or TRN3. Switch SW1 associates the transverter with the corresponding number at the K2. SW1 selects an analog voltage level depending upon the position of the switches. This voltage is sent as the ID signal to controller U1. Controller U1 monitors the AuxBus signal from the K2 and enables transmit/receive switching when the transverter ID corresponding to the setting of SW1 is received.

When the transverter is used rigs other than an Elecraft K2, all the switches are Off. The transverter is enabled whenever the transverter power switch is On.

When a transmit mode command is received via the KEY IN connector or by the 8R line from a K2, controller U1 provides a ground return to close relay K5. Relay K5 provides +12 volts to relays K1, K2, K6 and K7 and supplies bias voltage to RF power module U7.

I.F. Port Enable: Relays K8 and K9 must be energized to connect the external rig to the transverter circuits. These relays are energized by controller U1 by providing a ground return on the IF EN command line.

When the transverter is used with an Elecraft K2, the controller enables the I.F. port only when the transverter is selected by the K2 band switch as described above. This feature allows several transverters to be “daisy-chained” together through the 28 MHz TX/RX and 28 MHz RX connectors.

When the transverter is used with other rigs, the I.F. port is enabled whenever power switch S2 is On. If several transverters are “daisy-chained” together, the desired transverter selected by turning its power switch On and leaving any other transverters Off.

I.F. Overload Protection: If the transverter is not switched to transmit mode before a high-level I.F. signal is applied to the 28 MHz TX/RX input, mixer Z1 might be damaged. This will happen if the external rig does not supply a ground the KEY IN connector or, if a K2 is used, the 8R signal at the DB-9 connector does not go low to change the transverter into transmit mode. To prevent damage to the mixer, a protection system will automatically disconnect the external rig from the transceiver circuits and limit the signal level at the mixer I.F. port.

Diodes D6 and D12 in the overload detector circuit rectify a sample of the transmit RF and produce a DC level that will cause the control circuits to open relays K8 and K9. This voltage is supplied as the ODET (overload detect) signal to controller U1 on the Front Panel board. Also, when an overload is detected controller U1 flashes the front panel LEDs at about a 1 Hz rate to alert the operator. The transverter will remain disconnected with the LEDs flashing until the controller is reset by turning the power switch Off, then On again.

The control circuits may not release relays K8 and K9 fast enough to prevent damage to mixer Z1 from a high-level 28 MHz I.F. signal, so LEDs D10 and D11 are used to protect the mixer. LEDs D10 and D11 will conduct and limit the I.F. signal to a safe level. LEDs are used because their greater forward-conduction voltage avoids the need to use diodes in series.

External PA Keying: When the transverter switches to transmit mode, controller U1 provides a signal to Q4 that turns it on, providing a path to ground at EXT PA KEY jack J5 to key an external power amplifier.

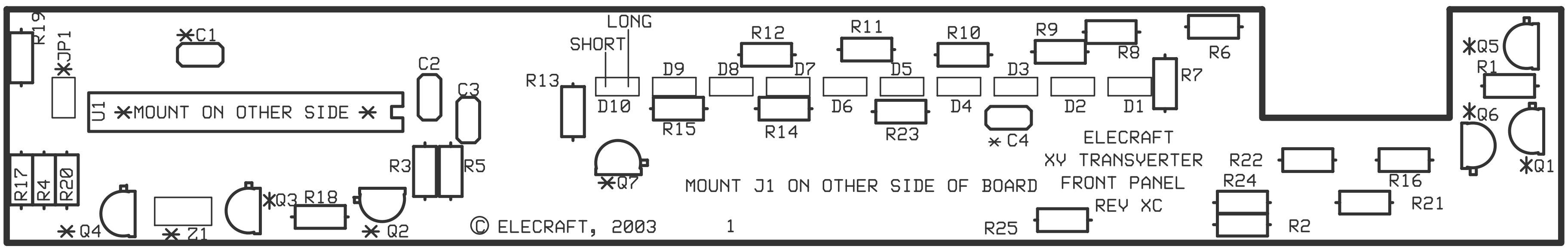
Power Monitor: D1 produces a DC voltage proportional to the RF power output of U7. The voltage, Po, is sent to controller U1 on the front panel. The controller drives D1 through D10 to indicate the RF power level from 1 through 30 watts. The LED’s below 20 watts are green. The 20-watt LED is yellow, and the 25 and 30 watt LED’s are red to indicate that the specified maximum power output is being exceeded.

