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High Dynamic Range 222 MHz Transverter Kit
DEM Part Number 222-28K or CK

Operational Overview:

The DEM 222-28 is a 222 MHz to 28 MHz transmit and receive converter. It will operate with most High Frequency transceivers that are available on the market today. The 222-28 has a linear output power of approximately 25 watts. At full compression, the output power may reach 35 watts, but would be recommended for CW or FM operation only. On the receive side, a GaAs-FET preamplifier, a high level mixer (+17 dBm Local Oscillator), and a 3 chamber helical filter provide a sensitive, yet over-load proof front end with superior out of band rejection. The DEM 222-28 has a built in transmit / receive relay with provisions for external switching so that adding a high power amplifier to your 222 MHz system is easy. Options have been provided for a key line input of PTT Low (ground) or PTT High (+Voltage). Auxiliary contacts are included for either transmit or receive with a common line for many applications. The 28 MHz IF levels are adjustable on both transmit and receive and have a dynamic range of approximately 25dB. This is very useful for adjusting your maximum output power and setting the "S" meter level on your IF receiver. IF connections are via BNC connectors. The control, power, and auxiliary connections are via RCA jacks, and the 222 MHz connectors are BNC, UHF or Type 'N' (users choice). The 222-28 is housed in a 7.4" x 4.7" x 2.2" aluminum die cast enclosure with an external 7" x 4" x 3/4" heat sink to provide cool operation under any condition.

DEM 222-28 Operating Specifications:

Operating Voltage:	12.0 - 15.5 VDC, 13.8 nominal
Current Drain:	5 amps maximum on Transmit, 350 mA on Receive
Output Power:	Maximum 25 W linear, 35 watts maximum. Output has 25 dB of adjustable range. Minimum 1 mW (0dBm) for 10 watts output power.
Maximum IF Drive Power:	200 mW (+23 dBm) with 25 dB IF adjustment range (Standard Setup)
Receive Noise Figure:	1.0 dB maximum, 0.8 dB nominal
Conversion Gain:	+17 dB nominal with 25 dB adjustable IF attenuator

DEM 222-28 Assembly Options:

External TR switching control	TXIF amp for < 0 dBm input @28 MHz
Separate Transmit and Receive ports	Common IF port with 10 watts input
PTT high and PTT low Keying (not RF sensed)	Optional LO crystal for full band operation
Type 'N' , UHF or BNC connectors on 222 MHz ports	Factory alignment available on all kits

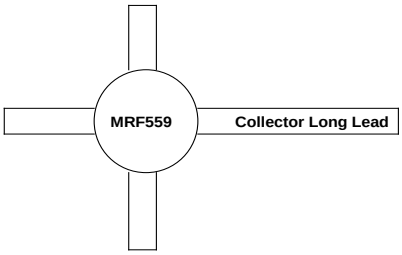
Printed Circuit Assembly Notes:

Your kit is provided with easy to read placement diagrams that show the component layout and the reference designators that correspond to the provided component list. Each side of the printed circuit board (PCB) is also shown to eliminate mirror image assembly errors.

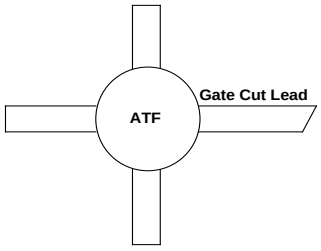
Assembly Tips:

Soldering surface mounted active components (transistors etc.):

- The DOTS on the MMIC's (IC1, IC2, IC4, IC7) determine their orientation and must be observed and positioned correctly prior to soldering. The GaAs-FET (Q4) and Bipolar (Q5) orientation is determined by their lead formation, either longer or angle cut. The GaAs-FET Q4, (see figure 1B) angle cut lead is the Gate side which corresponds to the "G" on the assembly diagram. The long lead on the Bipolar Q5,(see figure 1A) is the collector and corresponds with the "C" on the assembly diagram. Leads on all active surface mounted components should be somewhat flat against the mounting surface, if they are not, a small tool such as a small bladed screw driver can be used to flatten them (See Figure 2).
- 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)



Q5 Figure 1A



Q4 Figure 1B

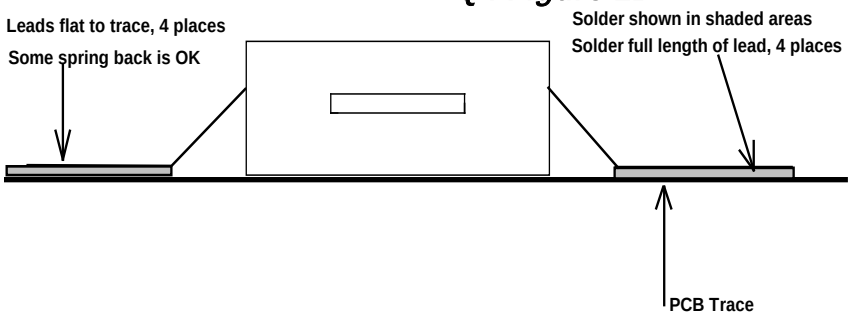


Figure 2 Typical side view of four leaded surface mounted device, lead bending close to body

Soldering surface mounted passive components (chip resistors / capacitors):

- 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.
- 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 end with the previously melted solder and allow it to flow into the solder, once solidified, remove holding tool.
- Now heat and flow the 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 top side 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 draw backs 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 222-28K is fairly 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.

Bottom Side Suggested Assembly:

Referring to the bottom side view of the PCB titled DEM 222-28K Bottom Side Assembly you will see that there are five (4) surface mounted active components. (3 MMIC's, 1 transistor) The bottom assembly operation should begin by orienting the PCB with the bottom side assembly diagram. Orientation can be determined by observing the notches on the long sides of the PCB. The following assembly order is suggested: ***Observed polarity using either the DOTS or lead configuration as explained in the Assembly Tips section.***

1. Fit Q5 in place and trim the leads to keep them on the mounting pads, do not allow the leads to bridge traces. Once trimmed to fit, solder Q5 in place.
2. Install and solder the balance of the active components IC1, IC2, IC7.

The bottom side is complete, observed your soldering and component orientation one more time to ensure everything is correct

Top Side Suggested Assembly:

L9, L11, L12, L13, L14, L15 must be formed prior to installation. It is suggested that L9 to be formed on a 1/8” drill bit mandrel. For all others, use a 3/16" diameter drill bit or mandrel. Winding coils is not an exact science and you should not be intimidated by it. Using the supplied wire, extend about ¼" in a perpendicular direction off of the drill bit and wind the wire around it, counting each revolution as one turn. When the total number of turns is completed (see the component list) cut the wire an additional ¼" beyond the mandrel. Form the two ¼" leads so they are pointing in the same direction. 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 ¼" 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. Do not allow the outside diameter to increase so that the coil will not fit in the mounting hole.

