



## High Dynamic Range 70CM Transverter Kit DEM Part Number 432-28K or CK

### ***Operating Specifications:***

Operating Voltage:	11.0 - 16.5 VDC, 13.8 nominal
Current Drain:	4 amps maximum on Transmit, 600 mA on Receive
Output Power:	Maximum 10 W linear. Output has 25 dB of adjustable range.
TX Drive level	-20 dBm to 10 watts depending on the IF configuration used
Receive Noise Figure and gain:	>1.0 dB NF @ 17dB nominal conversion gain

### ***Operational Overview:***

The DEM 432-28CK and K is a 70cm to 28 MHz transverter with a new list of features that has increased its performance over the past models. The most noticeable improvement in the transverter is in the receive section. The addition of a High IP3 PHEMT LNA design followed by two separate helical filters and an improved high-level mixer (+17 dBm Local Oscillator), provide a sensitive, yet over-load proof front end with superior out of band rejection. This is the best receive converter on the market today! The transverter will operate with all 28 MHz. transceivers with transverter ports or at 10 M power levels of up to 10 watts. The 432-28 has a maximum linear output power of 10 watts and can be limited with an adjustable attenuator to preset the output power if you chose to use an additional power amplifier. The 432-28 has a built in transmit / receive relay but provisions have been made to allow separating the transmit and receive ports to add a high power amplifier or to interface the transverters additional receive filtering with an external or mast-mounted preamplifiers. Additional options have been included to custom tune your receive gain requirements for the best performance (sensitivity and IMD) possible.

Dual oscillators are provided for operation in the satellite portion of the band. Keying options for +1 to + 15 VDC, PTT-H or a closure to ground, PTT-L, have been provided. Auxiliary relay contacts to control external transmit and receive functions are available. If you have the CK version, the control, power, and auxiliary connections are RCA jacks, all IF connections are BNC connectors, and the 70cm connectors are Type 'N' (2 supplied). The 432-28CK is housed in an 8.7" x 5.7" x 2.2" aluminum die cast enclosure.

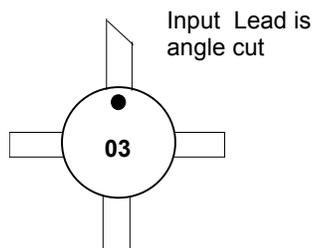
### ***General Instructions:***

Before starting assembly, read the complete document. Then inventory the components and review the component placements and schematic. All of this "prep work" is the best way to determine what tools will be required and to properly identify the components used. It will help to understand important alignments of the active components or any other component such as a relay or filter that are difficult to remove from the circuit board after installation. This is also the time to decide which option or options you will want to install if any. Take time to review the suggested assembly tips and practice if necessary winding coils or soldering surface mount components. Some of the components will be the smallest size you may have ever seen! Some may be the strangest shapes! Take time to look at them all so you are not surprised when it comes time to install it! If you have any questions about the assembly of this kit now is the time to consult us at Down East Microwave. If you are ready, get started and have fun!

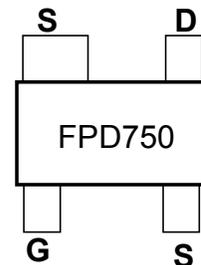
### General Assembly Tips

#### Soldering surface mounted active components (transistors etc.):

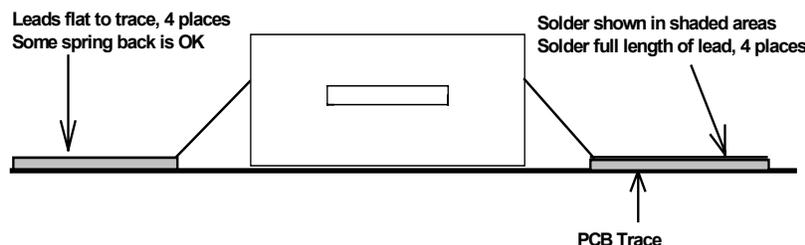
- The DOTS on the MMICs (IC1 - IC7) determine their orientation (See Figure 1A) and must be observed and positioned correctly prior to soldering. IC 9 is configured by its tab. The PHEMT (Q6) orientation is determined by it's lead formation (See Figure 1B) which corresponds to the assembly diagram. Leads on all active surface mounted components should be somewhat flat against the mounting surface, if they are not, a tool such as a small bladed screw driver can be used to flatten them.
- Align the component in place based on the diagram.
- While holding the component in place, solder one lead to hold the component in place and observe the alignment of all leads.
- If the alignment is acceptable, solder the remaining leads. You need enough solder to cover the lead and mounting surface for the entire lead length. Additional amounts results in a smaller solder roll! (See Figure 2 shaded areas)



**Figure 1A**



**Figure 1B**



**Typical side view of four leaded surface mounted device, lead bending close to body**

**Figure 2**

#### Soldering surface mounted passive components (chip resistors, capacitors and inductors):

- Determine the component mounting position based on the assembly diagram.
- Without the component in place, heat one side of the mounting area and flow a small amount of solder on it. (Tin the pad)
- Place the component in the correct position per the assembly diagram, it should now have one end over the previously melted solder.
- Holding the component in place with tweezers or other soldering aid, heat the pad with the previously melted solder and allow the component to flow into the solder. Remove the heat and when the solder has solidified, remove holding tool.
- Now heat and flow solder to the other side of the component and your done!



### **Soldering leaded components (resistors, capacitors, diodes, etc.):**

Depending on your available tools, you can solder your transverter's components from either the top or bottom of the PCB. It is suggested for the home assembler to use a method that is comfortable. A simple holding vise can be utilized to allow the components to be 'dropped in' from the topside and soldered on this side without flipping over the assembly. As an alternate method, you can insert one component at a time in the correct mounting location and gently push down to the circuit board, while holding the component, flip over the circuit board and bend the leads over in opposite direction to hold the component in place. Although this is the most reliable method, there are some drawbacks if the component must be removed when the PCB is installed in the enclosure.

### **Rework of soldered components if needed:**

The easiest method to rework soldered components is to employ a de-soldering braid that is specifically designed for this purpose. It can be purchased at any electronics store. Place the de-soldering braid on the lead that you are removing and apply heat to it. Without excessive pressure, the solder will melt and flow into the braid leaving the lead or component ready to be removed. The DEM 432-28K or CK is easy and fun to assemble even for the first time kit builder and can be completed in any order that is comfortable, however DEM Inc. suggests the following assembly procedure to minimize errors and possible frustration.

### **Printed Circuit Assembly Notes:**

Your kit is provided with easy to read component placement diagrams that show the component placement and the reference designators that correspond to the provided component list (Bag 1 - Bag 4). Each side of the printed circuit board (PCB) is also shown to eliminate mirror image assembly errors. The Top and Bottom side assembly operation should always begin by aligning the PCB outline with the out line of the component placement diagrams. Use the notches on the longer sides of the PCB board as a key. You may also use the printed lettering on the topside of the PCB board for an indicator. You will also notice on the assembly diagram that there are circles, double circles, and "X" shown. These are shown to provide locating help when installing components. Components are mounted in the single holes. **Double Circles are Mounting Holes and Holes with "X" are for Wire installation only!**

### **Surface Mount Component Suggested Assembly:**

Referring to the PCB assembly diagrams, you will see that there are five (5) surface mounted MMIC's on the bottom side and three (3) MMIC's and a FET on the Top side. All four of the Top side active components may be installed as options depending on whether your application requires them or not. The details of these options start on page 13.

The assembly operation should begin by orienting the PCB with the topside assembly diagram. Orientation can be determined by observing the notches on the long sides of the PCB. *Observed polarity using either the DOTS or lead configuration as explained in the Assembly Tips section.*

### **Surface Mount Component Suggested Assembly:**

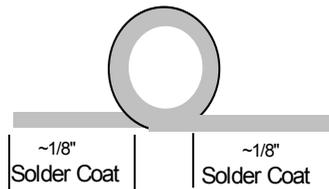
1. On the **TOP** side, depending on your requirements, install and solder Q6 and IC9. They both have very specific orientations. Q6 has only one wide lead.
2. On the bottom side, install and solder the balance of the bottom side active components IC1 - IC3, IC6-IC7.
3. Recheck orientation of all active devices installed with component placement diagram.



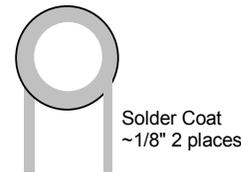
**General Assembly:**

Start by installing all surface mount resistors, capacitors and inductors. Install as shown on the topside component placement. Most of them are located by Q6 and IC9. Follow the surface mounted passive component assembly tips presented earlier in this document if required.

L1, L6, L21, L22 and L23 must be formed prior to installation. The coils should be wound around the supplied 1/8" wooden mandrel. Winding coils is not an exact science and you should not be intimidated by it. Using the supplied specified enamel wire size, extend about 1/4" in a perpendicular direction off the mandrel and wind the wire around it, counting each evolution as one turn. When the total number of turns is completed (BAG 3 component list) cut the wire an additional 1/4" beyond the mandrel. Form the two leads so they are pointing in the directions shown in the forming side view details below.



