DEM Part Number L144-28INTCK
144 MHz Transverter Kit and complete kit

Power Out:	50 mW linear minimum
Noise Figure and Gain:	3.5 dB NF nominal, 5 dBG maximum
DC Power Requirement:	12 - 15.5 VDC, 13.8 nominal @ 0.5 Amps

Operational Overview:

The new DEM L144-28INT is a low power, high performance 144 MHz to 28 MHz transverter design to be used in conjunction with most 28 MHz transceivers. **This transverter is not designed to be used as a stand-alone 2-meter device!** It is intended to be used as a 2nd conversion IF for microwave transverters. The L144-28INT has a nominal linear output power of 50 mW. On the receive side, a high dynamic range amplifier, a high level double balanced mixer (+17.0 dBm) and a three chamber helical filter are employed to providing a over load resistant low gain front end with superior selectivity. It is similar design as our high performance 2 meter transverter without the GaAs FET front end. The transverter may be configured in different manners to suite any requirements.
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 28 MHz. IF receiver. IF and RF connections are via BNC connectors. The control, power, and auxiliary connections are via RCA jacks. The 144-28INT is housed in the same aluminum clam shell enclosure as our microwave transverters.

This transverter kit, may be configured to yours and your transceivers specifications. It is important to fully understand the functions of your transceiver before interfacing the transverter. Please review your owner's manual for any details regarding transverter operation. If necessary, you may consult us regarding interfacing. We have not interfaced every transceiver on the market, but could help you in making the correct decision regarding yours.

Configuration Overview: The DEMI VHF/UHF transverter line is designed to interface and operate with most High Frequency transceivers that are available on the market today. Since you choose to purchase a kit version, you may configure it to your specifications and interface it with your desired transceiver. This configuration may be changed or altered at any time if you desire to utilize a different transceiver or change you system's configuration.

1. 2M connections:

Configuration of the 2M ports may be done at any time if desired. A simple change of component placement on the circuit board decides if you will have a Common port for the 144 MHz signal or have separate ports for RX and TX. If Capacitors C45 and C44 are placed, the common port is enabled. If Capacitors C45A and C44A are placed, split or separate ports are enabled. Correct cabling is required to complete the connections.

2. 10M connections:

Configuration of the 10M ports may be done at any time if desired. Actual component placement does not change, only the connections of the coax determine if it is a Common IF port or separate TX and RX ports. Attention to details is important for the drive levels. See the IF configuration chart below.

28 MHz. IF Configuration Drive ranges

	-20 dBm to 0 dBm	1-200 mW Drive	200 mW-1W Drive	1-10W Drive
R19	1000 pF	1000 pF	100pf	10 pF
50 Ohm	Not Installed	Not Installed	Installed	Installed
IC3	Installed	Not Installed	Not Installed	Not Installed

Depending on the drive range of your transceiver, the combination of the three listed components above are use in the various configurations. Select a configuration and indicate the components on you component placement. If installing the optional IC3 in the transmit IF section of the transverter, be sure to cut the shorting ribs before installation.

3. Other Options:

There are options for connecting a PTT-H connection in the IF and RF coax. This is useful in portable operation when using a small transceiver that generates a positive voltage on the coax during transmit. On the IF side of the transverter, L14 is connected. On the RF side , if you desire to key the microwave transverter with a positive voltage, any combination of L19 and C43 and A and B may be placed then wired in the final wiring.

A future option will be to add a synthesized LO to the 144-28INT."Hooks" have been provided for a future installation.

The KIT Details: Please read through the complete document before starting assembly!

This document assumes the assembly of the complete kit. The assembly of the board kit is contained within this document but all details referring to the final assembly may or may not apply to you own integration of the 144-28INT board. Use what you require form the assembly manual as guidance.

The following component list contains both pre-assembled components and components to be assembled by the kit builder which are in **Bold Print**. Verify that all components in **Bold print** are supplied in the kit. Some Vials have extras components. There are some components installed on the circuit board that will need to be changed or not used in your configuration. It is suggested to ***Highlight*** the components on the component placement document that ***are to be installed, altered or changed*** as you inventory the values against the component list.