The metering circuit is calibrated by potentiometer R10 and using an external RF power meter.

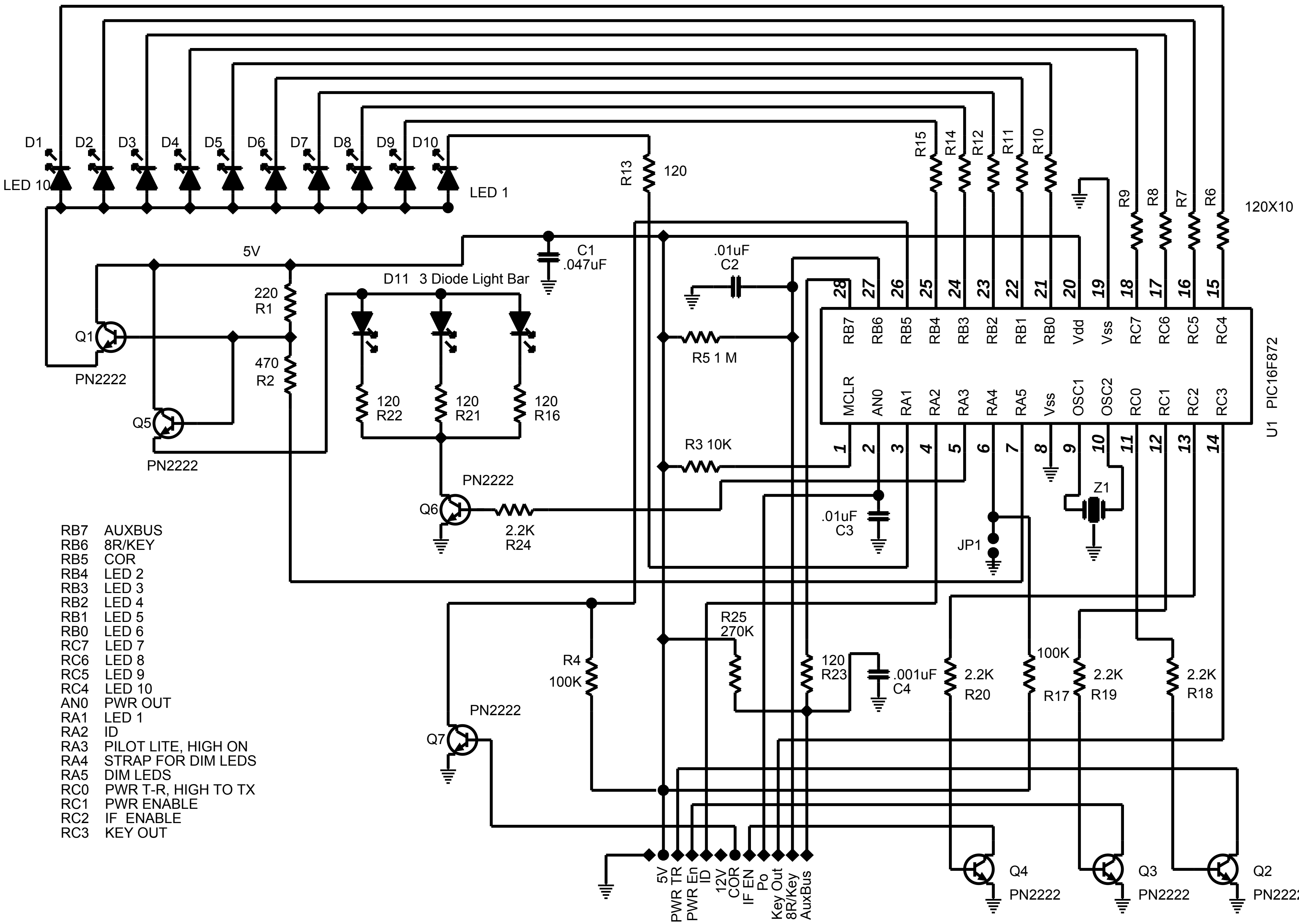
Display Mode: When the transverter is used with an Elecraft K2, the behavior of the LEDs on the front panel follows the display mode selected by the operator at the K2. These selections determine the LED brightness and whether the power output LEDs illuminate in a line extending from the left or if only one LED corresponding to the power output illuminates (bar-dot mode). The display mode information is reported to controller U1 via the AuxBus. The controller changes the brightness by varying the bias on Q2 and Q5 on the Front Panel board.