L21, L22 & L23



L1 & L6

Dress the turns together if they are out of shape from winding, remove the coil from the drill bit. The coil forming is complete! To ensure a positive solder connection, the 1/8" leads should have the enamel insulation removed prior to soldering. This can be accomplished by applying solder to a hot soldering iron tip and placing the lead in the molten solder, you will see the insulation bubble indicating that it has melted (The tinned lead should be a silver color indicating that the insulation has been removed and the solder has tinned the base metal, if not repeat the process). As an alternative, the enamel can be removed by scraping the 1/8" leads with a razor blade until the base metal is exposed. Solder coat the exposed base metal, do not allow the outside diameter to increase so that the coil will not fit in the mounting hole. Install and solder all prepped inductors as shown on the component placement diagram, surface mount or through hole.

**Now assemble and solder the components in the following suggested order as shown on the component placement diagram.**

STEP	OPERATION and NOTES
1	Form, install and solder CR1 - CR5, CR8 and CR10 (7 total) Note: <b>Ensure proper polarity</b>
2	Form, install and solder L2 - L5, L7 - L16, L19 molded Chokes
3	Install and solder C3 ,C14, C76, and C77.
4	Form, install, and solder all leaded resistors
5	Form, install, and solder all leaded capacitors. <b>Note: Ensure proper polarity on all Electrolytic capacitors as shown on the assembly document.</b>
6	Install and solder Q1 - Q5, <b>Note: Ensure proper polarity by following component placement</b>
7	Install M1. Align all pins and be careful of the solder flow.
8	Install Filters F1 - F4. Do not bend over the case tabs. Solder all leads on the bottom side
9	Install Relays K1, K2
10	Install Y1 and if 2 <sup>nd</sup> oscillator option is required. Install Y2.
11	Install VR2- VR5

Install and solder wires in the shown areas on the component placement diagram (holes with an "X") per the table below. Do not lay wires directly on the board or route underneath the PCB! Even though this makes for a neater assembly, doing either will cause undesired oscillations and spurious responses.



Strip  $\approx 1/4$ " from each end and solder tin the end prior to installing the wires. **NOTE:** Flying leads are wires that will be connected later in the assembly process.

WIRE	FROM	TO	SIZE in Inches
#26 Teflon	TXON near R21	TXON near C69	6"
#26 Teflon	+13.8 SW bus near R1	Flying Lead (for Power Switch)	2"
#26 Teflon	+13.8 SW bus near R1	Flying Lead (for LO switch)	4"
#26 Teflon	+13.8 SW near CR3	+13.8 SW near K2	3 "
#26 Teflon	+13.8 SW bus near R1	+13.8 SW middle of K1	3 1/2"
#26 Teflon	+13.8 SW bus near R1	+13.8 SW near C28	3 1/2"
#26 Teflon	TXLED	Flying lead	2"
#26 Teflon	LO1	Flying lead	2"
#26 Teflon	LO2	Flying lead	3"
#22 Teflon	RXIF	Flying Lead	1 1/4"
#22 Teflon	TXIF	Flying Lead	1 1/4"
#26 Teflon	RXON near R24	RXON near VR4	3 1/2"
#26 Teflon	TR near Q5	TR near K2	3"
#26 Teflon	+13.8V near C75	Flying Lead	4 1/2"
#18 Teflon	+13.8V Solder to pad near C75.	Flying Lead	4 "

Select either a PTT- High (+1 to +15 VDC) transmit keying or a PTT - Low (Push To Talk to ground) keying function for the transverter. This input is required for keying the transverter and will depend on your transceiver. **Consult your transceiver's manual for details if you are not sure.** Install and solder a 4" #26 Teflon wire in the desired connection and leave it as a flying lead. If you plan to use an external amplifier or preamp that requires a transmit key line, the extra set of contacts in relay K1 may be utilized. The contacts are marked C (Common) NO (normally open) and NC (normally closed) and are referenced to Receive. You may connect the C to either ground, (any via hole) or a voltage (+13.8SW) if required. Use the supplied #26 Teflon wire. Then depending on your requirements, either the NO or NC may be connected to the AUX jack on the back wall of the transverter after the PCB is installed.

**Post soldering:**

All leads including wires extending through to the bottom side of the PCB should be **trimmed as short as possible** to eliminate possible shorting to the enclosure when installed. Check your work for solder bridging to adjacent traces, incorrectly installed components, and missing components.

Now refer to the bottom side component placement diagram and review the positioning of the brass angle. Position it as shown and solder it to the ground plane. It is suggested to re-flow the solder under the F2 and F4 filter. This may be a high spot on the board and it is important to not have any gaps between the brass angle and the ground plane but also have the brass as flush to the ground plane as possible. The printed circuit is now ready for testing.

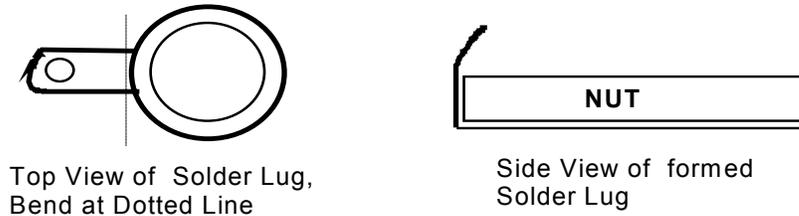
**PCB assembly into the enclosure:**

The enclosure is machined at the factory for your convenience. Notice that the enclosure and the PCB have corresponding holes, which are directional and must be aligned correctly. The PCB installation in the enclosure is easy if the suggested assembly steps are followed. If not already done, remove the cover from the enclosure and wipe the inside clean to remove any remaining metal particles that may have been trapped during machining. Install the 4-40 x 3/8" mounting screws that correspond with the PCB in the enclosure. There are twelve total. Install the screws through the outside of the enclosure and attach a 4-40 nut to them on the inside of the enclosure. Make the nuts snug but do not tighten. Then trial fit the PCB. If one or more screws do

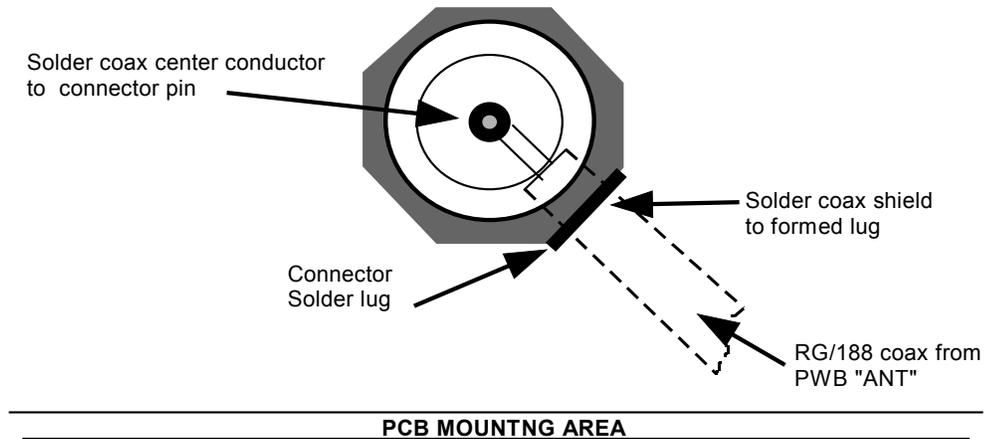
not line up with the PCB, loosen the nut slightly, and re-position the screw, then fit the PCB again. When all mounting screws are aligned, tighten the nuts.

Now install all of the connectors in the enclosure. Using Figure 3A and 3B, install the type "N" connectors as shown. Cut the center pins to 1/8" in length. The coaxial cable will be installed on the connector after it is attached to the PCB. Now install the remaining rear wall mounted connectors, per the location in Figure 4.

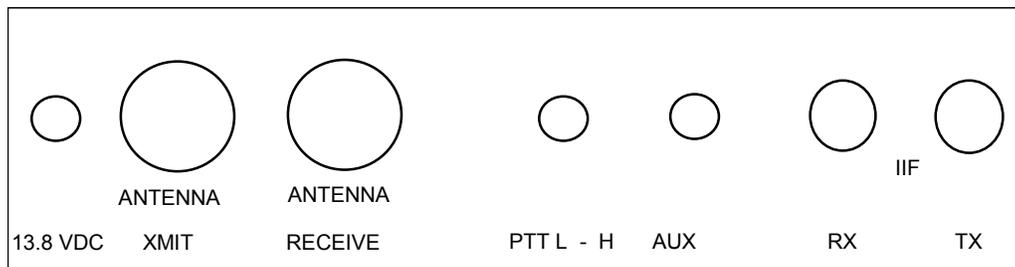
**Prepare the solder lug as shown prior to installing**



**Figure 3A**



**Figure 3B Inside View of Enclosure, Solder Lug Installation on the 'N' or UHF Connector**



**Figure 4 Connector Mounting Positions, Outside View**

- 2 - BNC connectors at the RXIF and TXIF positions using the supplied 3/8" nuts. If washers are supplied, install them on the inside of the enclosure. Do not install solder lugs. If you have difficulty tightening the connector, connect an adapter or cable connector and hold this while tightening to keep it from spinning.
- 3 - RCA connectors for AUX, PTT-H-L and 13.8 VDC using the supplied hardware. The flat washer should be installed under the solder lug on the inside of the enclosure. After tightening, the lug should be bent away from the wall.