Be sure to have your configurations worked out in advance to determine what components may be left out of the assembly or indicate which of the options are required. A further note is all components except for the three listed in the IF configuration can be installed and implemented at a later date if a change of configuration is desired or found to be a better option through experimentation.

Resistors (R) values are in Ohms

R1 470	R8 39	R15 220	R23 470
R2 470	R9 51	R16 1K Pot	R24 39
R3 1.5K	R10 1K	R17 220	R25 1K
R4 100	R11 330	R19 Short, or Cap	R26 1K
R5 51	R12 1K Pot	R20 330	
R6 100	R13 220	R21 39	
R7 100	R14 220	R22 1K	

Capacitors (C) values are in ρF unless otherwise specified "E" = Electrolytic

C1 0.1μF	C11 1000	C21 56	C32 1000	C42 27
C2 1-4 piston	C12 1.0μF	C22 150	C33 1000	C43 100
C3 0.1μF	C13 0.1μF	C23 1000	C34 1000	C44,A 100
C4 18	C14 33	C25 56	C35 150	C45,A 100
C5 33	C15 36	C26 1000	C36 0.1μF	C46 100 μF "E"
C6 0.1μF	C16 33	C27 150	C37 1000	C47 150
C7 1000	C17 1000	C28 1000	C38 150	C48 0.1μF
C8 0.1μF	C18 1000	C29 0.1μF	C39 0.1μF	C49 1000
C9 Not used	C19 150	C30 1000	C40 100	C122 1000
C10 0.1μF	C20 150	C31 1000	C41 27	

Inductors (L) values are in ηH unless otherwise specified

L1 7 turns #24 1/8" dia. Enamel	L8 330	L15 1.0 μH
L2 330	L9 150	L16 39
L3 1.0 μH	L10 220	L17 82
L4 56	L11 330	L18 39
L5 120	L12 150	L19 1.0 μH OPT
L6 120	L13 330	L20 1.0 μH
L7 56	L14 1.0 μH OPT	

Solid State, Relays and Filter Components

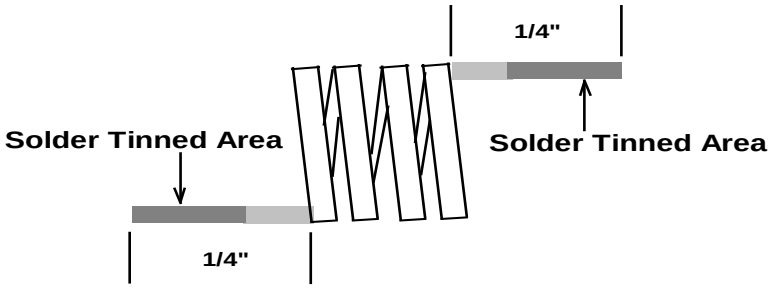
D1 1N4000 Type	IC1 PHA-1	Q1 2N5179
D2 MPN3404	IC2 SYM-18H	Q2 2N5179
D3 MPN3404	IC3 MAR-6 (opt)	Q3 MMBT 3904
D4 1N4000 Type	IC4 MAR-6	VR1 78S09
D5 1N914	IC5 PHA-1	PTC-50 and shield
D6 1N4000 Type	IC6 PHA-1	Y1 Crystal 116 MHz
D8 1N914	K1 G6Y	PC Board
D9 1N914	K2 D2N or G5V	LO shield
F1 144-3	K3 G6Y	(3) 4-40 x1/4" screw
(2) 4-40 lock nuts	(2) #4 washers	(1) 4-40 nut

HARDWARE

Enclosure	Front Switch panel
Rear Connector Panel	Switch
Red LED	Green LED
(4) BNC connectors	(3) RCA connectors
(3) 1000pF Disc	(2) 3/8" hole plugs
(4) 4-40 x ¼" standoffs	(4) #4 lock washers
(3) 4-40 x ¼" screws	(1) 4-40 x 3/8" screw
THC 50 Ohm Load	26" of Teflon Coax
(8) Black panel screws	(4) Rubber Feet
Set of labels	

Start Assembly:

1. Refer to the bottom side assembly and first install the relays K1-K3, and Q1-Q2. Do not solder the cans of Q1 and Q2 to the circuit board but be sure they fit flush to the board. Cut excess leads as short as possible.
2. Install on the top side, solder on the bottom side, F1, D1-D9, R12 and R16. Cut all excess leads on the diodes.
3. Install VR1. Insert it into the via holes and bend it down to the board. With a 4-40 and nut, bolt into place then solder leads. Cut off excess leads.
4. Install all IC's except IC2 and IC3 unless you need the TXIF gain stage in your configuration. Remember to cut the ribs. Do not be afraid to flow solder on all of the ground connections filling via holes.
5. Install C2 first by tinning the base. Then tin and heat the pad while flowing the base of C2 on to the pad. Then solder the lead to the ground pad.
6. Form L1 with the supplied #24 enamel wire. See diagram below

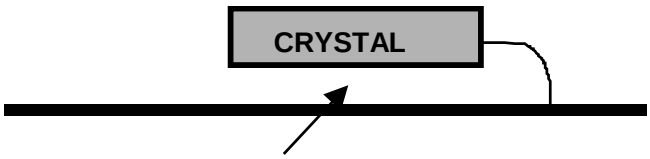


Top view of normally formed coil, (4 turns shown)

After forming (7 turns!) Bend the leads to be parallel with the turns of the coil, trim and fit to the pad then install .

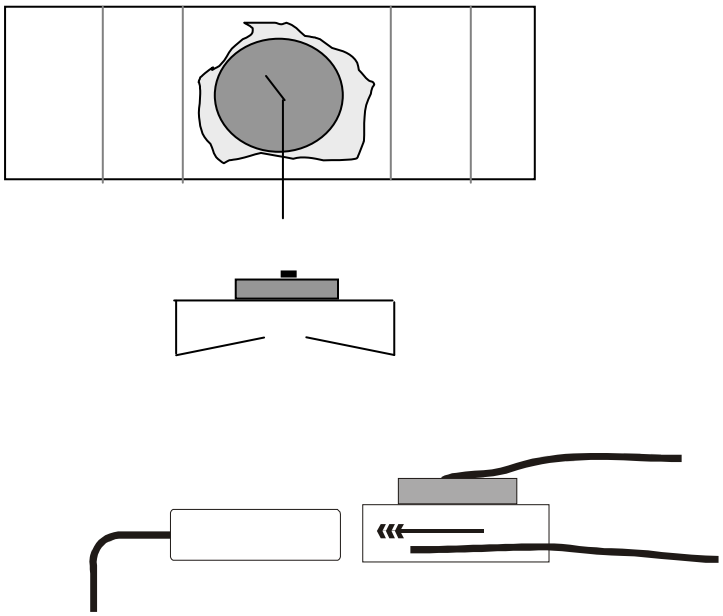
7. Install R8, R21, R24 and whatever value component is required for R19 depending on the configuration.
8. Install all chip inductors L2 –L20 except for L14 and L19 unless those options are chosen.
9. Install C12 and C46 then depending on the configuration, install C44 and C45.

10. Now there are wrong value capacitors on the board. They are C18, C26,C28 and C30-C33. There are two options. Remove the components and solder new 1000pf in their place or just solder the 1000 pf on top of the existing capacitors.
11. Install the Crystal Y1 and the PTC assembly. The Xtal is shown on the component placement in the upright position for clarity. It is installed and bent down over L2 for proper assembly as shown below.



1/16" Space between PCB and Xtal

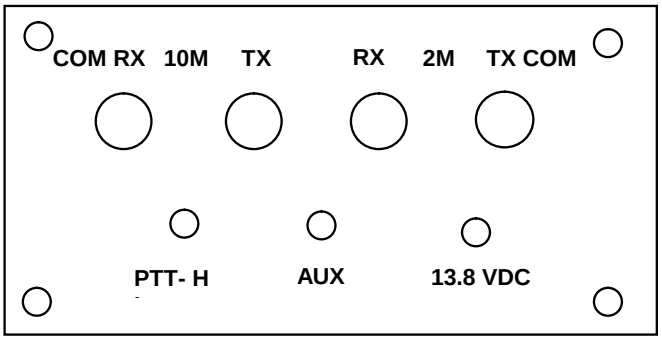
12. Assemble and install the heater assembly as shown. The positive side of the heater is wired to the +9 connection. The ground connection is attached to the open ground near IC1.