Appendix A – Schematics and Parts Placement Diagrams

XV Front Panel Board

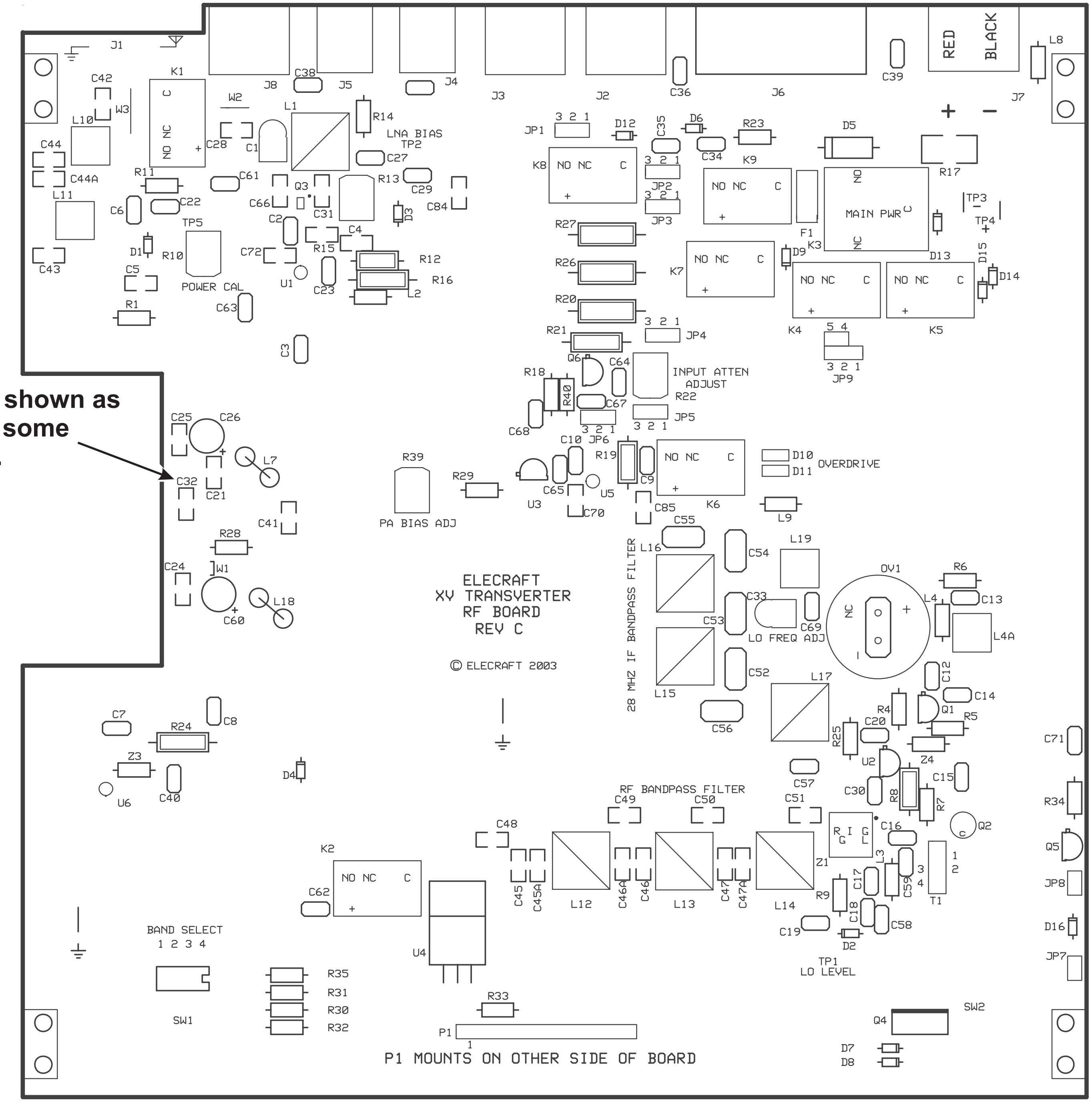


XV Transverter, Front Panel

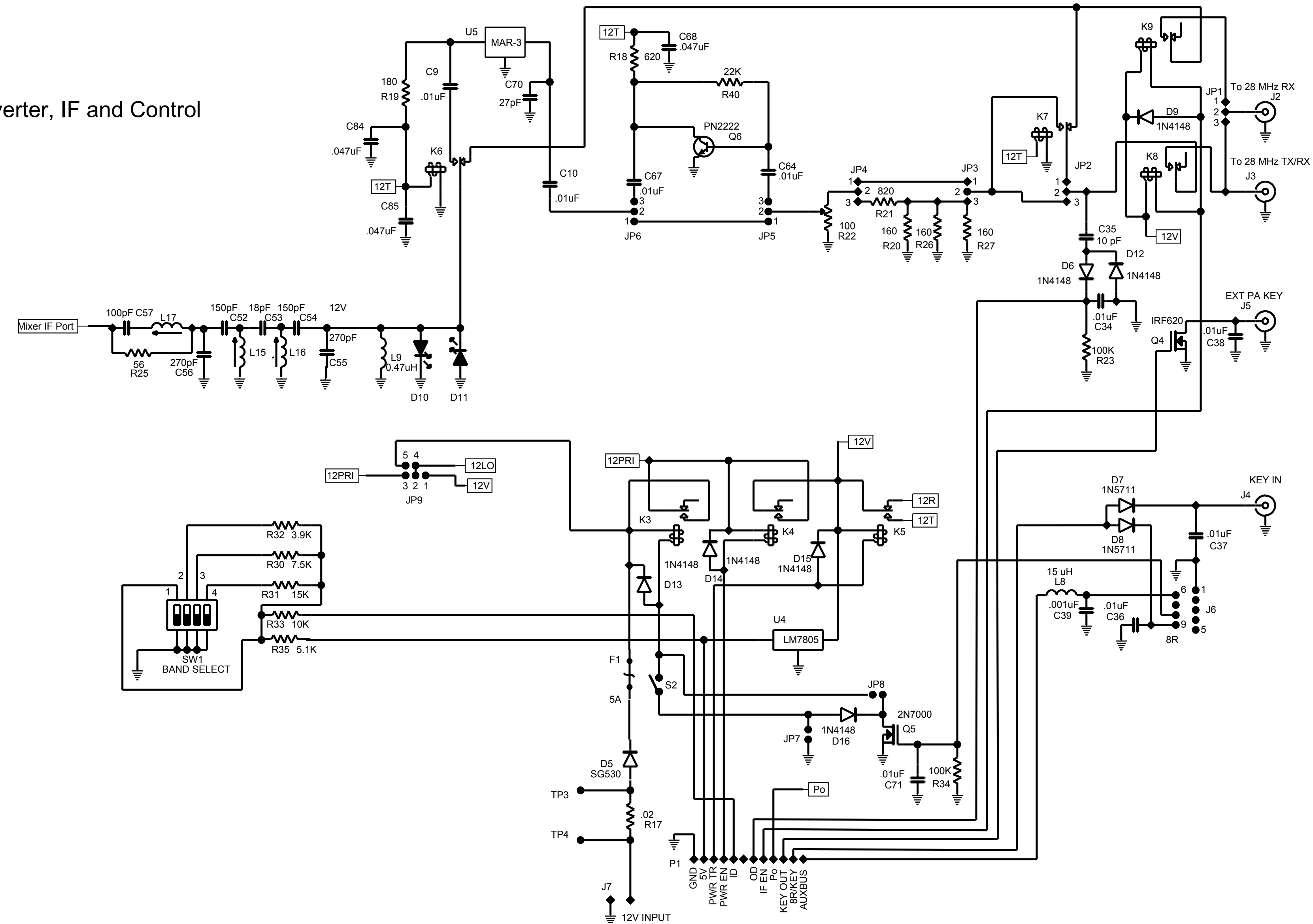