**PCB assembly into the enclosure, continued.**

Place the circuit board over the mounting screws and place two nuts on opposite corners on the screws extending through the PCB and tighten evenly. Now install VR1 by first trial fitting it into position. Cut the leads to fit using a 4-40 x3/8 screw in the enclosure mounting hole as a depth guide. Bend the leads slightly so that the body of VR1 will fit flush on the enclosure. Place a nut on the 4-40 screw and tighten. Then tack solder one or two leads of VR1. Remove the PCB from the enclosure and solder VR1 correctly and trim the excess leads. Now re-install the circuit board as before with VR1 attached to the enclosure.

- 1 - Mount the POWER switch using the supplied hardware. Mounting of the switch should be so it is toggled per Figure 5.
- 2 -Mount the LO2-432 switch using the supplied hardware. Mounting of the switch should be so it is toggled per Figure 5.

At this point, some of the flying wires will need to be connected in the enclosure to allow preliminary electrical testing. Refer to Figures 4 and 5 for correct connectors.

Connect the #26 Teflon (PTT-L or PTT-H) wire to the wall mounted RCA jack, then connect a 1000pF capacitor (labeled "102") to the center pin and solder lug and solder (See Figure 4).

Connect and solder the #26 Teflon wire from LO2 on the PCB to the lower terminal on the LO switch. This terminal will be closest to the printed circuit board.

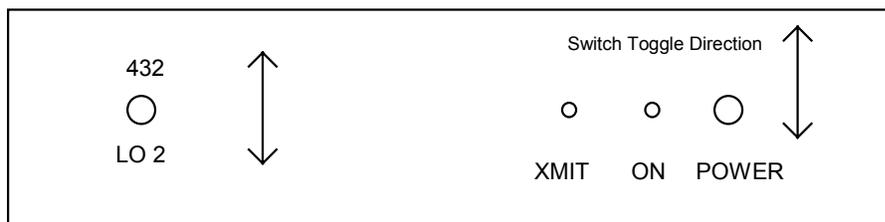
Connect and solder the longest #26 Teflon wire from the +13.8SW bus near R1 to the middle terminal on the LO switch.

Connect and solder the #26 Teflon wire from LO1 on the PCB to the terminal closest to the opening on the wall mounted LO switch.

Connect and solder the #26 Teflon wire from the +13.8V on the PCB (near C75) to the middle terminal on the wall mounted POWER switch and solder.

Connect and solder the last #26 Teflon wire from the +13.8SW bus (near R1) to the terminal on the wall mounted POWER switch that is closest to the opening in the enclosure.

Connect the #18 Teflon wire from the 13.8V connection and solder it to the center of the wall mounted DC power jack (13.8 VDC). Then Connect and solder the 100µF capacitor to the DC power jack, observed polarity, positive lead to the center pin of the jack, negative to the ground terminal.



**Figure 5 Switch / LED Mounting Positions**



**Electrical Test Verification of PCB. Receive only:** Apply 13.8 volt, current limited supply (0.5 amps) to the RCA DC Power jack. The center pin is positive. Turn on the power switch. The transverter will now be in the receive mode. Check the voltages in the order shown, on the test table then continue by checking the oscillator section. Voltages are referenced to ground, which is the enclosure. Use the component placement diagram for test point location.

TEST	Test Point Location	VOLTAGE
RX1	+13.8SW	Power supply Voltage
RX2	Junction of C84 & R42	5.0 ± 0.5VDC
RX3	Junction of R42 & R39	3.5 - 4.5 VDC v
RX4	Junction of IC9 & L29	5.0 ± .5VDC
RX5	Junction of R19 & C34	5.0 ± 1VDC
RX6	Lead of C33 closest to R19	1.5 ± .5VDC
RX7	Junction of R18 and C33	5.0 ±1VDC
RX8	Lead of C32, closest to R18	2.5 ± .5VDC
RX9	Junction of R16 and C25	2.0 - 7.5 VDC
RX10	Leg of C24, closest to VR5	1.5 ± 1.0VDC
RX11	Verify LO1 and LO2 correspond to Switch	Power supply voltage
RX12	Junction of R24 and IC4 (if installed)	5.0 ± 1VDC
RX13	Junction of C43 and IC4 (if installed)	1.8 ± .5VDC

Due to variances in GaAs FET devices, voltages will vary. Optimal performance occurs between 37 - 43 mA as measured across R42.  $I \text{ in mA} = E \text{ (voltage drop across R42)} \div \text{the value in Ohms of R42}$ . The current may be adjusted by changing the value of source resistance. Higher source resistance, lower drain current. There is no need to adjust the values if it is in tolerance.

**RX Test Trouble shooting**

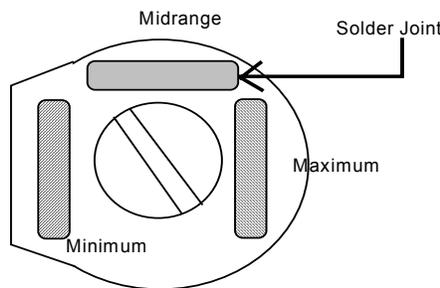
Failed TEST	Probable causes
RX1	+13.8SW shorted to Ground, Power supply in current limit, Missing wire.
RX2	Output on VR4 shorted to ground, Q6 or IC9 installed incorrectly.
RX3	If voltage is 5.0V, Q6 is damaged, not installed correctly or R38 is open. If it is < 3.0 volts, Q6 not installed correctly or damaged
RX4	Check L29. Open or shorted to ground. IC6 shorted to ground, defective, or installed incorrectly.
RX5	Missing +13.8SW wire to VR5. R19 wrong value or shorted. IC3 shorted to ground, defective, or installed incorrectly.
RX6	If >2.5 VDC, and RX5 test passes, replace IC3. If < 1.0 VDC, C33 is shorted or the input of IC3 is shorted to ground.
RX7	R18 wrong value or shorted. IC2 shorted to ground, defective, or installed incorrectly.
RX8	If >3.0 VDC, and RX7 test passes, replace IC3. If <2.0 VDC, C32 is shorted or the input of IC2 is shorted to ground
RX9	R16 wrong value or shorted. IC1 shorted to ground, defective, or installed incorrectly.
RX10	If >2.5 VDC, and RX9 test passes, replace IC3. If < 1.0 VDC, C24 is shorted or the input of IC1 is shorted to ground.
RX11	Switch wired wrong. If low voltage, wire, capacitor or regulator shorted to ground on the LO input on PCB.
RX12	R24 wrong value or shorted. IC4 shorted to ground, defective, or installed incorrectly.
RX13	If >2.5 VDC, and RX12 test passes, replace IC4. If < 1.0 VDC, C43 is shorted or the input of IC4 is shorted to ground.



If any of the RX tests fail, repair or consult Down East Microwave before proceeding with the oscillator testing.

**Local Oscillator 1 (432) Testing:**

Verify that there is a 101.000 MHz. crystal in the Y1 position. If there is only one crystal installed, it should be in the LO1 oscillator position. This test will not work if a crystal is not installed. Switch the LO switch to the 432 position. Probe TP1 with the positive lead of a Voltmeter. Adjust C3 for maximum voltage, note where the capacitor is positioned. A midrange position is preferred. If the capacitor is at the maximum (bottomed out clockwise), spread coil L1, 1 to 2 turns and readjust C3 so it comes off of the bottom. If the capacitor is at minimum position (top maximum counter clockwise), compress coil L1 and if necessary, you may need to wind a new coil with an extra turn and replace it. The final voltage at TP1 should be approximately 1.0 - 1.5 volts. If a frequency counter is available probe TP1 and adjust C3 for 101.00000MHz. If your frequency counter is capable of measuring up to 500Mhz., you can probe the junction of C34 and M1 to verify that four (4) times the fundamental frequency of the crystal (404.00000 MHz.) is present. If the specified voltage at TP1 cannot be obtained please start the Local Oscillator trouble shooting section on the next page. If the frequency cannot be obtained, skip to step #8 of the Local Oscillator trouble section. If the LO 1 is working correctly, skip to the TX testing section. If you have the install the 2<sup>nd</sup> Xtal, repeat the above steps noting that you now adjust C14, stretch and compress L6, and probe TP2. C14 is different and midrange is indicated in the next figure. Your final frequency will be the frequency marked on your 2<sup>nd</sup> Xtal x 4. Again, if the specified voltage at TP2 cannot be obtained please start the Local Oscillator trouble shooting section on the next page. If the frequency cannot be obtained, skip to step #8 of the Local Oscillator trouble section.



C14 Capacitance Position

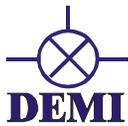
**Local Oscillator Trouble Shooting Section:**

All circuit values used in this trouble shooting section assumes the LO1 is the problem. LO1 and LO2 are the same except for the type of capacitor use for C3 and C14. If you are trouble-shooting LO2, substitute the component designators. Also, understand that it is possible that the voltage at TP1 may be low and the oscillator could be working perfectly. But, this should be verified.