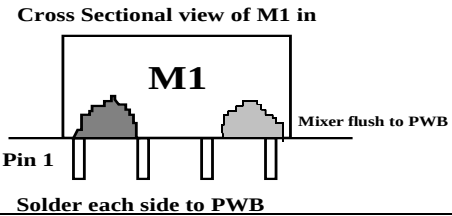
Top Side Suggested Assembly continued:

The top side assembly operation should begin by orienting the PCB with the top side assembly diagram. Orientation can be determined by observing the notches on the long sides of the PCB. You will notice on the assembly diagram that there are circles shown which will provide locating help when installing components. These have the following meaning:

Double Circles = Mounting Holes Circles with Xs = Wire Connections

First install Q4. Note its orientation and solder into place using the tips for soldering surface mount active components provided in the beginning of this document. Now following the surface mounted passive component assembly tips, install C41, C42, R21, R22, C64 and C11. These are the surface mount components around Q4. Install C46, C47, C49. These are surface mounted 1000pF capacitors located on the left side of the PCB near the hybrid power module. Now install C36 and C40. Be sure to pick the 2 surface mount trimmer capacitors that are in Bag 2. Now install L15, R33 and R24 next. These components need a little extra forming. One lead of each needs to be surface mounted. Simply bend one of the leads of L15 to be parallel with the coil form. Position L15 so that the one lead is installed in a via hole in the ground plane and the opposite lead lies on the transmission line. You may need to "trim to fit" this lead. Keep the connection as short as possible and the coil as close to the PCB as possible. R24 and R33 are formed by bending one lead in a right angle and placing this lead in the proper via hole. "Trim to fit" the other lead to the transmission line keeping the leads as short as possible and the body of these components as close to the PCB as possible. If you require the TX optional gain stage, IC4, refer to the *User Options* section in page 12 before installing. The circuit board will require a simple modification.

All surface soldering is now complete. Assemble and solder the rest of the components in the following suggested order while observing all polarities as shown on the assembly diagram.

STEP	OPERATION and NOTES
1	Form, install and solder CR1, CR2 , CR3, CR4, CR7 **Note: Ensure proper polarity**
2	Form, install and solder L1, L2, L4, L6, L10, L16 - L20 (molded inductors)
3	Install and solder C36 and C40. C24 is installed with the top leg on ground. Cut off half of the bottom pin before inserting
4	Form, install and solder all leaded resistors including R7, R10 and R20 if used
5	Form, install and solder all leaded capacitors including C59 if used. **Check polarity**
6	Install and solder Q1, Q2, VR1, VR2, VR3. Install Q3 with a ¼" gap between it and the PCB
7	Install L9, L11 - L15
8	Install Y1, 194 MHz. crystal . Leave a 1/8"space between it and the PCB
9	Looking at mixer M1, notice the "MCL" marking on the top of it's case. This should be installed as the component placement document indicates. Solder the leads, being sure that the mixer is seated flush with the PC board. Then on the top side, tack solder the case to the PCB surface, one spot on each side 
10	Install Relays K1, K2. Be sure they are flush with the PC board
11	Install Filters F1, F2, F4. Note these filter are not polarized, do not bend over the leads. Be sure they are flush with the PC board and solder all leads on the bottom side

Install and solder wires in the shown areas on the board indicated by circles with an X using the sizes shown in the table below:
Strip ≈ ¼" 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
#26 Teflon	TXON	TXON	5½"
#26 Teflon	RXON	RXON	2"
#26 Teflon	TR	TR	2"
#26 Teflon	+13.8 SW near C27	+13.8SW	2 3/4"
#26 Teflon	TXLED	Flying Lead	2½"
#26 Teflon	+13.8 SW near CR1	+13.8SW	4"
#26 Teflon	+13.8 SW near CR7	+13.8SW	5½"
#26 Teflon	TTL and PTT	Flying lead	2½"
#26 Teflon	+13.8SW	Flying lead	2½"
#26 Teflon	SWLED	Flying lead	1½"
#26 Teflon	RXIF	Flying Lead	2"
#26 Teflon	TXIF	Flying Lead	1¼"
* #26 Teflon	TXON	TXOPT	2"

* Only if the optional TX gains stage is installed

After soldering, all leads including wires on the bottom side of the PCB should be **trimmed as short as possible** to eliminate possible shorting to the external enclosure when installed. Look over your work for solder bridging to adjacent traces, incorrectly installed components, etc. The printed circuit board is now complete.

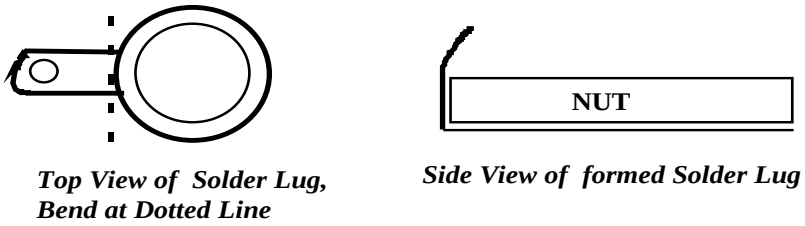
PCB assembly into the enclosure:

The heat sink and enclosure are pre-drilled at the factory for your convenience. Notice that the heat sink, enclosure and the circuit board have corresponding holes which are directional and must be aligned correctly. The heat sink and the enclosure are attached with a common screw / nut combination. Installation in the enclosure is easy if the suggested assembly steps are followed.

Wipe the inside of the enclosure clean to remove any remaining metal particles that may have been trapped during the machining process. Align the enclosure and heat sink pre drilled holes, place the heat sink on the enclosure. Place one cap screw in a pre-drilled hole from the "fin" side of the heat sink. While holding the screw in the heat sink with the provided Allen Key wrench, start a 4-40 nut on the screw threads inside of the enclosure and hand tighten only. Install one more screw in a diagonal location from the last screw and hand tighten only. Install the balance of the cap screws from the 'fin' side of the heat sink and install the nuts. Tighten all the nuts.

Install 1 - Type “N” or UHF connector. Chose one and install the ground lug per figure 3A then tighten with ground lug oriented as shown in figure 3B .

Prepare the solder lug as shown prior to installing



Top View of Solder Lug, Bend at Dotted Line

Side View of formed Solder Lug

Figure 3A

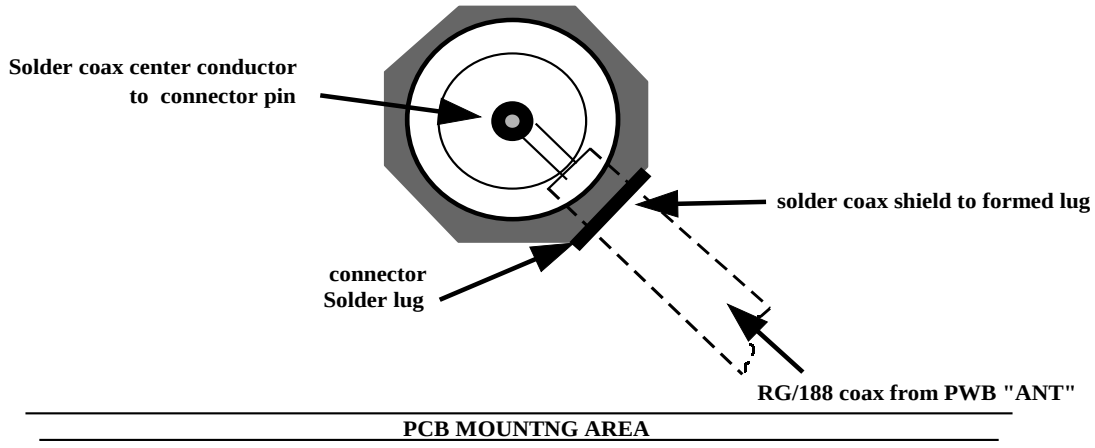


Figure 3B Inside View of Enclosure, Solder Lug Installation on the 'N' or UHF Connector

Install the rest of the rear wall mounted connectors per Figure 4:

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. If you have difficulty tightening the connector, connect an adapter or cable connector and hold this while tightening to keep it from spinning.
1 - BNC connector at the Antenna position as in step one (1), but under the nut place the 3/8" solder lug. Bend the lug away from the wall to form a right angle.
3 - RCA connectors for auxiliary, PTT and 13.8VDC using the supplied hardware. The flat washer and the solder lug should be installed on the inside. After tightening, the lug should be bent away from the wall.