XV RF Board

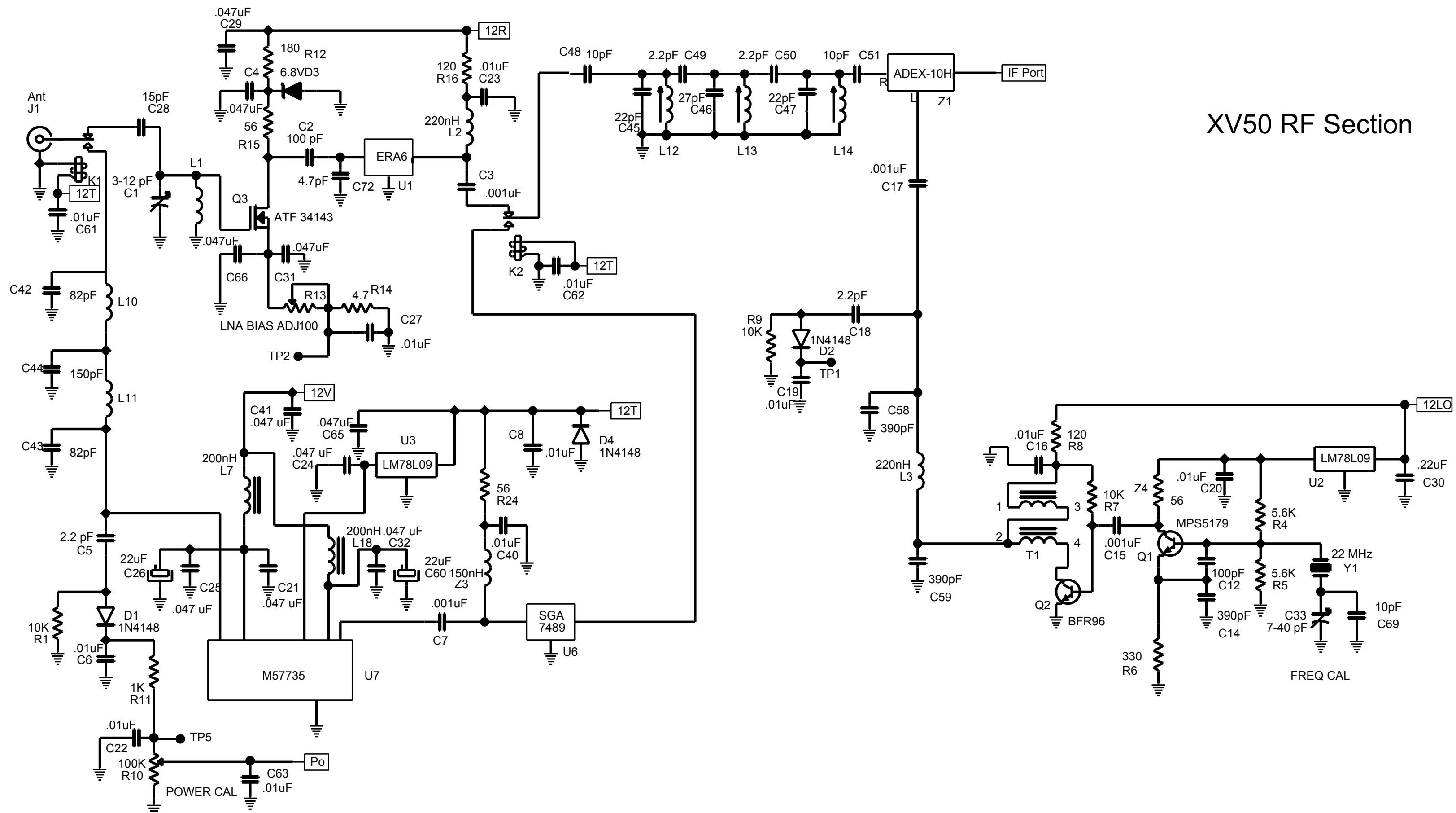
May be shown as C58 on some boards.