The crystals used in this circuit are 5<sup>th</sup> overtone design. If L1 is distorted enough or the components tolerances are out, you can cause the oscillator to operate on a different overtone. **Crystal failure is a very rare occurrence!** If there is any voltage peek at TP1 while adjusting C3, and L1 does not vary much from its specifications, it should be assumed that the oscillator circuit is correct. For verification of this, perform the following tests 1 - 8. If the oscillator is on or close to frequency, (404.00000) skip to test #8.



1. Verify voltage at the junction of L5 and CR1. This should be  $0.7\text{VDC} \pm 0.3\text{ VDC}$ . If it is high, CR1 is missing, installed backwards, damaged, or L11 is missing or open. If it is 0VDC, check for a short in the circuit after R8. Use schematic and component placement diagram. If you find an error in assembly, correct it and restart the oscillator test.
  2. If the voltage is correct at the junction of L5 and CR1, probe the junction of R16 and C25 with a voltmeter while adjusting C3. The voltage should vary. Adjust C3 for a *minimum* voltage at this point. If less than 4 volts can be achieved, the multiplier section of the oscillator is working correctly. If the voltage stays high (6 - 7 volts) and doesn't vary downward during the adjustment, the problem is in the main oscillator circuit.
  3. With the voltmeter, probe the junction of R6 and Q2. This voltage should vary when C3 is adjusted. If it does not vary, then the problem is in the Q1 circuitry. If it does vary and there is no change of voltage on TP1, then the problem is either a defective Q2 or its bias circuitry. Verify the suspected transistor by following step 4.
  4. To verify the bias voltages of transistors Q1 and Q2, you need to measure these voltages at the transistors leads. Remove the PCB from the enclosure and keep the +12 volts connected. Be sure that there is a ground connection between the enclosure and the PCB. Examine the schematic and component placement diagram for exposed leads of other components that are connected to the desired test points. Start by verifying the output of the 9 Volt regulator, VR 1. Then check Q1. Collector = 9 volts. Base = 1.5 - 2.5 volts. Emitter = 1.3 - 2.2 volts. For Q2, collector = 9 volts. Base = 1.3 - 2.2 volts. The Emitter is TP1.
  5. If these voltages do not check out correctly, you need to make the determination if the bias resistors, chokes and L1 are installed correctly. They may also have a solder bridge on the bottom side of the PCB. All of the resistors should check out with a ohm meter except R2 which is shorted with L1. Also, verify the placement of Q1 and Q2. If the transistors are installed incorrectly, or a solder bridge caused a wrong bias voltage (higher than specified) assume that the transistor is destroyed. You may still try it after repair, but it is unlikely!
  6. If the voltages check out OK, verify that C6, C5 and C2 are installed correctly and do not have any solder shorts. Measure with an ohmmeter.
  7. If they check out OK, its time for the final test. Remove the Y1 crystal and L2 inductor. Be careful with L2. It is brittle! Now install a 51-ohm (36 - 75 ohm will work) resistor in the Y1 position. Apply power to the circuit and probe TP1. If you can obtain a voltage swing by varying C3, then verify what frequency it is operating on with a frequency meter or a FM broadcast radio. You should be able to adjust C3 for 101 MHz. If not, stretch and /or compress L1. If you cannot obtain any oscillation or if the frequency cannot be obtained with the specified L1 size, then the oscillator circuit is assembled wrong or Q1 is defective. If you can adjust the frequency, set L1 (stretch and/or compress) so that C3 is in the mid position. Leaving everything adjusted correctly, power down the circuit and remove the resistor in the Y1 position and re-install Y1 and L2. Power the circuit up. If it doesn't oscillate, you have a defective crystal or open L2.
  8. If the oscillator is operating but the frequency cannot be netted, verify that C3 is in mid position. If not re-adjust L1 to do so. If the oscillator shuts down when the frequency gets close, and C3 is in mid position, allow the oscillator to run at any frequency for 24 hr. before attempting re-adjustment again. You may continue the testing and assembly of your transverter. Just don't do the final assembly. If after re-adjustment, and you are sure of your frequency calibration (do not use a FM radio or HT for calibration!!!) and the L1 and C3 circuitry adjustment is correct, return the crystal for replacement.
- After the oscillator is performing to specification, re-install the PCB in the enclosure and continue with the Transmit Electrical Test.



**Transmit Electrical Test:**

The voltage checks listed are for the transverter in the TX mode with any oscillator enabled. After verifying that the DC power is connected to the transverter and the power switch is in the on position, place the transverter in the Transmit mode. This is done by keying the PTT-L or PTT-H circuit. Either ground or the +13.8V supply will work. This will also depend on how you have configured your transverter. As you enable the TX mode, a “click” may be heard from the relays on the PCB. All voltages are referenced to ground (the enclosure).

TEST	Test Point Location	Correct Test Results
TX1	TR connection near Relay K1	0.7 VDC ±0.5VDC
TX2	ANT connection near K2 and K2 side of C68	Measure short with Ohm meter
TX3	TXON connections - All Positions	Power supply voltage
TX4	RXON connections - All positions	0 VDC
TX5	TXLED connection	Power supply voltage
TX6	Junction of C70 - C72	5.0± 0.5VDC
TX7	Junction of R34 and C64	5.0 ± 1VDC
TX8	Leg of C62 closest to R34	2.0 ± .5VDC
TX9	Junction of R33 and C62	3.5 ± .5VDC
TX10	Leg of C58 closest to R33	2.5± 0.5VDC
TX11	Junction of L16 and CR5	0.8 ± .3VDC
TX12	Junction of R22 and IC5 (if installed)	3.5 ± 1VDC
TX13	Junction of C51 and IC7 (if installed)	1.5 ± 0.5VDC

**TX Test Trouble shooting:**

Failed TEST	Probable causes
TX1	Missing +13.8SW or TR jumper wires. Missing or defective Q7, R29, or CR8
TX2	Defective K2 or not soldered correctly
TX3	Defective K1, shorted TXON voltage to ground, If defective all other tests will fail.
TX4	Defective K1 or PTT circuit not working correctly
TX5	R32 missing or shorted
TX6	VR3 Missing or shorted to ground. C70 installed backwards
TX7	If low, IC7, R34 installed incorrectly or shorted. If high IC7 defective or installed incorrectly
TX8	If low, IC7 shorted. If high, defective IC7
TX9	If low, IC6 , R33 installed incorrectly or shorted. If high, IC6 defective or installed incorrectly
TX10	If low, IC6 shorted. If high, defective IC6
TX11	If low, R21missing,CR8 or CR5 shorted. If High, CR8, CR5 is backwards, damaged or missing.
TX12	If high, IC5 defective. If low, missing jumper wire, defective IC5, solder short, wrong value R33
TX13	If low defective IC5 or installed incorrectly. If high IC5 defective

**\*\*If any of the Transmit tests fail, repair or consult Down East Microwave before proceeding with the Kit!!!\*\***

If all of the tests pass, you may mount the PTC-50 Thermistor next. The Thermistor is used for frequency stability and does not need to be installed at this time but it is convenient. If you are unsure of the Xtal’s performance or question the oscillators performance, it may be installed later. If so, install the rest of the 4-40 nuts on the top side of the PCB and repeat a few of the electrical tests to verify that nothing was shorted on the PCB after assembly. Then proceed to the power module installation section. If you wish to install the PTC-50 now, continue to the next page.

### **PTC-50 Thermistor installation**

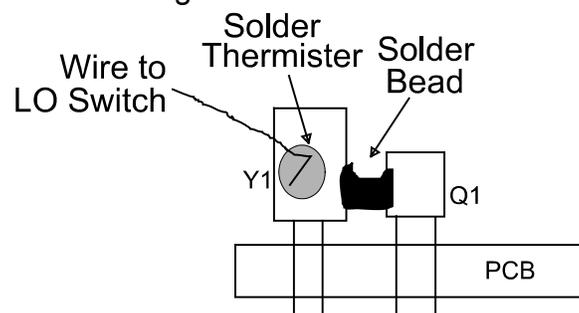
The installation of the PTC-50 Thermistor may be done at any time but it is most convenient to do it before the final wiring is completed. Because it is important to determine if the oscillator circuit is 100% functional before installing the Thermistor, some double work is required. We, at the Down East Microwave factory, install the Thermistor after complete assembly and the oscillator has aged for 24 hours (a burn in period). You may do the same but it is not required. Just expect to see some frequency drift for the first 24 hours of operation.

To install the Thermistor correctly, remove the PCB from the enclosure. To do this, unsolder the PTT wire, and the 3", #18 wire from their RCA jacks. Then remove both the LO and the Power switches from the enclosure. Next remove the 2, 4-40 nuts and the VR1 mounting screw. The PCB should come out of the enclosure.