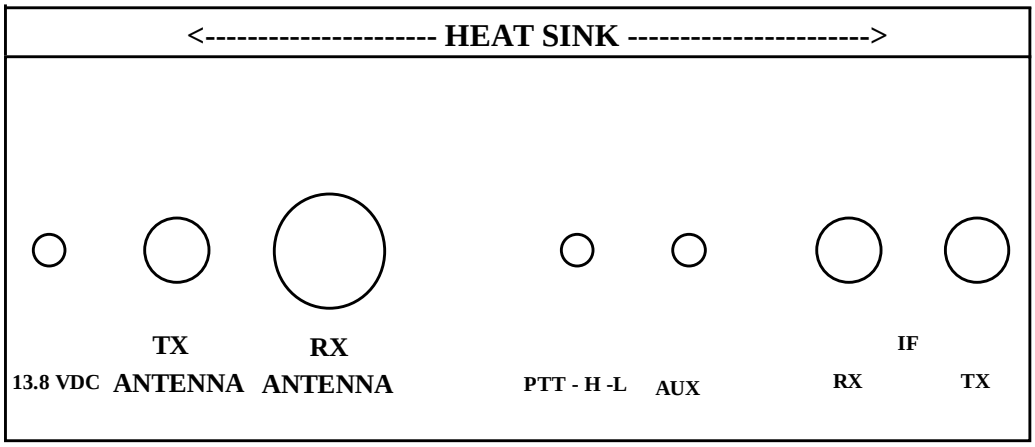


Figure 4 Jack Mounting Positions Outside View

Place the finished circuit board over the eight 4-40 screws and gently push flat against the nuts. Place two nuts on opposite corners on the screws extending through the PCB and tighten evenly. Do not install or tighten other nuts in place until electrical testing is completed. For now , install the power switch in the remaining 1/4" hole using the supplied hardware. Mounting of the switch should be so it is toggled per Figure 5.

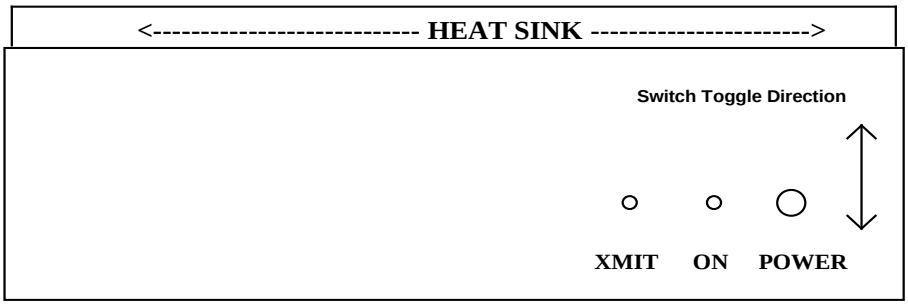


Figure 5 Switch / LED Mounting Positions

At this point, some of the flying wires will need to be connected in the enclosure to allow preliminary electrical testing as follows:

Depending on the keying circuitry required by you IF transceiver, connect the #26 Teflon from either the TTL or PTT point on the board to the wall mounted RCA jack labeled PTT - H-L. Then connect a 1000pF capacitor to the center pin and solder lug and solder (See Figure 4 for jack location).

Connect and solder a #26 Teflon wire from the wall mounted DC POWER jack to the middle terminal on the wall mounted switch and solder (See Figure 4 for jack location)

Connect the #26 Teflon wire from +13.8SW to the normally open terminal on the wall mounted switch. This terminal will be closest one to the opening of the enclosure.

Connect and solder from the center pin to the solder lug, a 1000pF capacitor to the AUX jack.

Receive Electrical Test Verification:

The following information is provided to electrically pretest the transverter prior to final assembly. If you have a frequency counter it would be helpful but is not mandatory. Apply 13.8 volts to the 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. If voltages are not in spec, refer to the trouble shooting table below. The die cast enclosure is ground.

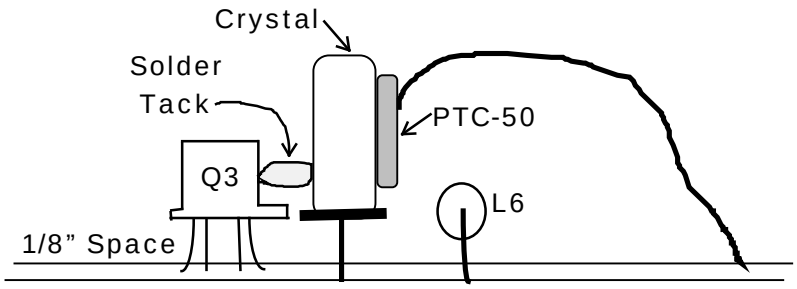
TEST	LOCATION	VOLTAGE referenced to Ground
RX 1	RXON	13.8 ±1 VDC (power supply voltage)
RX 2	Junction of C11 & R24	2.0 - 3.0 VDC
RX 3	R14 lead toward F1	5.5 VDC ± 2 VDC
RX 4	Junction of C26 & VR1	9.0 VDC ± 0.2 VDC (regulator output)
RX 5	TP1	1.0 - 2.0 VDC
RX 6	Junction of R28 & C61	6.0 ± 1.5 VDC

TEST	Symptoms	Probable Cause
RX 1	Low or High VDC	Power supply not adjusted correctly or current limited
RX 1	0V or low voltage	100μF capacitor or 13.8 VSW shorted to ground. Also check RXON.
RX 2	Voltage 1- 1.9 VDC	If VR2 has 9 V output, remove R21
RX 2	Voltage > 2.5 VDC	Install a 24 resistor across R21 position
RX 3	Voltage > 7.5 VDC	Ground leads not soldered on IC 1 or Replace IC 1
RX 3	Voltage < 3.5 VDC	R 14 or C8 shorted to ground
RX 4	Voltage > 9.3 VDC	Regulator in backwards
RX 4	Voltage < 8.7 VDC	Short in oscillator circuit (Q2, Q3, IC7) or C26 installed backwards
RX 5	Voltage < 1.0 VDC	R17, R18, R6 Wrong value. L27 open. Q3 Shorted on installed wrong
RX 6	Voltage < 5.5 VDC	R28 wrong value, R28 Shorted. IC7 installed backwards
RX 6	Voltage > 8.5 VDC	IC7 not soldered correctly or No good.

Oscillator Testing:

With the positive lead of a Voltmeter, probe TP1. Adjust C24 for maximum voltage If the voltage can not be peaked try compressing or spreading the turns of L9. If necessary, you may need to wind a new coil and replace it if the diameter is not 1/8". The final voltage after peaking should be > 1.0 VDC but it may be OK if below. Just be sure to peak it. If a frequency counter is available probe TP2 and fine tune C24 for 194.000MHz. If at any time the voltage or frequency can not be obtained in this test, check all components in the oscillator circuit for proper installation. Be sure that the base of C24 is soldered directly to the active circuit and is not shorted to the ground plane. Then re-verify the RX test voltages.