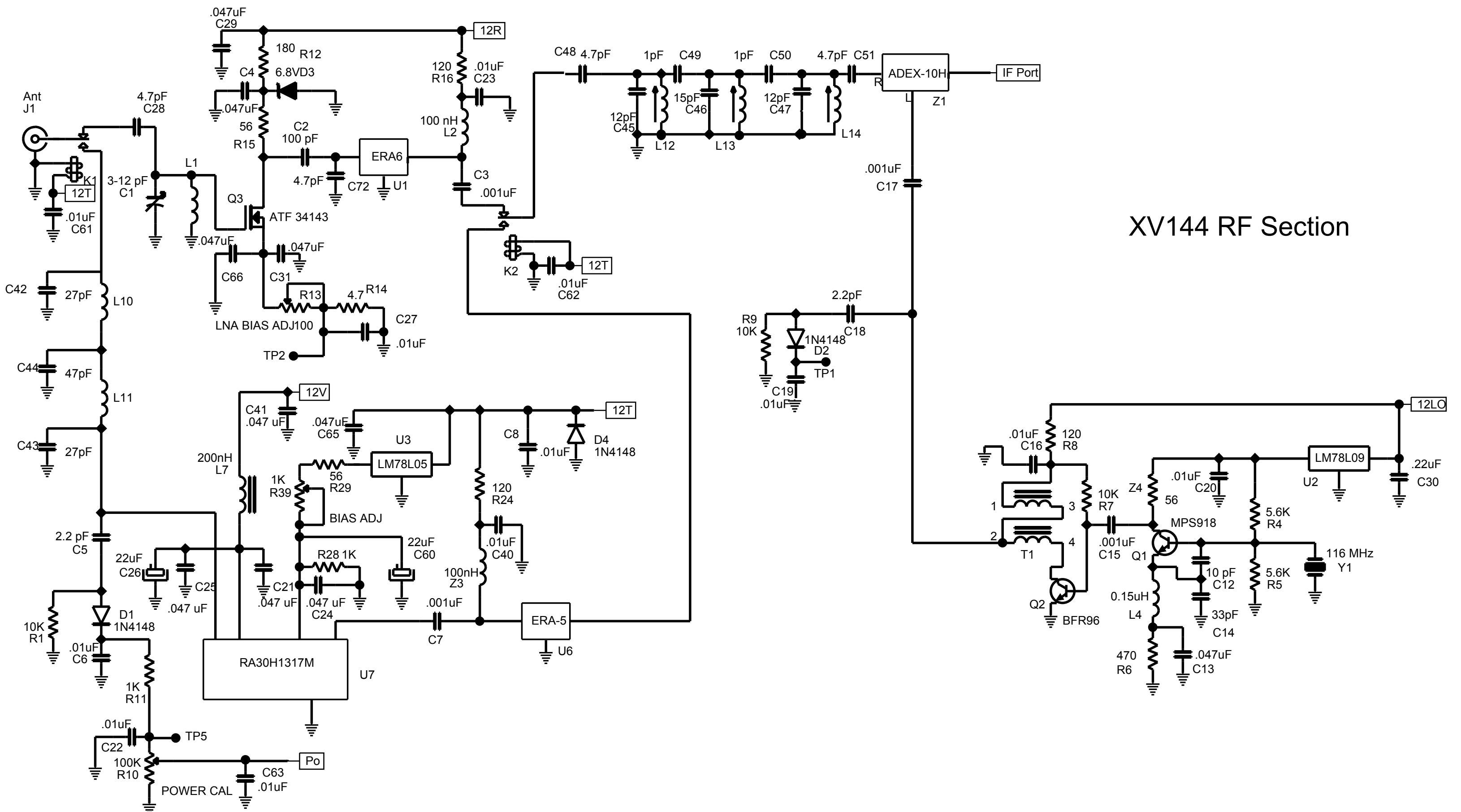
XV Transverter, IF and Control



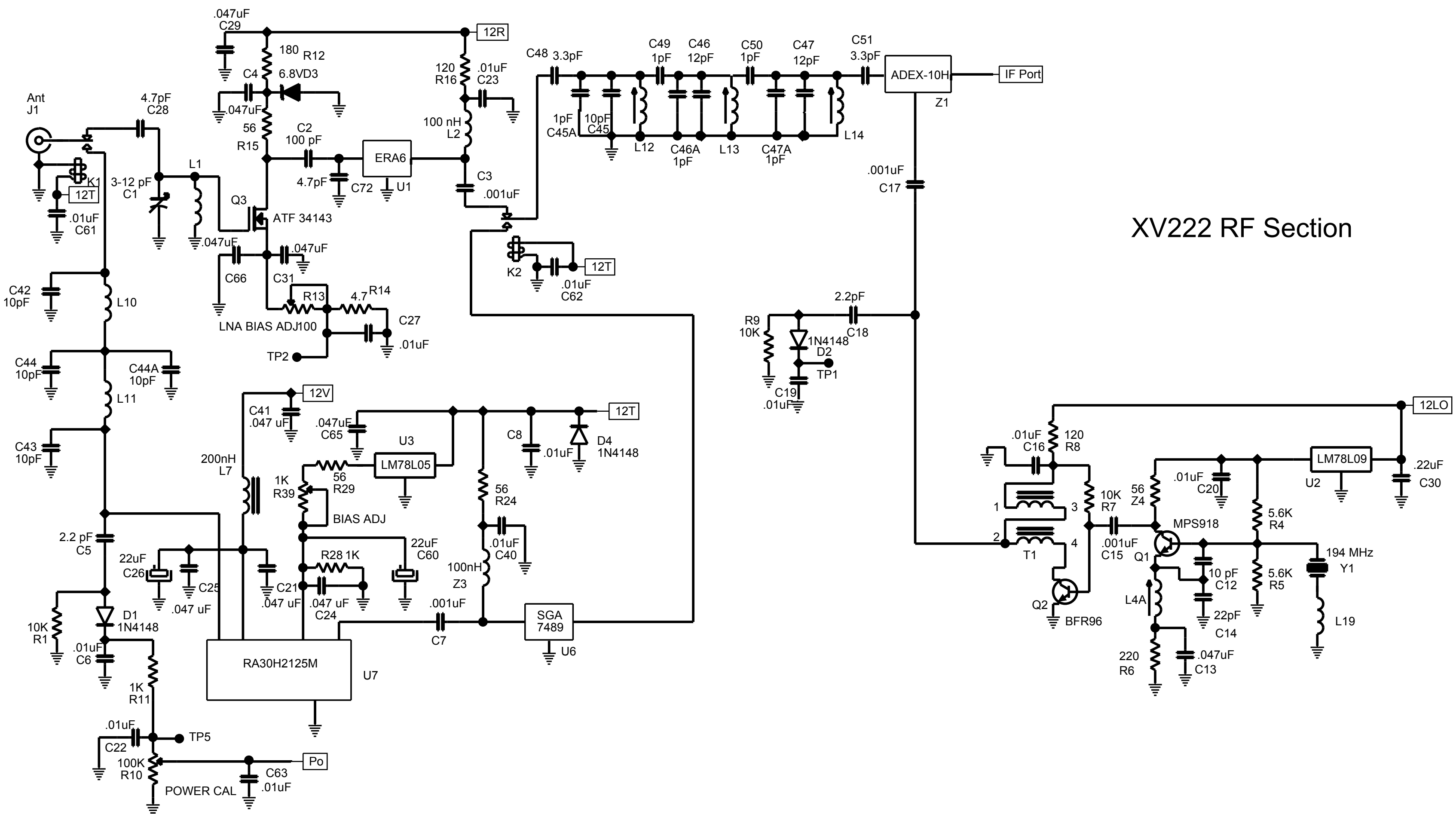
XV50 RF Section



XV144 RF Section



XV222 RF Section



Appendix B – Troubleshooting

RF Power Module U7 voltages:

XV50	U7 Pin (from rear)	RX Mode	TX Mode
	1	0	do not measure
	2	13.6	13.2
	3	0	9
	4	13.6	13.2
	5	0	do not measure
XV144,222	1	0	do not measure
	2	13.6	
	3	0	3.5 – 4.5
	4	0	do not measure

Typical voltages at test points and active devices (all in VDC):

Location		Rx Mode	Tx Mode
U6	Output Pin	0	5
U4	1	13.6	13.6
	2	0	0
	3	5	5
Q2	B	0.25 – 0.8	0.25 – 0.8
	E	0	0
	C	6.5	6.5
Q1	B	4,1	4.1
	E	3.6	3.6
	C	8.5	8.5
U5	Output Pin	0	4.7
U1	Output Pin	3.0 – 6.0	3.0 – 6.0
U3	Input	0	13.6
	Output XV50	0	9
	Output XV144, XV222	0	5
TP1	XV50	0.8 – 1.2	0.8 – 1.2
	XV144	1.2 – 1.8	1.2 – 1.8
	XV222	1.0 – 1.5	1.0 – 1.5
TP2	ALL XV	200-275 mv	

Appendix C – Jumper and DIP Switch Settings

Jumpers

The following is a summary of all the jumpers and their functions. The recommended jumper settings are provided in the Installation instructions for most station configurations. This summary is provided for general information and to aid troubleshooting in case your transverter does not behave as expected.

POWER SWTICH OPTIONS

These are two-pin jumpers. X indicates a shorting block in place. O indicates no shorting block.