Locate the Thermistor and remove one of the attached wires with some heat from a solder iron. Then review the diagram below. Note that the Thermistor is attached by solder to the crystal. Start by tinning the case of the crystal. Heat the case with an iron and flow some solder on it. Then while still heating the case, place the side of the Thermistor without the wire, in the molten pool of solder and remove the iron. Now before the crystal / Thermistor assembly cools, note where the crystal and Q1 almost touch. Heat the case of Q1 with your iron and flow a bead of solder so that it attaches to the crystal. Allow it to cool and then inspect for a good solid connection. If in doubt, re-flow and add more solder. Now attach the lead of the Thermistor to the via hole by VR1. This via is the output of the VR1, which is 9VDC. If the second local oscillator is used, a Thermistor may be installed to that crystal if desired but is not included in the kit. It would also be recommended to exchange VR2 for a higher wattage regulator unless it is tied to 13.8VDC. IF the second oscillator is used for satellite operation, the frequency stability may not be that important because of the Doppler shift. You may now re-install the PC board in the enclosure and continue the assembly on the next page.

Some important notes about the PTC-50, Crystal heater installation. The crystal needs to be attached to the Q1 or Q3 transistor for two reasons. One is to provide a DC path for the Thermistor through the case ground of the transistor. The other is to maintain a constant temperature of the oscillator transistor. We have found that this is best for frequency stability. The theory is that the internal air temperature of enclosure will be less than the crystal and oscillator transistor with the Thermistor attached. If that is always the case, the temperature remains constant on the most temperature sensitive components.

If the solder bead is not attached to the transistor, the Thermistor will not heat up unless a wire is attached from the crystal case to ground. This is not as effective as the total attachment.



**Proper Attachment of Thermistor to Crystal**



### **Power Module Installation:**

Place the power module (IC8) on the enclosure floor in its mounting location and trim the leads so they do not extend past the mounting pads. They should be approximately 3/8" long once trimmed. Now find the tin plate shield and trial fit it over the power module. You will need to trim some of the openings in the shield to clear the power module leads. Wipe the mounting surfaces of the enclosure floor and flange of IC8 to *verify the surfaces are free any foreign matter and deep scratches before applying a thin even coating of thermal compound* to the mounting flange. Then place IC8 on the enclosure floor while lining up the leads with the traces of the circuit board. Install two 6-32 x 3/8" screws through the outside of the enclosure up through the mounting flange of the module and through the shield mounting holes. Install two 6-32 nuts and verify that the leads of the module do not touch the shield. Then position the module and shield so that the shield touches the PCB and tighten the 6-32 screws. Solder the module's leads to the traces then tack solder any part of the shield to the ground plane of the PCB. Make as many connections as possible. This shield provides the lowest possible inductive path between the PCB and the module. This is important for stability.

### **LED Installation:**

**Note:** The longer lead on the LED is positive.

- Prepare the "XMIT" LED by supporting the **SHORT** lead (negative) at the LED body, bend the lead 90° away from the longer lead.
- Place the "XMIT" LED in the wall mounting hole (see Figure 5) and place the previously formed lead on the ground plane circuit close to the edge of board and solder.
- Cut the positive lead of the "XMIT" LED to approximately 3/8". Form a "J" in the lead by bending with pliers.
- Connect the #26 Teflon wire from the hole in the PCB near labeled TXLED, to the "J" formed positive lead on the "XMIT" LED.
- Place the positive lead of the "ON" LED in the hole by R1 labeled ON LED.
- Form the "ON" LED so that the body fits into the hole in the enclosure.
- Tack solder the ground side of the "On" LED to the ground plane

### **Final PCB assembly into the enclosure**

- Connect the #18 Blue Teflon wire from the wall mounted DC power jack (13.8VDC) and solder., Connect and solder the 100µF capacitor to the DC power jack, observed polarity, positive lead to the center pin of the jack, negative to the ring ground terminal.
- Connect the #22 Teflon wire from the stand alone hole in the PCB labeled RXIF to the BNC RX jack and solder.
- Connect the #22 Teflon wire from the stand alone hole in the PCB labeled TXIF to the BNC TX jack and solder.

### **DEM 432 - 28 User Options:**

The following final assembly instructions cover all of the options that are available for this kit. This list of suggestions will help you decide which options you will want to install.

**Common Antenna for both transmit and receive.** If you plan to connect an antenna directly to the transverter or use a solid-state amplifier with antenna switching built in, do this assembly.

**Add an external preamplifier and bypass the internal GaAs-FET.** If you plan to use an external or mast mounted preamplifier, this option is suggested. Any additional gain in front of the stock transverter will degrade the IMD performance, and reduce the dynamic range of the transverter by the amount of additional gain.



**Common IF option.** If you use and transceiver with a single transverter port or a transceiver with a power level up to 10 watts.

**Split RX / TX Ports for high power amplifier use.** If you plan to use a tube type amplifier with external preamplifier and sequenced switching schemes, such as an EME station, assemble this option.

**Auxiliary switching contacts.** Used for external switching circuits or to hard key a solid state amplifier.

**Install the TXIF or RXIF gain stages.** Only if the TX drive is low from the transceiver. Only if RX IF gain is desired.

**Common Antenna for both transmit and receive:**

Prepare the common output coaxial cable as follows: (See Figure 6)

Cut the coax 2" - 2 1/32" long.

Remove the outer insulation 1/2" from one end and 1/4" from the other.

Remove the braided shield 1/4" from the 1/2" stripped side.

Remove the braided shield 1/8" from the other side.

Remove the center conductor insulation from each end allowing an extension out of the remaining shield. Cut the center conductor wire to ~1/16" to prevent shorting.

Solder tin the center conductor on both ends and solder tin the shield on the 1/2" end.

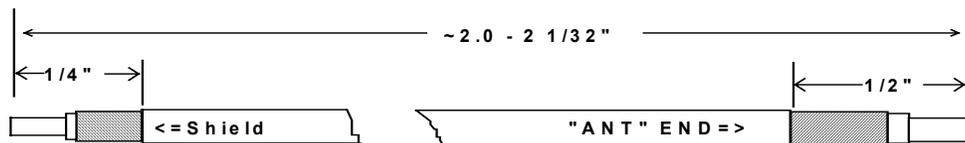
Bend the center conductor on the longer stripped end 90°

Position the 1/2" stripped end on the circuit board by placing the center conductor in the hole on the board labeled "ANT". This hole is located near relay labeled K2. See figure 7.

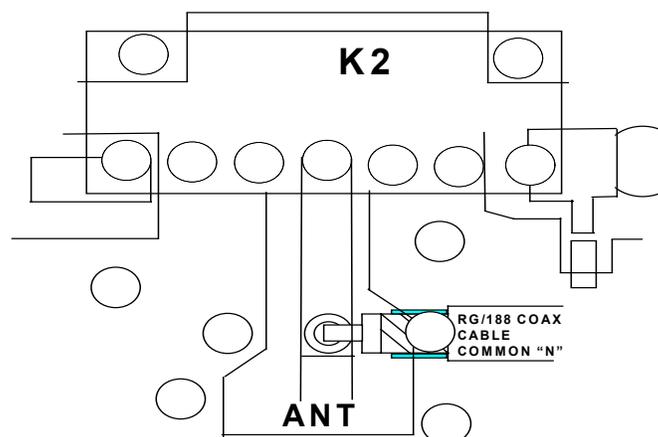
Solder the shield to the ground area adjacent to the "ANT" hole for the center conductor, then solder the center conductor in the "ANT" hole.

Route the coaxial cable around the relay to the solder lug on the wall mounted 'N' connector

Solder the shield to the solder lug, then solder the center conductor to the 'N' connector center pin as in figure 3A.



**Figure 6 Cable shown broken for clarity**

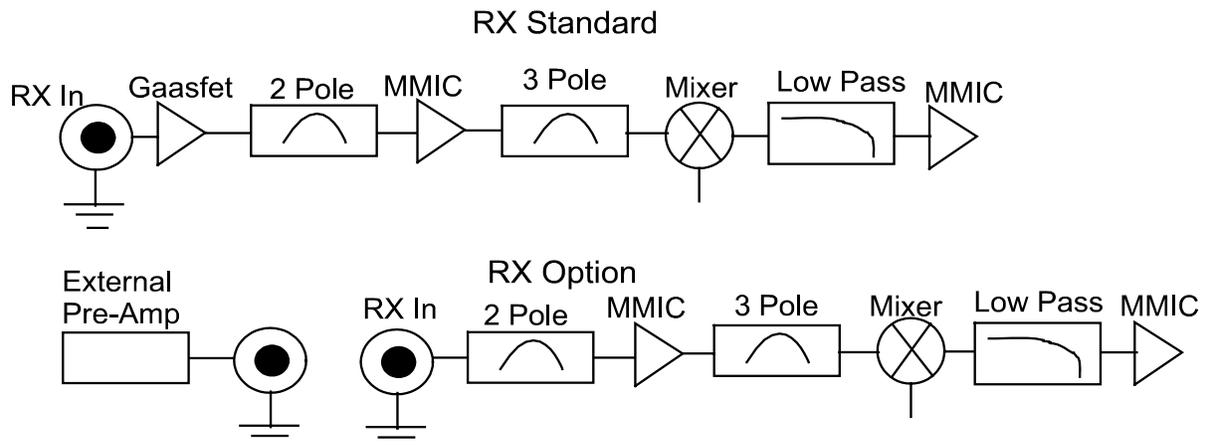


**Figure 7 Coaxial Cable mounting on PCB shaded areas are solder points**

## Add an external preamplifier and bypass the internal GaAs-FET

On the following page is block diagram of the receive converter. It shows the standard and an option of using an external preamplifier. It is recommended that if you use an external or mast mount preamplifier, you should bypass the internal one. The transverter may be configured this way at any time.