After the Oscillator voltage is set, install the PTC Thermistor as shown in the diagram below. Heat the Thermistor with a solder iron and remove one wire. Then tin one side of the crystal case. Now holding the Thermistor in place, re-heat the crystal and flow the solder to attach the Thermistor to the crystal. Now squeeze Q3 and the Crystal together until they touch each other. Tack solder the crystal and Q3 together. This is important. The case of Q3 is ground an this completes the DC circuit for the Thermistor. This will also keep the temperature of Q3 stable which in turn minimizes frequency drift. The frequency of the oscillator will need to be readjusted, but the final frequency adjustment should be done after 72 hours of operation to insure that there will not be any more drift from aging.



Transmit Electrical Test Verification:

The voltage check list below is for the transverter in the TX mode. To place the transverter into the TX mode either apply a Positive voltage > 1.5 volts to the TTL input or ground the PTT line. The choice is made by you depending on your transceiver. If Test voltages do not check, refer to the trouble shooting table below.

MODE	LOCATION	VOLTAGE Reference to Ground unless Specified
TX 1	Relay K1	Audible Click (when Transverter is keyed)
TX 2	Relay K2	Audible Click(when Transverter is keyed)
TX 3	TXON	13.8±1VDC(supply voltage)
TX 4	TXLED	13.8±1VDC (supply voltage)
TX 5	Junction of R26 & C12	3.5±1VDC
TX 6	Junction of C13 & IC2	1.5±0.5VDC
TX 7	R25	1.2 ± .5 VDC Across R25
TX 8	Output of VR3	9.0±0.5VDC
TX 9	Anode of CR4	1.4±0.3VDC
TX 10	Cathode of CR4	0.7±0.3VDC
TX 11	Junction of R20 &C32	3.5±1VDC (optional gain stage)
TX 12	Junction of C7 & IC6	1.5±0.5VDC (optional gain stage)

TEST	Symptoms	Probable Cause
TX 1	No Click	+13.8SW wire not connected or K1,Q1,R1,CR2 installed incorrectly
TX 2	No Click	+13.8SW wire not connected or K2,CR7 shorted or installed incorrectly.
TX 3	No voltage	K1 Relay not functioning, or wire shorted to case
TX 4	No Voltage	R29 or C54 shorted
TX 5	Voltage > 5 VDC	Ground leads not soldered on IC 2 or R26 wrong value.
TX 5	Voltage < 3.0 VDC	R 26 wrong value. C12 or IC 2 shorted to ground
TX 6	Voltage < 1.0 VDC	Input of IC 2 or C13 shorted to ground
TX 6	Voltage > 2.5 VDC	If TX5 Test OK, Replace IC2
TX 7	Voltage > 1.5 VDC	R30 wrong value or missing. Or increase value of R31
TX 7	Voltage < 0.9 VDC	L20 open. R30 wrong value or shorted. Or decrease value of R31
TX 8	Voltage > 8.5 VDC	VR3 Installed backwards or shorted. C45 shorted or installed backwards.
TX 9	Voltage <1.0VDC	Missing TXON wire or shorted.R3,C4,L1 CR4,C32 missing or shorted
TX 9	Voltage >2.0VDC	CR3 ,CR4, L2 missing or open
TX 10	Voltage >0.5VDC	CR4, C34, L10, C33, L2, CR3, C5 shorted
TX 11	Voltage > 5.0VDC	Ground leads on IC 4 not soldered
TX 11	Voltage < 2.5VDC	Ribs not removed under IC 4.TXOPT Jumper not installed. IC4 backwards
TX 12	Voltage > 2.5 VDC	IC 4 backwards or damaged

***** DO NOT PROCEED UNTIL THE ABOVE CHECK POINTS ARE VERIFIED *****

Once check points are verified, install the remaining six 4-40 nuts on the screws holding the PCB.

Power Module Installation:

Place the power module (IC5) 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. Wipe the mounting surfaces of the enclosure floor and flange of IC5, verify the surfaces are free any foreign matter before applying a thin even coating of the supplied thermal compound to the mounting flange. Place IC5 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 mounting flange into the enclosure floor and tighten evenly. **NOTE:** Make sure IC5 is mechanically sound to the bottom of the enclosure. Improper seating of the hybrid could result in poor grounding and heat transfer causing damage to the power module. Forming the leads flat to the traces, solder all leads of IC5 to the circuit board.

LED Installation:

Note: The longer lead on the LED is positive.

- Prepare both LED's by supporting the **SHORT** lead (negative) at the LED body, bend the lead 90º away from the longer lead.
- Place the "ON" LED in the wall mounting hole (see Figure 5) and place the previously formed lead in the plated through hole closest to the edge of the board and solder.
- Repeat this process for the "XMIT" LED placing the formed lead in the next plated through hole away from the other 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 filter F4 labeled TXLED, to the "J" formed positive lead on the "XMIT" LED.
- Cut the positive lead of the "ON" LED to approximately 3/8". Form a "J" in the lead and attach the flying lead from "SWLED" and solder this connection.

PCB assembly into the external enclosure, continued

- Connect a piece of #18 Teflon wire from the wall mounted DC power jack (13.8 VDC) and solder, then route the wire to the pad labeled +13.8 V near the power output module and solder to the surface (**Note:** Wire will not fit in the hole in this pad). Connect and solder the 100mF capacitor to the DC power jack, observed polarity, positive lead to the center pin.
- Connect the #26 Teflon wire from the stand alone hole in the PCB near R9 labeled RXIF to the BNC RX jack and solder.
- Connect the #26 Teflon wire from the stand alone hole in the PCB near R12 labeled TXIF to the BNC TX jack and solder.

The following assembly order is recommended for completion of the transverter for common RX/TX connector. For split TX / RX refer to section 1 of DEM 222-28 user options.

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

Cut the coax 2" - 2 1/32"
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.
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 90º

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. Angle the coax so that it is facing the trimmer capacitors C36 and C40 (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 screw.

Push the center conductor through the hole in the solder lug and allow the shield to penetrate the hole (See figure 3). Solder the shield to the solder lug, then solder the center conductor to the 'N' connector center pin.

If you prefer to use a common RX/TX BNC connector, prepare the coaxial cable as stated above. Routing of the cable will be in the opposite direction away from the trimmers C36 and C40. Remember to solder the coax's shield to the solder lug on the BNC connector.