13. All components should now be installed except for IC2. If you desire to test the LO circuit separately, continue to the next step of wiring. If not, install IC2 and then wire the board.
14. Wire the board as shown on the bottom side assembly. The wire lengths are listed. Cut and tin each end 3/16" -1/4" long. Then on the top side use a 1" length and connect the PTT to the desired High or Low connection.

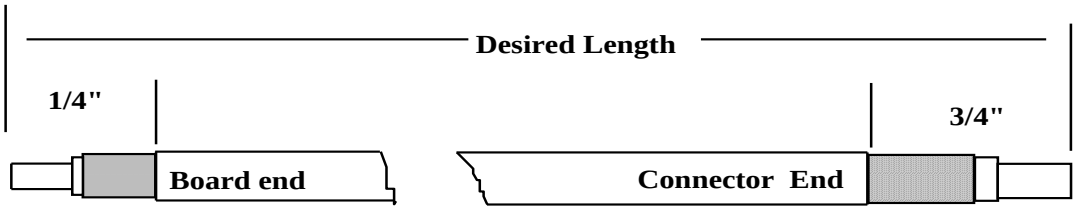
Oscillator Testing and Final Assembly:

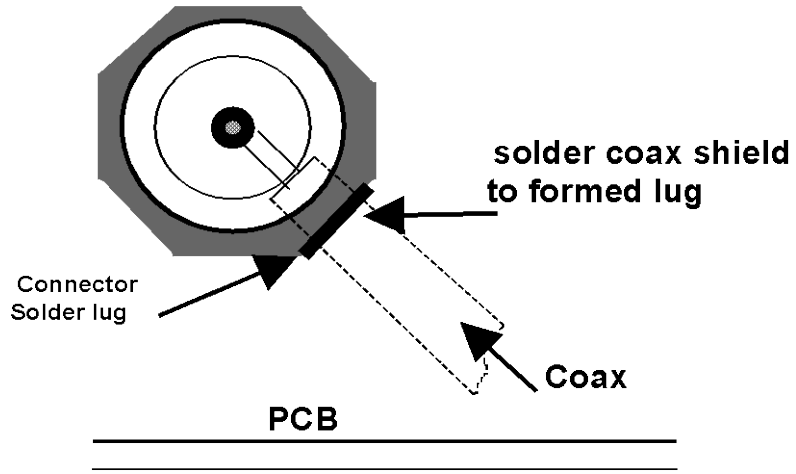
1. If you have the complete kit, install the Switch SW1. If you have the board kit only, you may install you own switch or just place a jumper wire in place of the switch.
2. If you have not installed the mixer, IC2, and wish to test the LO as a separate circuit, connect a coax to the pad of C17 and ground. You may now either connect a power meter of a frequency meter to the coax. There should be +17dBm at that port.
3. Connect DC power to the long 10" lead and ground. Turn the switch on and power will be on all over the board. Check the output of VR1, +9 VDC. If it is loaded down, trace the wiring and look for shorts or incorrect wiring. If OK, first check voltage at the oscillators TP-1. If there is no output on the frequency or power meter or the oscillator is not running the voltage will be around .5 VDC. Adjust C2 to achieve output or a voltage peak of above 1.2 VDC. You may also need to separate the windings of L2 to achieve a peak or output. You may net the frequency but it is not necessary now. Just verify it will adjust through the range. Solder the cans of Q1 and Q2 to the ground and then verify again that the oscillator functions.
4. Power down the transverter and trial fit the shield. Line up the mounting holes and the trimmer hole and gentle push down to leave an impression in the insulating material in the shield. You then can cut the insulation out of the shield where the Xtal fits and possible where L1 fits. Remember, Snug is good! When the fit is complete, bolt shield to the board using the 4-40 screws with washers and the lock nuts on the bottom of the board. Then check the output power or frequency to verify operation. If the mixer is installed , the frequency can be probed near C17. Final step is to solder the cans of Q1 and Q2 on the bottom side then recheck. Remove coax and install mixer if tested uninstalled.
5. Final testing is accomplished after final assemble in the enclosure. If you have a board kit only, the actual electrical testing is the same so it does not matter when its done.
6. Install the four ¼" standoffs with lock washers. Just make them snug after compressing the lock washers. Then install the board with four 4-40 x ¼" screws. Remove the screw that is holding VR1 in place first.
7. Insert the Green LED at the R22 connection and the Red at the R23 connection and ground. Do not solder. You may pre-bend the leads so the LED will fit into the front panel. Then install the front panel with the black panel screws. Be sure to align the LED's. then solder in place. Remove the board and cut off excess leads. Re-install the board and install R18 if it is required in your IF configuration.
8. Install the connectors with hardware in the rear panel. You can install them all or only the ones you require for your configuration. Use the hole plugs for the open holes. Point the ground lugs down on all connectors. Install 1000 pF disc capacitors on the RCA connectors and ground lugs.