1. If you do not wish to have the receive signal routed through the T/R relay in the transverter, refer to the component placement diagram and remove R38, L25, and R39. The pad that is the junction of C81, L25 and R39 is the new RX input. The RX signal will pass through the diplexer and then into the F4 filter.
2. If you wish to still use the T/R relay in the transverter, remove R35 and C76 from the PCB after performing the modification in step 1. Then run a jumper coax from the R35 pad to the new RX input.



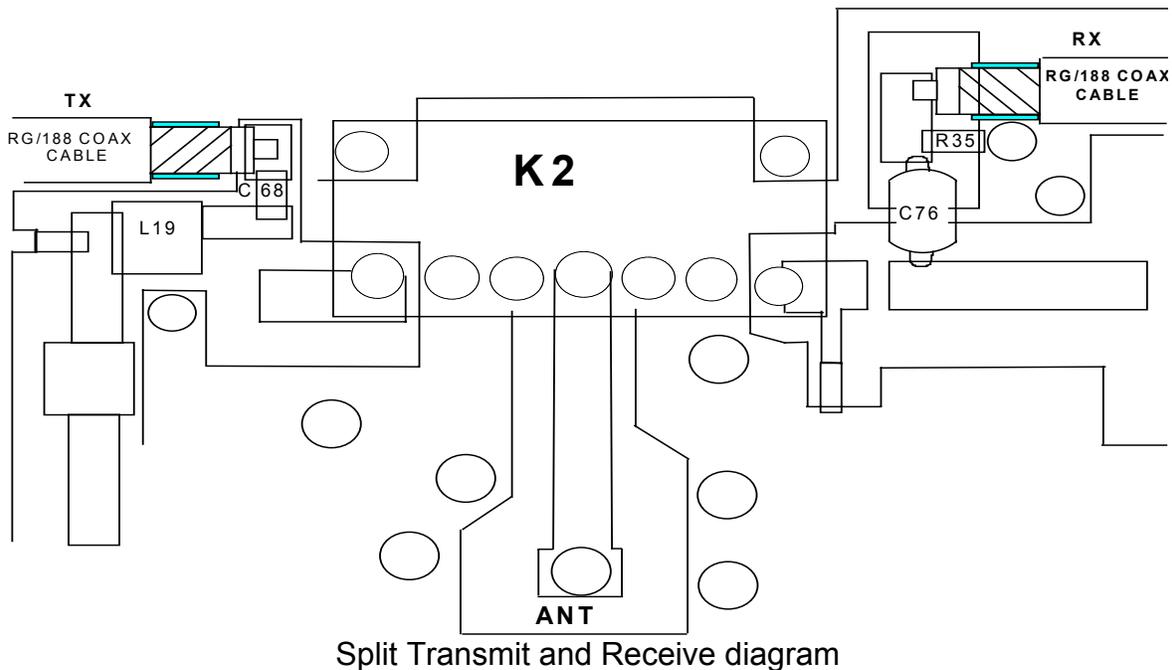
### **Common IF option:**

A common IF option is available for this transverter. If interested, it can be supplied as a kit. Please consult Down East Microwave Inc. for details. Options with up to 10 watts input power are available. It is easily installed at any time and comes complete with a new component placement diagram.

### **Split RX / TX Ports for high power amplifier use:**

1. Remove chip capacitor C68 from original position and place where shown on the diagram.
2. Prepare a 2" piece of RG/188 coax or similar and attach it to the new C68 placement as shown.
3. Attach the other end of the coax to the spare type "N" connector.

The RX input can be left assembled the way it is. This will provide additional receiver isolation during transmit. The K2 relay will function normally and will open the circuit to the RX input. This will not protect an external preamplifier. IF you decide to remove the K2 relay from the circuit, remove and replace C76 and R35 as shown in diagram below then remove the coax from the ANT connection on the PCB and attach it to the new position shown.



Split Transmit and Receive diagram

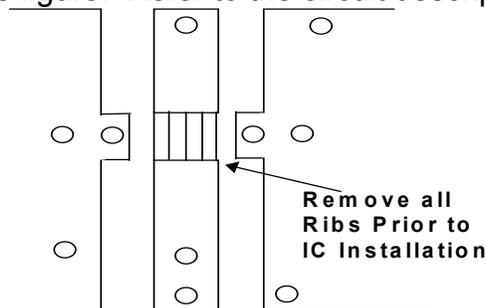
**Auxiliary Switching contacts:**

The auxiliary contacts in K1 are labeled C (common) NO (normally open) and NC (normally closed). The C connection can be wired to ground or +13.8 VDC. This will then be connected or dis-connected depending on the transverter is in transmit or receive. The contacts are marked for the receive mode. The NO or NC can be wired to the AUX connector on the enclosure.

**Install the TXIF or RXIF gain stages:**

You may require additional gain on either the TXIF or RXIF and want to install either IC4 or IC5. If your transceiver has less than 1 mW output on its transverter port, installing IC5 will enable the transverter to produce full output power. All of the associated bias components are installed and tested. Refer to the component placement diagram and locate IC5. Then remove the ribs as shown below. Cut them with a razor knife and heat with a solder iron. They will jump off the board! Then form the leads of the IC5 so that it lays flat on the circuit board. Solder it into place as shown on the comp placement.

The same thing may be done with RXIF. Note the dot on the IC before installing. **Caution!** Installing this gain stage will increase your IF gain, decrease the systems dynamic range, and will not improve your system's noise figure. Refer to the circuit description.



IC4 & IC5 Installation



### **Transverter Final Tune Up:**

Connect your transceiver to the transverter. Interfacing the transverter to the transceiver is easy. If your transceiver requires a DEM TIB or AOS, follow their instructions for interfacing. If the transverter was assembled for direct connection to your transceiver, follow the steps listed below.

1. Depending on the make and model of your transceiver, it may or may not be necessary to enable the transverter ports. Follow whatever instructions you have in your transceiver's operation manual to enable transverter operation. If it requires a special connector or cable assembly, it should be made now or contact Down East Microwave for assistance.
2. Connect all IF cables. Both receive and transmit are BNC connections on the transverter. Use good quality coax cable to connect the 28 MHz. transverter ports from your transceiver to the TXIF and RXIF connectors on the transverter.
3. Connect the Push to Talk line out of your transceiver to the transverter. It is labeled PTT-H or PTT-L on the transverter and uses a RCA connector. The correct keying type should have been configured for your transceiver during assembly.
4. Connect the 70cm antenna system or a dummy load with a power meter to the transverter. If you chose to assemble split transmit and receive sections one of the "N" connectors is the transmit side. Put the power meter or load there. Place a signal generator or an antenna on the receive connector.
5. Connect the DC power to the transverter. It uses a RCA type connector. 13.8 volts is optimum but the transverter will operate normally from 12 to 15 volts.
6. Preset the TXIF and RXIF gain controls. Turn the TXIF counter-clockwise (maximum attenuation) and the RXIF clockwise ( minimum attenuation).
7. Power your transceiver on and leave it in the Receive mode on 28.100 MHz.
8. Apply power to the transverter and turn on the power switch. The power LED should light and the transmit LED should not. Set the local oscillator switch to 432MHz.
9. Adjust the RXIF gain control counter-clockwise until a slight noise increase is heard in the transceiver or just a slight movement in the "S" meter is detected. Power the transverter on and off to verify the change in noise. The RXIF gain may be increased beyond this point, but it will start to degrade the dynamic range of your transceiver. Find a signal on the band or use a signal generator to determine correct frequency, or minimum detected signal level. Out of band signals such as local repeaters will be attenuated if their output frequency is above 438 MHz or below 430 MHz.
10. To test the transmit section, place your transceiver in the CW mode. It is recommended to test the transverter in the CW mode because most transceivers have carrier level controls in this mode only. If your transceiver has FM, it may be use to test the transverter if it has a power output control. Do not use SSB or AM because it is not possible to obtain maximum output power with a transceiver in these modes. Set the carrier/output power control to minimum or "0" output power. Place the transceiver into transmit. Note the transmit LED on the transverter. It should be on. While observing the power meter on the 70cm system, slowly increase the carrier control (with key down) or power output control to maximum on the transceiver. If the transverter is configured correctly for your transceiver, minimal power may be detected on the 70 cm power meter. Now slowly adjust the TXIF control in the transverter in a clockwise direction while observing the power meter. Set it to obtain a maximum of 10 watts maximum. If a power meter is not available, you may use a current meter on the DC power line to determine if the transverter is transmitting. A maximum of 4 amps should be obtained and it should vary as the TXIF control is varied. If 10 watts cannot be obtained with 4 amps of current drain, then with an insulated tool, stretch or compress the L21, L22, an L23 inductors in the output low pass filter. This will also help efficiency. After proper power is obtained, switch the transceiver



to USB and make a transmission. The power output and current drain should correlate to your speech pattern. If a minimum of 10 watts cannot be obtained, it could be a IF drive problem. Please consult Down East Microwave Inc.