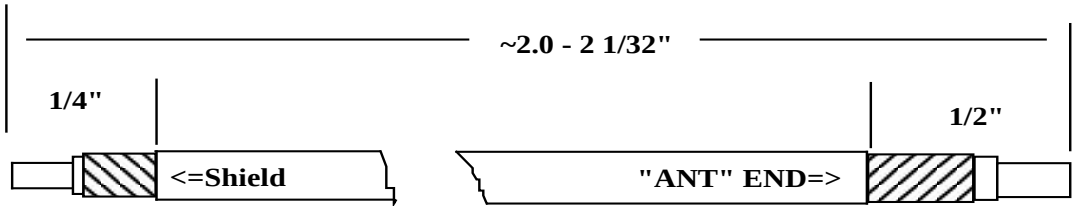


Figure 6 Cable shown broken for clarity

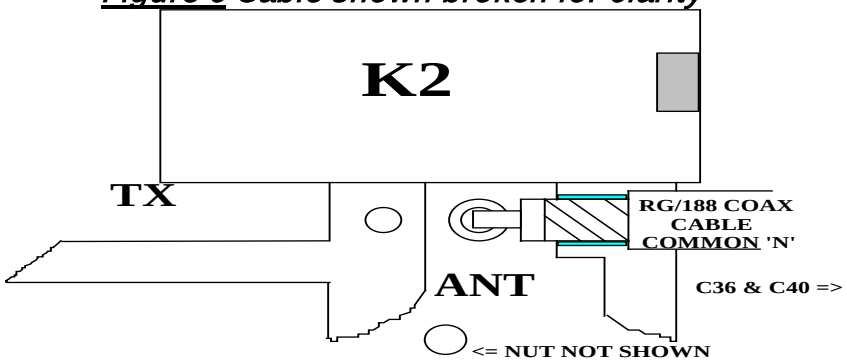


Figure 7 Coaxial Cable mounting on PCB shaded areas are solder points

Transverter Final Tune Up

The assembly portion of your kit is complete. You will now proceed with the final tune up as follows after connecting your transverter to your IF rig, (refer to Transverter interfacing document for your application):

1. Set R7 to the maximum value by turning fully counter-clockwise, this sets minimum TX gain.
2. Set R10 to the minimum value by turning fully clockwise, this sets full receive gain.
3. Connect the DEM 222-28 to your transceiver (Consult your transceiver's manual for connection details). Set the frequency of the transceiver for the weak signal portion of the band.
4. Apply power to the transverter, turn on the power switch, the power LED should be lighted and the transmit LED should be extinguished.
5. Place an Antenna or Generator on the RF connector and adjust C36 and C40 for maximum receiver signal strength in the IF receiver. Minimum noise figure and maximum gain occur at nearly the same point so tune for maximum signal strength. If a signal generator or "On the Air" signal is not available a fifty ohm coaxial termination maybe connected to the RF connector and adjust C36 and C40 for maximum noise in the IF receiver. **Note:** If the receiver is to be aligned on a noise figure meter, L15 can be "tweaked" in conjunction with C36 and C40 for desired noise figure and gain.
6. Your "On the air no signal present" 'S' meter resting position can now be set by adjusting R10. This control adjust the 28MHz output signal.
7. If you have a power meter or in-line forward SWR meter available for the rated output frequency and approximate 35 watt power level connect it to the antenna jack (or TX jack).
8. After verifying that the IF transmitter signal level is below 250mW, change the transceiver to the CW position with the carrier level set to minimum.
9. Switch the transceiver into the transmit mode. While observing the power meter slowly increase the carrier control to maximum keeping the power output below 25 watts for linear operation 35 watts for FM only.
10. If the carrier control is at the maximum and the power output is below 25 watts, slowly turn R7 increasing the output power to 25 linear watts or 35 FM watts maximum.
11. Output section coil adjustment should not be necessary unless power output levels can not be achieved. If power output is low, connect an Ampere meter in line with the power source to the

transverter. If the current level is 4 - 5 Amperes, use an insulated tool to slightly spread or compress coils L11 - L14 while observing the output power, adjust for maximum. If current consumption is below this value, the transverter may be under driven. Make sure that R7 is fully clock wise if so, the IF TX level should be verified to ensure that it is approximately 10mW. If proper power output and current consumption still can not be obtained check all connections and voltages. If you feel that your transverter is not living up to it's specifications, please consult the factory after verifying all voltages, components and IF drive level.

12. Put the top on the enclosure and install the screws.
13. Attach the 3/8" adhesive backed rubber feet to the cover.
14. Attach the supplied jack / switch labels to the enclosure by first cleaning the mounting surface with a multi-purpose household surface cleaner. Use figure 4 and 5 for placement location.

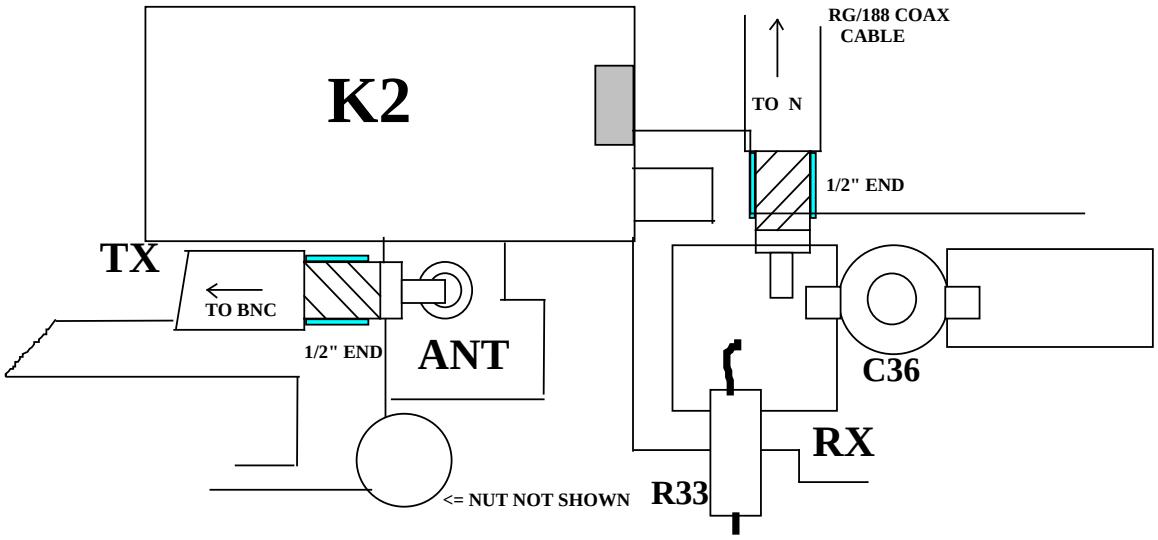
If you need external switching for relays or power amplifiers this can be accomplished via Relay K1 and the RCA Auxiliary connector. Consult the DEM 222-28 supplied schematic for switching details.

DEM 222- 28 User Options

1. Split RX / TX connectors

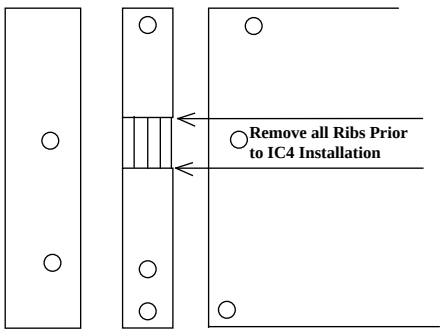
To operate with split TX / RX connectors it is necessary to perform the following modification, it is recommended by DEM that the 'N' connector be used on the receive side:

1. Remove capacitor C64, it is located near C36 trimmer capacitor.
2. Prepare two pieces of RG/188 coax as shown in Figure 6 of the DEM assembly documents.
3. Attachment to the circuit board will be per the figure below.
4. Route the RX cable to the N connector and solder as shown in figure 3 of the DEM assembly documents.
5. Route the TX cable to the BNC connector and solder the center conductor to the pin of the connector. Also, solder the shield to the solder lug installed on this connector.