9. Install the coax on the BNC connectors. Cut the IF coax to the lengths on the chart the solder as shown to the BNC solder lugs.

Common IF	7.5”	Common RF	3.0”
RXIF	7.5”	RXRF	4.5”
TXIF	8.5”	TXRF	3.0”





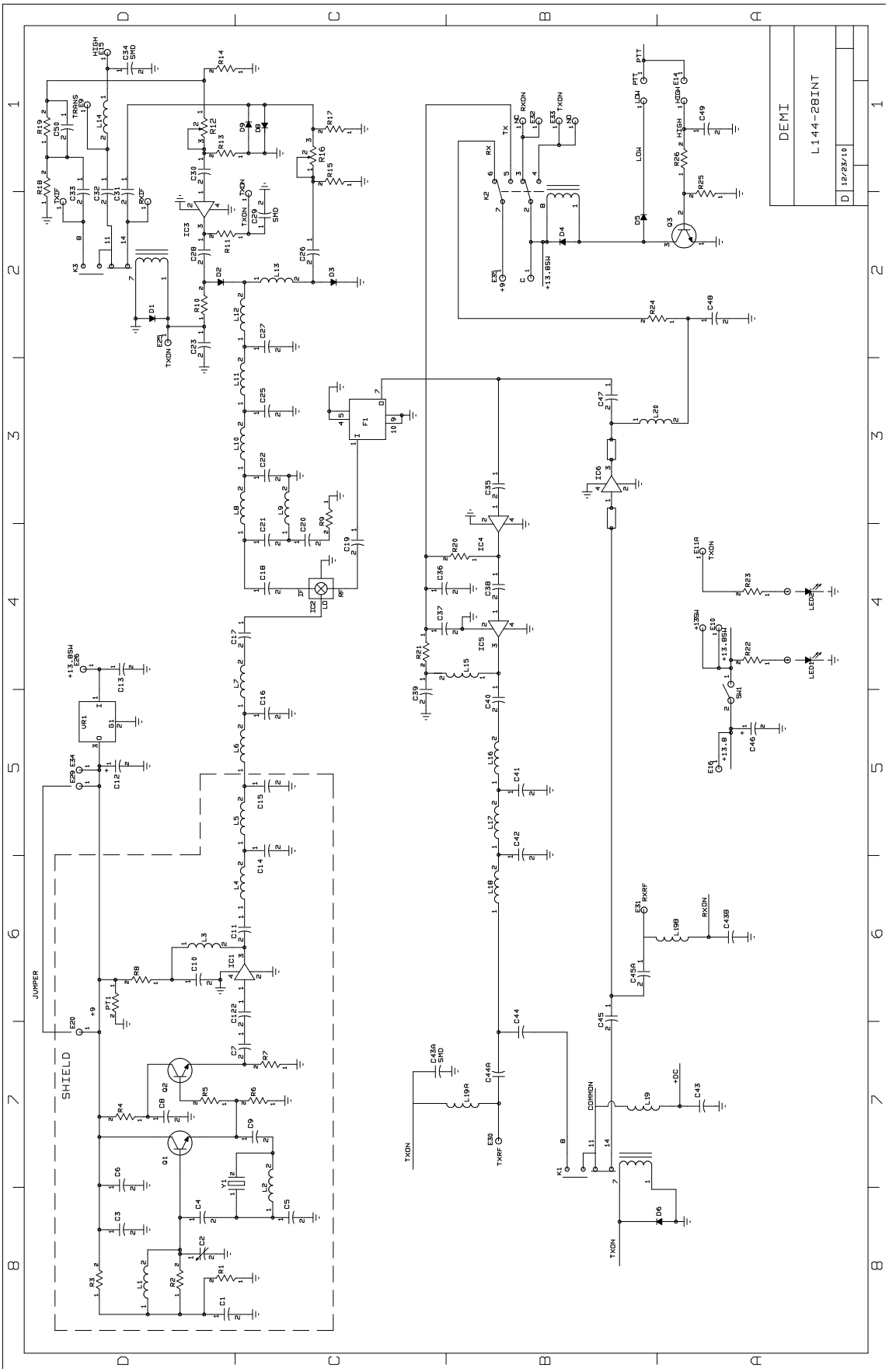
10. Screw the panel to the enclosure and solder the coaxes to the correct positions per your configuration. Then connect the DC power wire and the PTT wire to the specified RCA connectors.
11. The AUX can be wired or not. You can send a TX or RX voltage out or a switched 13.8 VDC. The AUX connector can also be used as an input if desired as a failsafe in a sequenced system. Your choice!
12. If you desire to have a “keyed” voltage on the RF connections to possibly key your microwave transverter, install L19 and C43 on the appropriate port. The junction of L19 and C43 is the connection to the +voltage signal you desire. CAUTION! Do not make this connection before you preliminary RF testing is complete. Most mw power meters do not have DC blocking and damage may occur if the DC connection is made during testing. Please provide a work around to verify.