11. You may re-adjust both RXIF and TXIF again if desired. The adjustments of the receive preamplifier and local oscillator frequency do not need to be touched but you may if you wish. Do not adjust any of the helical filters unless you have access to a spectrum analyzer at minimum.
12. Put the top on the enclosure and install the screws. Your transverter system is ready to use. Connect as you wish to use it in your 70cm system and have fun!

### DEM 432-28 Component List

Resistors values are in Ohms and are ¼W unless otherwise specified. All chips are 1206.

#### **BAG 1**

R1 1K	R9 470	R17 5.1K	R26 1K pot	R34 150 ½ W
R2 470	R10 680	R18 120	R27 220	R36 12 chip
R3 680	R11 1.5K	R19 56 ½ W	R28 220	R37 12 chip
R4 1.5K	R12 100	R20 47	R29 1K pot	R38 12 chip
R5 100	R13 47	R21 1K	R30 220	R39 300 chip
R6 47	R14 100	R22 330	R31 5.1K	R40 51 chip
R7 100	R15 1K	R24 150 ½ W	R32 470	R41 51 chip
R8 1K	R16 150	R25 220	R33 330	R42 24 chip

All capacitors are disc ceramic and are pF unless otherwise specified. "E"= Electrolytic . "TH" = Thru Hole Variable Trimmer "SMD" Surface Mount Variable Trimmer "PT" = Piston trimmer. "C" = Surface mount Chips. "ATC" = Ceramic Chips .

#### **BAG 2**

C1 1000 (102)	C18 0.1 µF	C34 1000 "C"	C56 100 "C"	C74 0.1 µF "C"
C2 0.1 µF	C19 2.2 µF "E"	C35 0.1 µF	C58 120	C75 100 µF "E"
C3 1-8 Piston	C20 0.1 µF	C36 1000 "C"	C60 0.1 µF	C76 1-6 "SMD"
C4 0.1 µF	C21 120	C37 39	C61 0.1 µF	C77 1-6 "SMD"
C5 15	C22 0.1 µF	C38 18	C62 120	C78 0.1 µF "C" (1008)
C6 39	C23 0.1 µF	C39 120	C63 0.1 µF	C79 0.1 µF "C" (1008)
C7 0.1 µF	C24 120	C40 1000	C64 120	C80 100 "C"
C8 120	C25 120	C41 270	C65 120	C81 100 "C"
C9 0.1 µF	C26 0.1 µF	C42 270	C66 6.8 "ATC"	C82 12 "C"
C10 2.2 µF "E"	C27 2.2 µF "E"	C43 1000	C67 6.8 "ATC"	C83 4 "C"
C11 0.1 µF	C28 0.1 µF	C44 0.1 µF	C68 100 "C"	C84 0.1 µF "C"
C12 0.1 µF	C29 0.1 µF	C45 1000	C69 0.1 µF	C85 2.2µF "E"
C13 0.1 µF	C30 0.1 µF	C51 1000	C70 100µF "E"	C86 0.1 µF
C14 1-6 "TH"	C31 0.1 µF	C53 0.1 µF	C71 0.1µF "C"	C87 100 "C"
C15 0.1 µF	C32 120	C54 1000	C72 100 "C"	C88 120
C16 15	C33 120	C55 0.1µF	C73 100 "C"	C89 0.1 µF "C"
C17 39				



**DEM 432-28 Component List continued**

All molded chokes have GOLD or SILVER multiplier and tolerance bands. Identify molded choke value by the significant color band combination. "C" = 0603 chips. "HW" are tightly wound enamel wire inductors.

**BAG 3**

L1 9 Turns 1/8" ID #24 "HW"	L10 1.0μH (Brown/Black)	L22 3 Turns 1/8" ID # 24 "HW"
L2 0.33μH (Orange/Orange)	L11 1.0μH (Brown/Black)	L23 2 Turns 1/8" ID # 24 "HW"
L3 1.0 μH (Brown/Black)	L12 0.22μH (Red/Red)	L24 4T 1/16" Blue "HW"
L4 1.0 μH (Brown/Black)	L13 0.33μH (Orange/Orange)	L25 39 ηH "C"
L5 1.0 μH (Brown/Black)	L14 0.22μH (Red/Red)	L26 39 ηH "C"
L6 9 Turns 1/8" ID #24 "HW"	L15 0.22μH (Red/Red)	L27 8.2 ηH "C"
L7 0.33μH (Orange/Orange)	L16 0.33μH (Orange/Orange)	L28 39 ηH "C"
L8 1.0μH (Brown/Black)	L19 1.0μH (Brown/Black)	L29 4T 1/16" Blue "HW"
L9 1.0μH (Brown/Black)	L21 2 Turns 1/8" ID # 24 "HW"	L30 56 ηH "C"

**BAG 4**

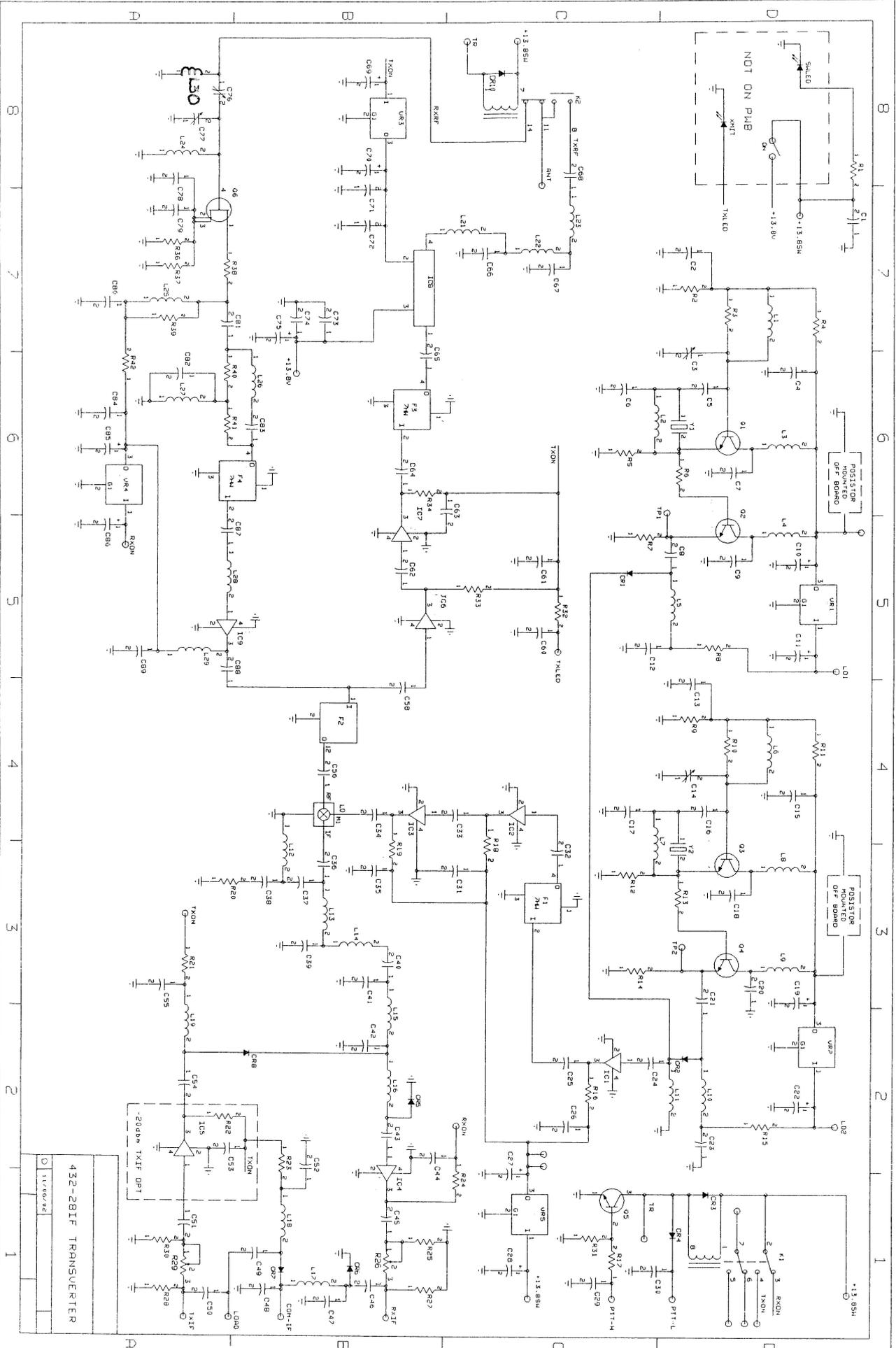
M1 SYM-14H	CR8 MPN3404	VR3 78L05
Q1 2N5179 Metal can	CR10 1N4000 type	VR4 7805
Q2 MPS5179	IC1 ERA-3	VR5 78S09
Q3 2N5179 Metal can	IC2 ERA-2	F1 TOKO 1547
Q4 MPS5179	IC3 MAV11	F2 TOKO 1354
Q5 PN2222	IC4 MAV11 (RXIF Gain, optional)	F3 TOKO 2537
Q6 FPD750 GaAsFET	IC5 MAR6 (TXIF Gain, optional)	F4 TOKO 2537
CR1 MPN3404	IC6 MAR3	K1 G5V-2
CR2 MPN3404	IC7 MAV11	K2 G6Y
CR3 1N4000 type	IC9 AH-31	Y1 Crystal 101 MHz 5th OVR
CR4 1N914 or (GLASS BODY)	VR1 78S09	PTC-50
CR5 MPN3404	VR2 78L09	