2. Optional Gain Stage

You have the option of installing a additional gain stage (IC4) in the transmit section of the transverter. Only consider this option if your transceiver has less than 0dBm output. Please feel free to consult Down East Microwave Inc. for the proper MMIC and bias resistor. If you elect to install a gain stage, a modification must be performed to the printed circuit board prior to continuing. The TXIF path will need to be broken before installation. Referring to the diagram below and the assembly document, remove the "Ribs" by cutting at the two indicated points with a sharp razor blade and heating with a soldering iron to remove. Proceed to install MMIC using the procedures outlined previously. Also install a jumper wire between the TXON and TXOPT vias.



DEM 222-28K Component List

There may be extra components in the bags not found on the parts list. **BAG 1 CONTENTS**: Resistors values are in Ohms and are ¼W unless otherwise specified. "CC"= Carbon Composition. Capacitors are chips and the values are pF unless otherwise specified. All chips are attached on a separate card in Bag 1.

BAG 1

R1 1K	R10 1K POT	R18 470	R26 330	C11 100 CHIP
R3 1K	R11 220	R20 330	R27 47	C41 0.1µF CHIP
R5 47	R12 220	R21 24 CHIP	R28 56 1/2W	C42 0.1µF CHIP
R6 100	R14 180 1/2W	R22 24 CHIP	R29 330	C46 0.1µF CHIP
R7 1K POT	R15 150	R23 1K	R30 100	C47 0.1µF CHIP
R8 220	R16 680	R24 100 1/2W CC	R31 1.5K CC	C49 0.1µF CHIP
R9 220	R17 1.5K	R25 15	R33 1K	C64 100 CHIP

BAG 2 CONTENTS: All capacitors are disc ceramic and the values are pF unless otherwise specified. "ELECTR" = Electrolytic "Trimmer" = Variables. Extra components are possible.

BAG 2

C1 0.1µF (104)	C16 120	C36 1-6 Trimmer SMD	C55 2.2µF ELECTR
C2 0.1µF	C18 0.1µF	C37 15	C56 2.2µF ELECTR
C3 1000 (102)	C19 1000	C38 18	C57 0.1µF
C4 1000	C20 120	C39 15	C59 0.1µF
C5 1000	C22 1000	C40 1-6 Trimmer SMD	C61 1000
C6 1000	C24 1-4 Piston Trim.	C43 2.2µF ELECTR	C62 0.1µF
C7 1000	C25 1000	C44 120	C63 120
C8 120 (121)	C26 2.2µF ELECTR	C45 2.2µF ELECTR	C67 120
C9 39	C27 1000	C48 1000	C68 2.2µF ELECTR
C10 1000	C28 0.1µF	C50 1000	C69 2.2µF ELECTR
C12 120	C30 2.2µF ELECTR	C51 120	C77 1000
C13 120	C32 1000	C52 18	
C14 18	C33 270 (271)	C53 1000	
C15 22	C34 270	C54 0.1µF	

BAG 3 CONTENTS: Hand wound (HW) inductors are #24 enamel wire, close wound unless otherwise specified. All molded chokes have GOLD and SILVER multiplier and tolerance bands. Please identify desired value by the significant color band combination.

BAG 3

L1 1.0µH (Tan Body)	L14 3 Turns 3/16" ID (HW)
L2 0.33µH (ORANGE/ORANGE)	L15 3 Turns 3/16" ID (HW)
L4 0.33µH	L16 1.0µH
L6 0.12µH	L17 0.22µH
L9 3 Turns 1/8" ID (HW)	L18 0.22µH
L10 0.22µH (RED/RED)	L20 Ferrite Choke
L11 3 Turns 3/16" ID (HW)	L26 1.0µH
L12 4 Turns 3/16" ID (HW)	L27 1.0µH
L13 4 Turns 3/16" ID (HW)	

BAG 4

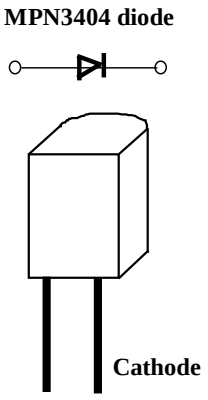
M1 TUF-1H or TUF-1HSM Mixer	IC2 MAR6
Q1 KN2222	IC4 MAR6 (optional)
Q2 MPS5179	IC7 ERA5
Q3 2N5179 (Metal Can)	VR1 78S09CV
Q4 ATF 21186	VR2 78L09
Q5 MRF559 or 940P1 or 1359-1	VR3 78S09CV
CR1 1N4000 Type Diode	F1 TOKO 1164A
CR2 IN914 (Glass Diode) or 1N4148	F2 TOKO 1146A
CR3 MPN3404	F4 TOKO 1166
CR4 MPN3404	Y1 Crystal 194.000 MHz 5th Overtone HC 18/U
K1 G5V-2	K2 G6Y
CR7 1N4000 Type	#26 Teflon Wire 3' Length
IC1 MAV11	PTC-50 Thermistor

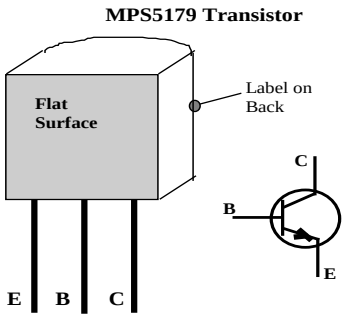
HARDWARE KIT

(2) 1000pF Capacitor	#22 Teflon Wire 4"
(1) 100mF Capacitor	#18 Teflon Wire 4", Blue
(2) LED, RED	RG/188U Mini Coax 6"
(1) SW1 Power Switch	(1) Hammond 1590D Enclosure
(3) BNC Female UG1094/U Connectors	(1) 3/32" Allen key wrench
(3) RCA Jacks - Control, Aux., Power	(1) 5" x 7" Heat sink
(1) Type “N” or UHF connector (user choice)	(1) Type "N" or UHF Connector
(8) 4-40 x 5/8" Cap Screws	(1) Label, Front "XMIT, ON, POWER"
(20) 4-40 Nuts	(1) Label, Rear "13.8VDC, XMIT RF RECEIVE"
(2) 6-32 x 3/8" Machine Screws for Power Module	(1) Label, Rear "CONTROL, AUX, RX IF TX"
(1) #4 Solder Lug installed on "N" connector	(4) Adhesive Backed Rubber Feet
(1) 3/8" Solder lug for BNC connector	(1) Heat Sink Grease

Miscellaneous Loose Parts:

1. RF Power Module IC5, M67712
2. Printed Circuit Board
3. Assorted dust particles and technical support from Frenchtown N.J.





222-28 Common IF Input Circuit Option

This option is used for common IF input for the 222-28 transverter. There are two versions of this option. It is a pin switch designed for High and Low Power. The Low Power version is used with a transceiver that has a single transverter port. Most of these types of transceivers do requires the extra gain stage (TXIF) to be installed in the transverter to increase the 28 MHz output level of the transceiver. This option should not be used if drive level is over 1mW. The High Power version should be used with transceivers that have up to 10 Watts of output. It has a 50 ohm termination mounted on the case for power dissipation. There are 2 parts lists for each version. The components designators are the same for both and only the parts required for the pin switches are listed. Assemble after the transverter PC board is completed using the component placement diagram.