Connect your transceiver to the transverter and Final Test:

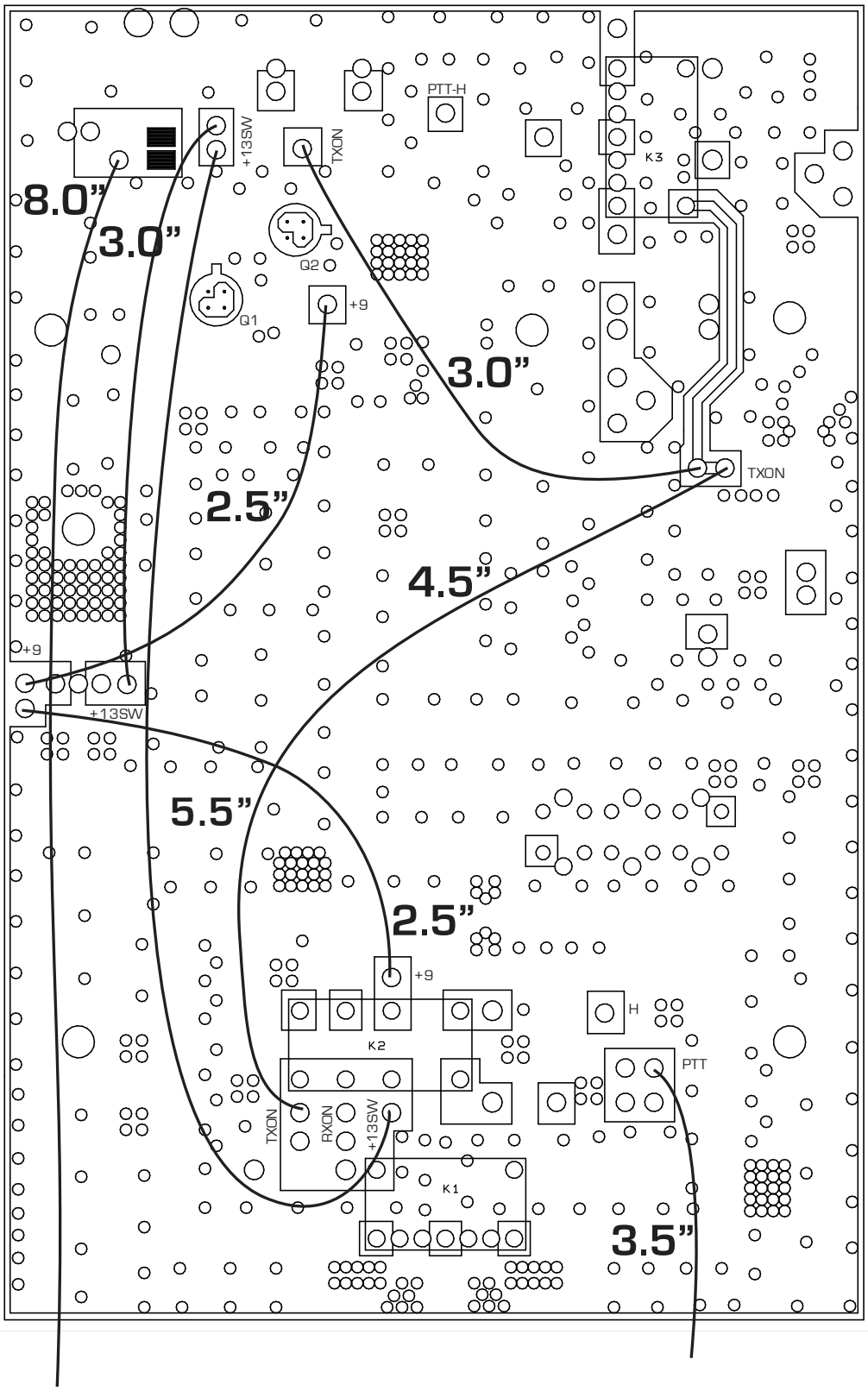
1. Depending on the make and model of your transceiver, it may or may not be necessary to enable the transverter ports. Follow whatever instructions you have in your transceiver’s