**HARDWARE KIT**

(2) 1000pF Capacitor	(4) Adhesive Backed Rubber Feet
(1) 100μF Capacitor	#22 Teflon Wire 4'
(2) LED, RED and holder	#18 Teflon Wire 4"
(2) Switch SPST	RG/188U Mini Coax 6"
(2) BNC Female UG1094/U Connectors	(1) Machined Die cast enclosure
(3) RCA Jacks - Control, Aux., Power	(13) 4-40 x 3/8" Screws
(2) Type "N" Connector and hardware	(26) 4-40 Nuts
(2) 6-32 x 3/8" Machine Screws for Power Module	(1) Label Set
(2) 6-32 nuts	(1) Thermal Grease
(1) Module Shield (when applicable)	(4) Cover screws
(1) Brass angle	

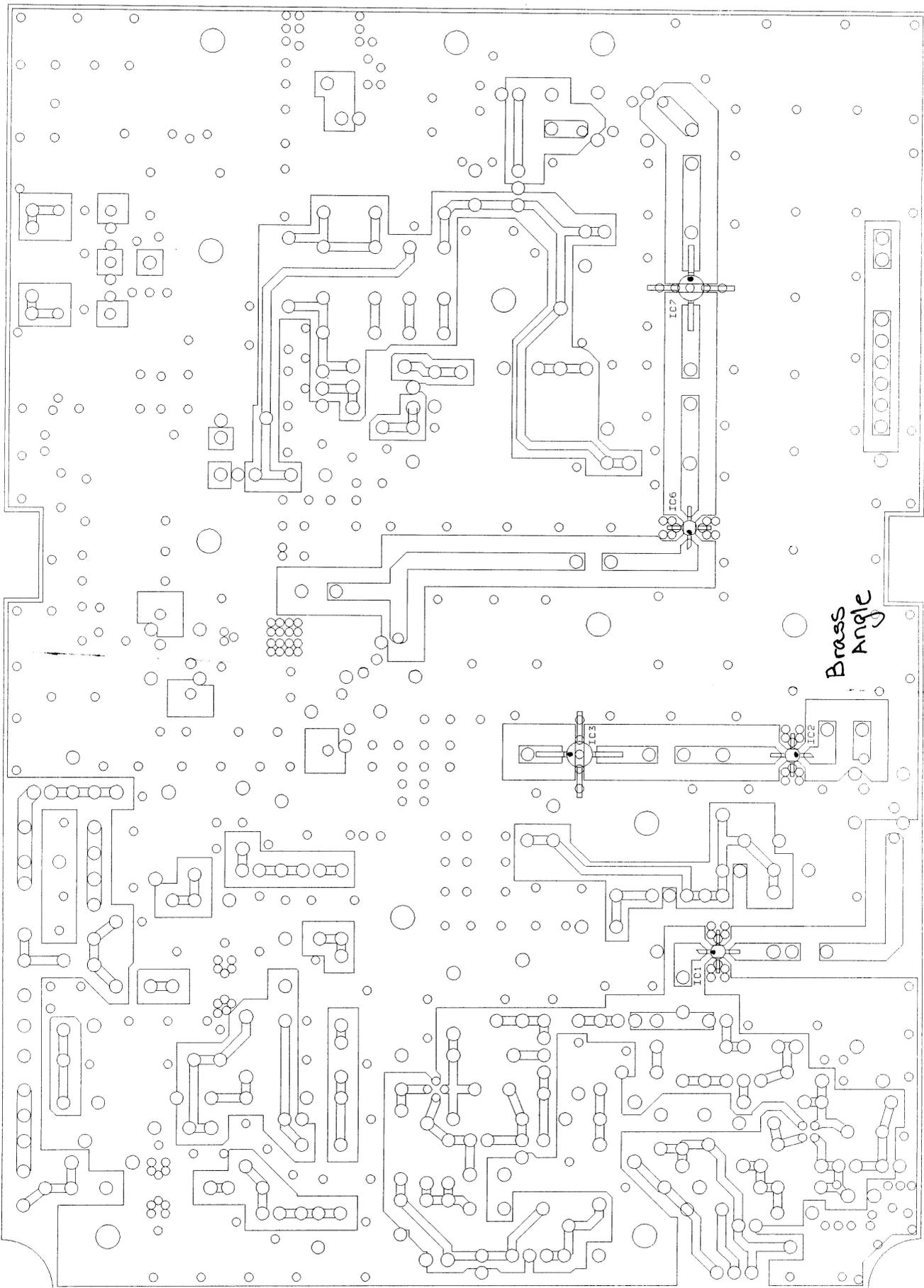
**Miscellaneous Parts:** (1) RF Power Module RA13H4047M, IC8, (1) Printed Circuit Board





432-2B1F TRANSVERTER

11/86/84E

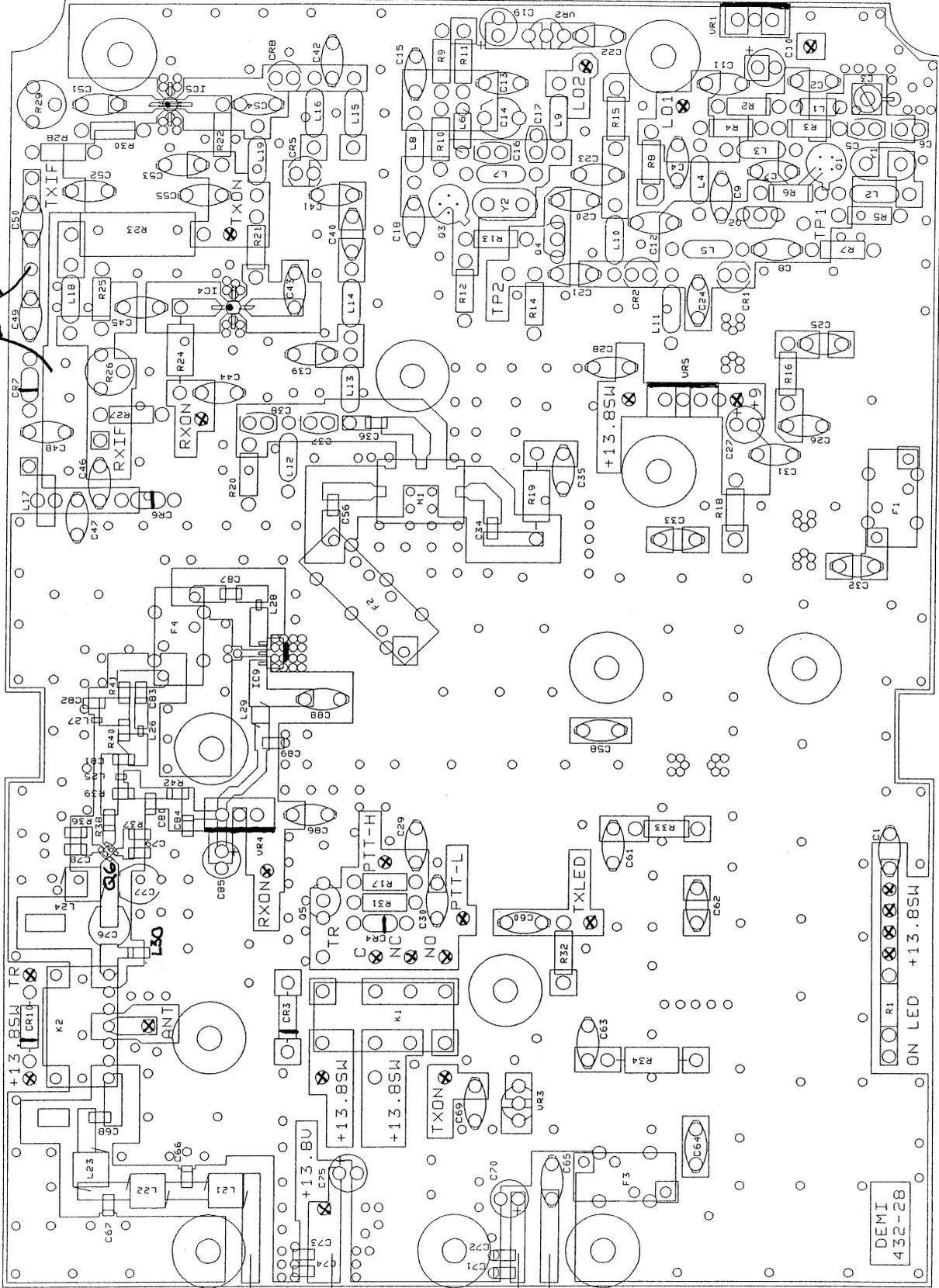


Brass  
Angle

Load →

Solder leads

Top Assembly



DEMI  
432-28

ON LED +13.85V

+13.85V

+13.85V

+13.85V

+13.8V

+13.85V