Components Parts List - Add to Standard PCB Parts Placement Diagram

Low Power Option

For transceivers with 250mW or less drive.

C71 1000pF	C75 100pF	CR10 MPN3404
C72 1000pF	C76 1000pF	CR11 MPN3404
C73 1000pF	C85 1000pF	L24 1.0 μH
C74 100pF	R34 1KΩ	L25 10T #28 T25-10

High Power Option

For transceivers with greater than 250mW but not to exceed 10 Watts of drive.

C71 1pF	C75 100pF	CR10 MA4P1200
C72 1000pF	C76 1000pF	CR11 MA4P1200
C73 1000pF	C85 1000pF	L24 1.0 μH
C74 100pF	R34 150Ω 1W	L25 10T #28 T25-10
R 50 ohm load		

1. Assemble version required by installing components on PCB per component placement diagram. Do not install C85 or 50 ohm stud.

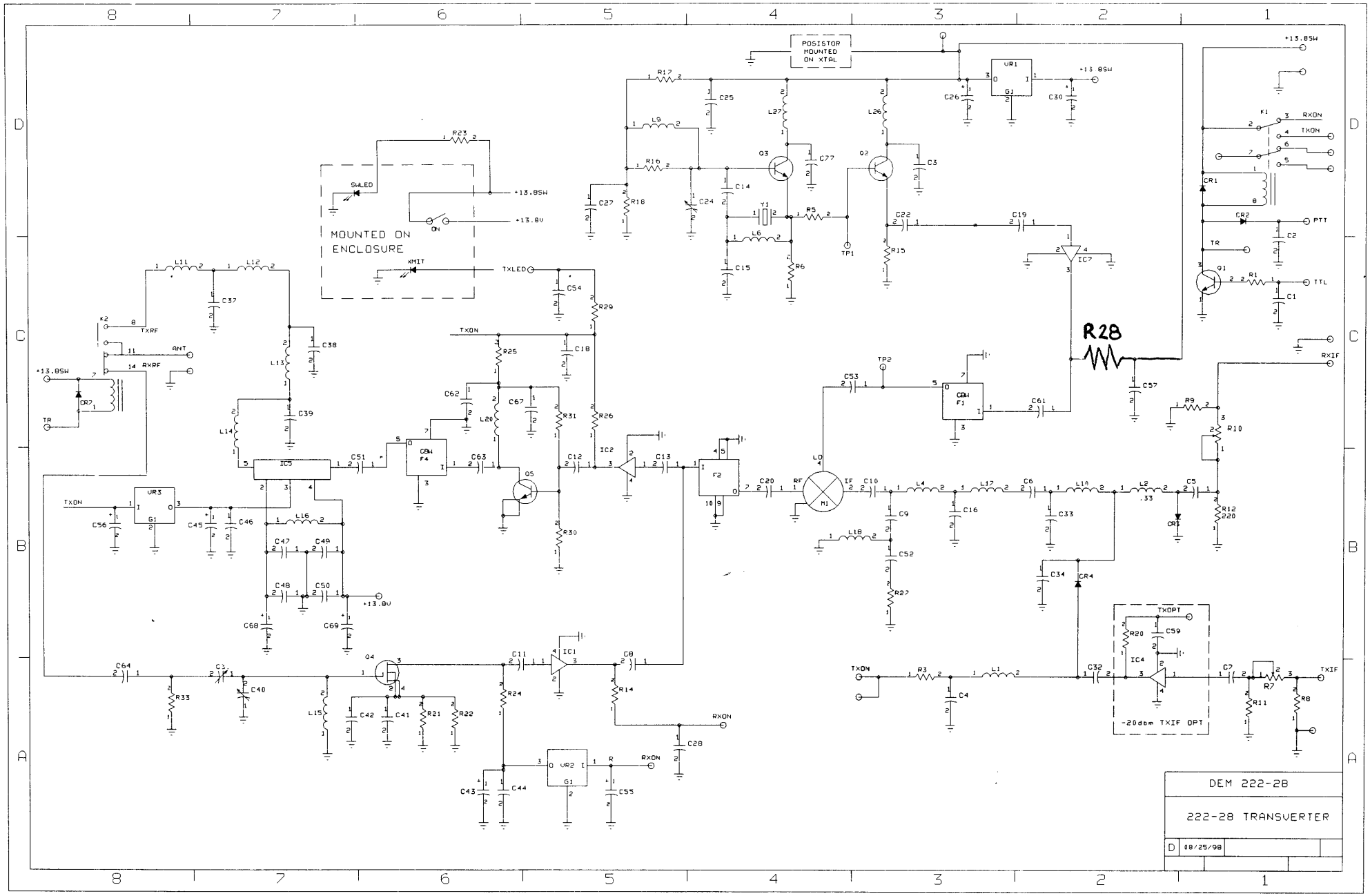
2. Test Transverter PCB per instructions and add the following:

Junction of R34 and C73. 0 volts on Receive
1.5 volts +/- .5 volts on Transmit

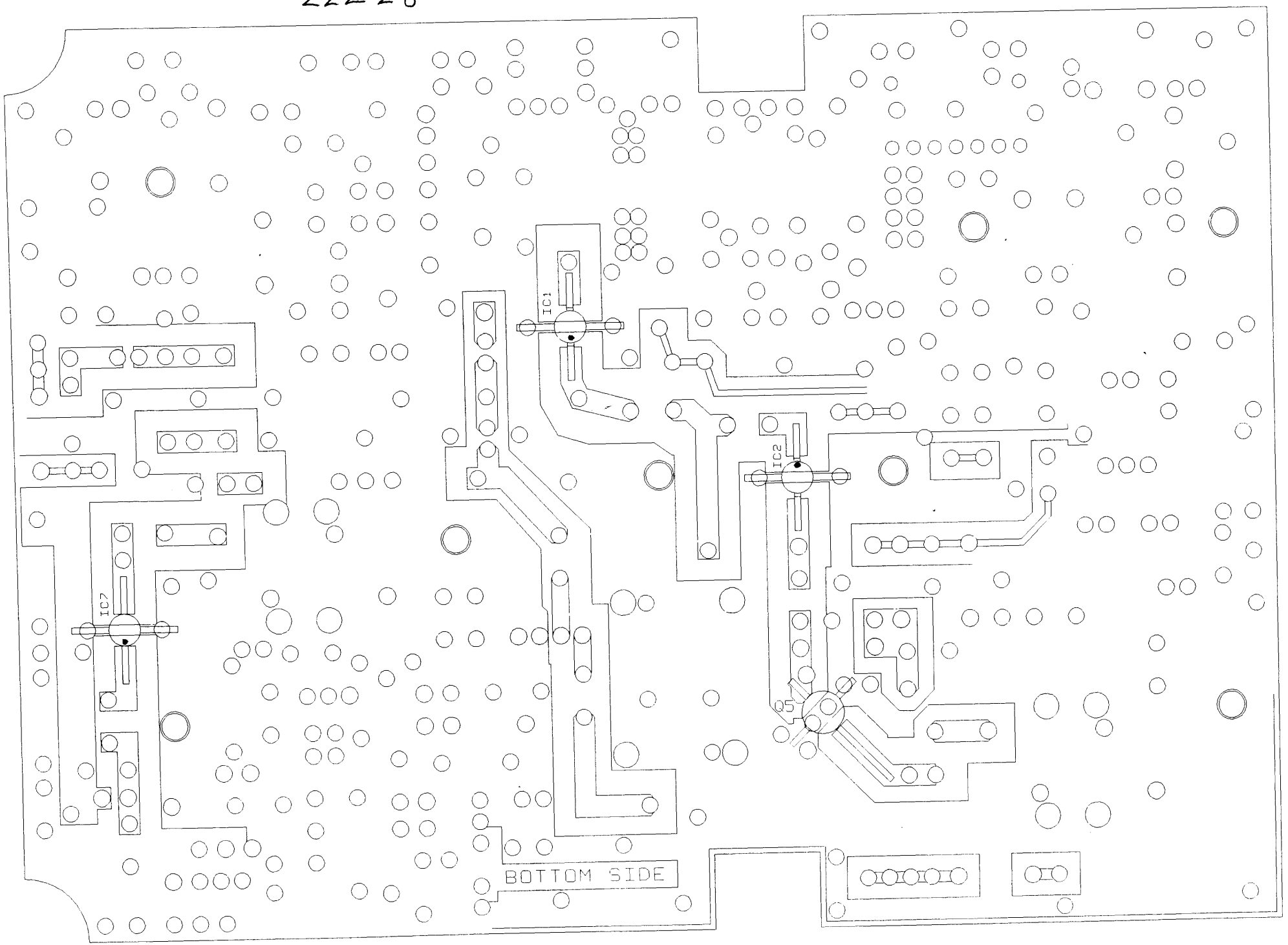
3. Install C85 to common IF input connector (labeled RXIF on standard installation) and solder to position on PC Board