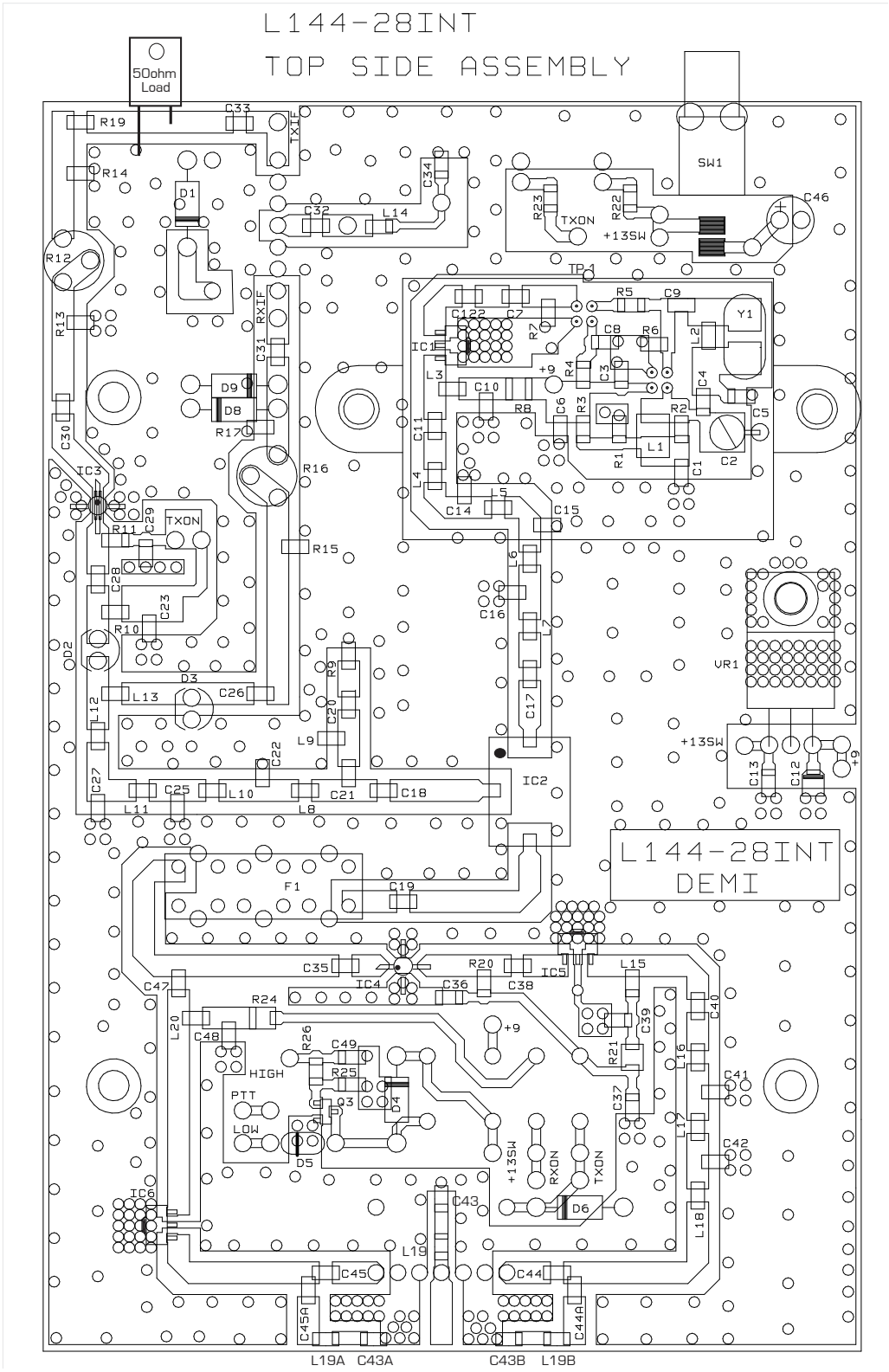
operation manual to enable transverter operation. If it requires a special connector or cable assembly, it should be made now.