Function	JP7	JP8	Notes
If 28 MHz Rig is **not** an Elecraft K2	X	O	If the transverter is connected to an Elecraft K2, be sure there is no jumper on J7. Possible damage to the transverter may result.
Disables the transverter On/Off pushbutton when an Elecraft K2 is used with the transverter.	O	X	Transverter power is turned On when the transverter is selected by the K2 BAND switches.
Enables the transverter On/Off pushbutton when an Elecraft K2 is used with the transverter.	O	O	**NOT RECOMMENDED.** This configuration will not damage the equipment, but may result in unexpected behavior of the transverter power switch.

I.F. POWER CONTROL

The following jumpers are set according to the approximate driving power from the 28 MHz rig. Fine adjustment is done using Input Atten Adjust, R22, on the transverter RF board. If you find R22 is difficult to adjust because it is set too close to one limit of its range, adjust the jumpers accordingly.

Do not exceed the maximum input power from the 28 MHz rig shown for each jumper configuration. Excessive power may damage the transverter.

Transmit I.F. Power from 28 MHz Rig	JP3	JP4	JP5	JP6	Notes
-20 dBm (0.01 mw) to 0 dBm (1 mw) max.	1-2	1-2	2-3	2-3	JP3 and JP4 bypasses the fixed attenuator. JP5 and JP6 enables amplifier Q6.
Up to +24 dBm (251 mw) max.	1-2	1-2	1-2	1-2	JP3 and JP4 bypasses the fixed attenuator. JP5 and JP6 bypasses amplifier Q6.
Up to +39 dBm (8 watts) max.	2-3	2-3	1-2	1-2	JP3 and JP4 enables the fixed attenuator. JP5 and JP6 bypasses amplifier Q6.

I.F. PORT CONFIGURATION

These jumpers configure the I.F. ports for either separate transmit and receive RF connections to the 28 MHz rig or common transmit and receive RF connection to the 28 MHz rig.

Function	JP1	JP2	Notes
Single I.F. Port Sharing Transmit and Receive	2-3	1-2	When single coaxial cable connects transverter to 28 MHz rig antenna connector.
Separate Transmit and Receive I.F. Ports	1-2	2-3	When separate coaxial cables are used for transmit and receive (e.g. K2 with K60XV module).

LOCAL OSCILLATOR POWER CONTROL OPTIONS

These jumpers allow the local oscillator to be left operating at all times power is applied to the transverter for maximum stability, or to turn it off to avoid possible interference from the local oscillator on other bands.

Power Option	JP-9
Local oscillator power turns Off when transverter is deselected at the Elecraft K2 or when the transverter Power switch is Off (if the transverter Power switch is enabled).	1-2
Local oscillator power is On whenever transverter power switch is On (if the transverter Power switch is enabled) even when the transverter is not selected by the Elecraft K2.	2-3
Local oscillator power is On whenever +12 volts is applied to the transverter, regardless of the Power Switch setting or whether the transverter is selected by the Elecraft K2.	4-5

TRANSMIT DELAY OPTION

This option allows holding the transverter in transmit mode for up to 200 milliseconds after the 28 MHz rig has switched the KEY line to receive to avoid timing problems with some rigs. It is not available when using an Elecraft K2. The K2 has the proper timing to work with the transverter as the fastest-possible speeds.

ⓘ **This jumper is located on the front panel board, between the end of the socket-mounted processor and the side of the transverter. Do not confuse it with JP1 on the transverter RF board.**

These are two-pin jumpers. X indicates a shorting block in place. O indicates no shorting block.

Function	JP1
50 ms T/R delay	O
200 ms T/R delay	X

DIP Switch

The DIP switch on the transverter RF board is used to identify whether the 28-MHz rig used with the transverter is an Elecraft K2 and, if the rig is a K2, which TRN number has been assigned to the transverter.

TRN	DIP SWITCH POSITIONS			
	1	2	3	4
NO K2	ALL SWITCHES OFF			
1	**ON**	OFF	OFF	OFF
2	OFF	**ON**	OFF	OFF
3	OFF	OFF	**ON**	OFF
4	OFF	OFF	OFF	**ON**
5	OFF	**ON**	**ON**	OFF
6	OFF	**ON**	OFF	**ON**
7	OFF	OFF	**ON**	**ON**
8	OFF	**ON**	**ON**	**ON**