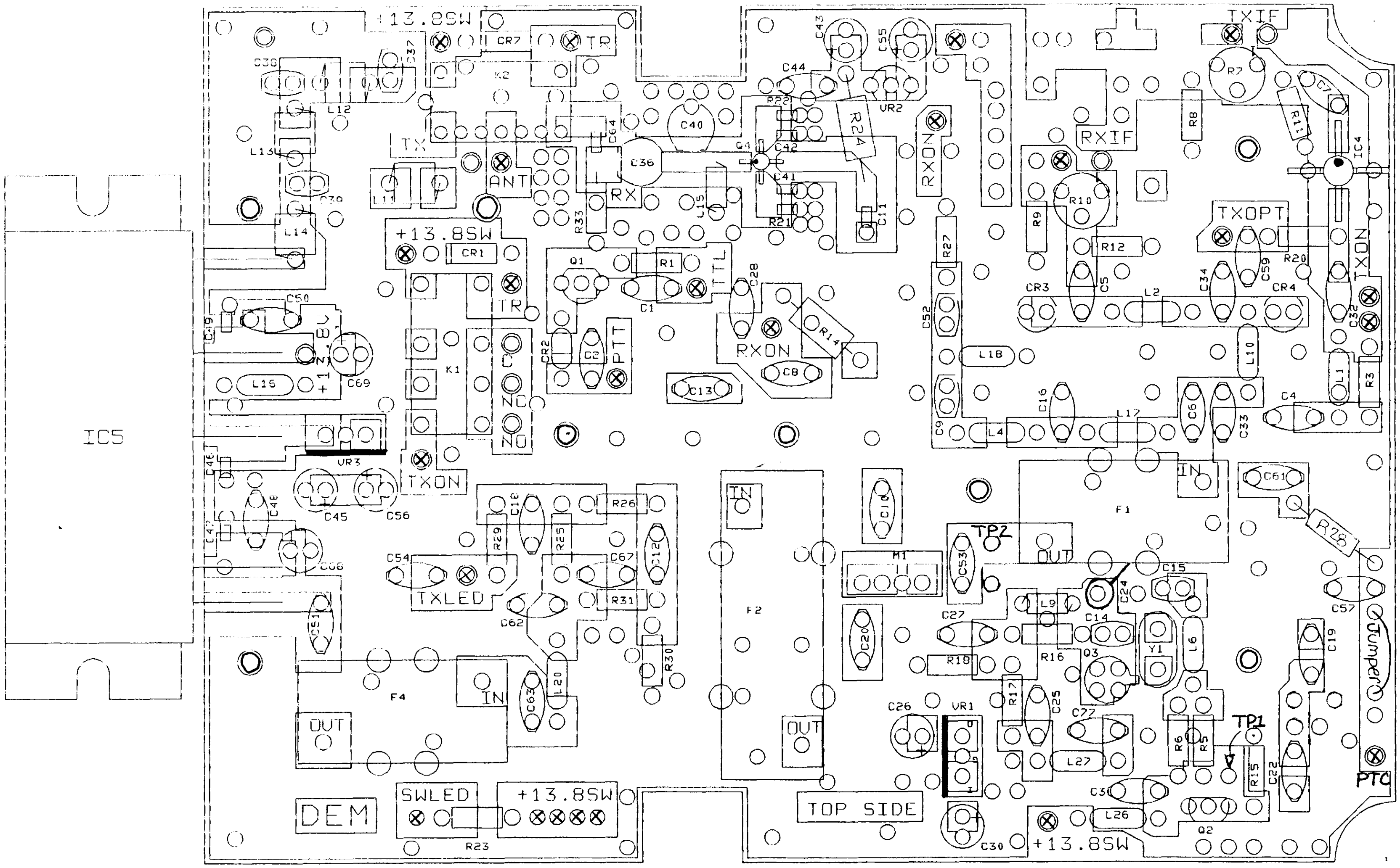
4. Install 50 ohm load and solder to circuit board if using High Power version.

5. Proceed to test


POSISTOR MOUNTED ON XTAL
MOUNTED ON ENCLOSURE
SW.LED
XMIT
ON
+13.8SW
+13.8V
TXLED
TXRF
ANT
RXRF
TR
TXON
RXON
RXIF
TXIF
TXOPT
PTT
TTL
R28
-20dbm TXIF OPT
DEM 222-28
222-28 TRANSVERTER
D 08/25/98

222-28




+13.8SW
TR
CR7
K2
C37
C38
L12
L13
TX
L11
ANT
C64
C36
RX
C40
Q4
C42
C41
R22
R21
R24
VR2
C43
C44
C55
C11
RXON
L15
R33
TXIF
R7
C7
R11
IC4
R8
RXIF
R10
R9
R12
TXOPT
TXON
R20
C5
CR3
L2
C34
C59
CR4
C32
L14
C39
CR1
TR
Q1
R1
C1
TTL
C28
R14
RXON
C8
C13
C50
C49
8V
C69
L16
CR2
C2
PTT
K1
C
NC
NO
C52
R27
L18
L10
L1
R3
C16
L17
C6
C33
C4
C9
L4
IC5
VR3
TXON
C46
C45
C56
C48
C47
C66
C18
R26
R29
R25
C54
TXLED
C67
C12
C62
R31
R30
C51
F4
IN
OUT
C63
L20
IN
F2
OUT
C10
M1
C53
TP2
C20
F1
IN
OUT
C61
R28
C15
C57
C24
C27
L9
C14
R16
Q3
Y1
L6
C19
Jumper
R18
R17
C25
C77
C26
VR1
L27
R6
R5
TP1
R15
C22
PTC
C3
L26
Q2
DEM
SWLED
R23
+13.8SW
TOP SIDE
C30
+13.8SW

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