2. Connect the 10M IF cables. They will depend on the configuration of the transverter. Use good quality coax cable to connect the transverter ports to your transceiver.
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 is already configured for your transceiver.
4. Connect the 2M ports to a dummy load, a power meter, or a microwave transverter
5. Connect the DC power to the transverter. 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 both the TXIF and RXIF fully clockwise.
7. Power your transceiver on and leave it in the Receive mode on 28.100 MHz.
8. Turn on the power switch of the transverter. The power LED should light and the transmit LED should not. If the 144-28INT is connected to a microwave transverter, power the microwave system on also.
9. If a microwave system is not connected to the 144-28INT, very little if any system noise will be heard in the 28 MHz. transverter. If you have a 2M signal generator, a signal may be applied for testing. If the microwave system is connected, the system gain should be quite obvious and require adjustment of the RXIF gain in the L144-28 INT to decrease the noise heard in the transceiver or just so there is a slight movement is detected in the “S” meter. 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 microwave band or use a signal generator to determine correct frequency, or minimum signal level.
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 or power 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 a steady maximum output power with a transceiver in these modes. Set the carrier/output power control to minimum or “0” output power. Place the L144-28INT into transmit. Note the transmit LED on the transverter. It should be on. After connecting a power meter to the L144-28INT or the microwave transverter system, observe the power meter and 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 power meter. Now slowly adjust the TXIF control in the L144-28INT in a counter -clockwise direction while observing the power meter. Set it to obtain the desired level in the microwave system or the desired 144 MHz drive level.
11. You may re-adjust both RXIF and TXIF again if desired. The adjustments of the local oscillator frequency may be done after warm up. The helical filters should not need adjustment. If you desire to net the frequency, allow a 15 min warm up with the transverter cover on, not screwed, just on. After final adjustment, recheck TX and RX gain controls with the cover on and if OK you are done.
12. If you desire to use any of the PTT through the coax connections, please verify operations now and make changes as needed. If you are complete, 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 microwave system and have fun!
13. Because of the helical filter tuning for the low end of the 2M band, If you desire a “wider” bandwidth operation on 2M, if you remove the slugs of filter F1, you will be able to obtain 144-148 MHz coverage while also improving on the LO bleed through.


DEMI
L144-28INT
D
12/23/10
SHIELD
JUMPER

L144-28INT
BOTTOM SIDE ASSEMBLY




L144-28INT
TOP SIDE ASSEMBLY
50ohm Load
L144-28INT
DEMI
L19A C43A
C43B L19B