



DEM Part Number 10368-144 _____
10.3 GHz. Transverter Serial Number _____

Specifications

Frequency after 10 Min warm-up:	10368.100 MHz. = 144. _____		
Noise Figure and Gain:	< 3.5 dB NF	<1.5 dB NF	> 17 dB Gain
Power Out:	>10 mW	> 1.9 W	Other _____
DC Power Requirement:	10-15.5 VDC @ .6 Amp for -144 LP or 2.5A for -144		
IF Option:	Common	or	Split
IF Drive Level Requirement Option:	0 - 250 mW 200 mW – 2 W 1-10W Other _____		
Keying Option:	PTT - to ground		TTL - Positive Voltage
PTT Signal Applied to transverter:	Through IF coax		On PTT Connector
Aux. Connection Output Option:	Ground on TX	+ Voltage on TX _____	
WTR Option:	None	Installed	Supplied

Performance and Potential

The 10368-144LP transverter makes an excellent portable rig. With a 10 mW transmitter output power and 3.5 dB receiver noise figure, the basic transverter system is capable of communications over any line-of-sight terrestrial path with a simple antenna.

For a step up in performance, the 10368-144 two watt transverter and modest antenna will provide many fun DX contacts with ease. For home stations or an EME system, either transverter may be utilized in a tower-mounted system with a larger antenna, power amplifier, and external receive preamplifier for the ultimate in 10 GHz. performance.

Set-up Instructions:

Please read this document at least once before attempting set-up. First, review all options installed in this transverter before interfacing to a standard transceiver. Interfacing should be made as simple a possible. Connect the IF cabling, the PTT keying line and the DC power to both the transverter and transceiver. If the transverter has been set up to be used with one of the DEMI transverter interfaces, follow the particular interface's set-up instructions. If you are unsure of the options installed, or find they are incorrect to interface your 2M IF rig, please consult the enclosed DEM-TC document for modifications. Always be sure the interfacing is correct to avoid unnecessary damage to your transverter! The interfacing options are user changeable and are covered in the DEM-TC document.

Use good quality 50 ohm cables for the IF connections and rugged cables for the PTT and DC power connections. Make clean solder connections to the feed-thrus. Be sure of the current handling capability of the DC voltage supply line.

Once all interfacing is complete, operation is simple. Remember the transverter should always be "hard-keyed". It is **not RF sensed**. If your 2M IF rig does not have an external keying



line, PTT-L, (Push to Talk to Ground), or PTT-H, (Positive Voltage on Transmit), you will need to install one. You may need to consult your transceiver's manual or manufacture for details. A positive voltage keying signal may also be applied through the IF coax.

To operate the transverter correctly, you will need to first set the RXIF and TXIF gain levels. (Shown in the **“Internal view of LP version enclosure layout” figure at the end of this document**) Open the transverter by removing the four top screws in the case. Lay the top half of the unit along side of the main body of the transverter. Connect a forward power meter to the TXRF port or to the common connection of the installed WTR. If you do not have power meter for measuring output power at 10 GHz., install a good quality 50 ohm load. If you have a separate RXRF port, terminate it with a 50 ohm load also. Switch both the transceiver and transverter on. Do not transmit! Allow the transverter to warm up, (2 minutes is enough for the test) and notice the receiver noise. Switch the transverter off and on to distinguish the difference. If the noise level is to high or low, adjust the RXIF gain control to set the noise level in the transceiver to a desired level. That's it for the receiver.

To adjust the transmit level, first set the TXIF gain control to maximum attenuation by turning the control full counter-clockwise. With the transceiver in CW, key the transceiver. Do not use full or semi-break in! The idea is to key the system with out having a RF transmission. Do not use FM or AM. SSB could be used if the Mic gain is turned to minimum. Observe the TX indicator on the transverter and listen for the relays energizing. If your transceiver has a “power level control” set it for minimum. Now in CW, key the system and press the CW key. You may now also use FM for this test. Observe the output power on your power meter. If you do not have a meter, observe the current drain of the transverter. Increase the output level of your transceiver to the normal level of operation. Do not go beyond 10 watts if your transceiver is capable. Then adjust the TXIF gain control until you achieve the desired output level on your power meter. Adjusting it without a power meter is a little tricky but can be done. Observe the current meter. At the point of output power saturation, the current drain will start to decrease. It may only be a few mA's so use a sensitive meter! Simply peak the current drain with the TXIF control. That is the maximum linear power output adjustment!

Please note frequency calibration listed on the top of this document. This is how it was adjusted at the factory. It will drift over time and is considered normal aging. If you have a frequency meter, you can measure it at the coax junction of the MICRO-LO board installed in the top cover if desired. It can be adjusted as shown in the MICRO-LO document. Be sure that the PCB is at least warm to the touch before adjusting the frequency.

Do not adjust any bias adjustments in the 2 watt version. They have been pre-set for best performance and can only be measured by removing the pallet assembly from the enclosure. Also, do not adjust any of the filters with out observing the results on a power meter or spectrum analyzer. This completes the set-up of the transverter. Close the enclosure and replace the four screws. The transverter is ready for action or integration into a larger system.



Operation and Design:

The 10368-144 or 10368-144LP transverter is a combination of circuit boards designed by W1GHZ and Down East Microwave Inc. All circuitry operates from an internal 9 VDC regulated supply which allows the use of standard batteries for portable operation or 12 VDC power supplies for home use with out external regulation. A block diagram is supplied in this document to show the DC wiring of the transverter and the interfacing of the various circuit boards used in the transverter. This is provided for information and location of adjustment points to aid in your station integration. This will also aid you if you decide to add a pre-amp, power amp, T/R switch or sequencer to your system and wish to use some of the internal switching circuits or to install / un-install the various available options. Separate documents are provided for all of the internal electronics.

For further information on operating and the basic design of the 10368-144LP, please read W1GHZ's paper in the 1999 Eastern VHF/UHF conference proceedings, the 1999 Microwave Update proceedings and various QEX articles. This design has seen a few changes since the original, but the basic concept is still the same.

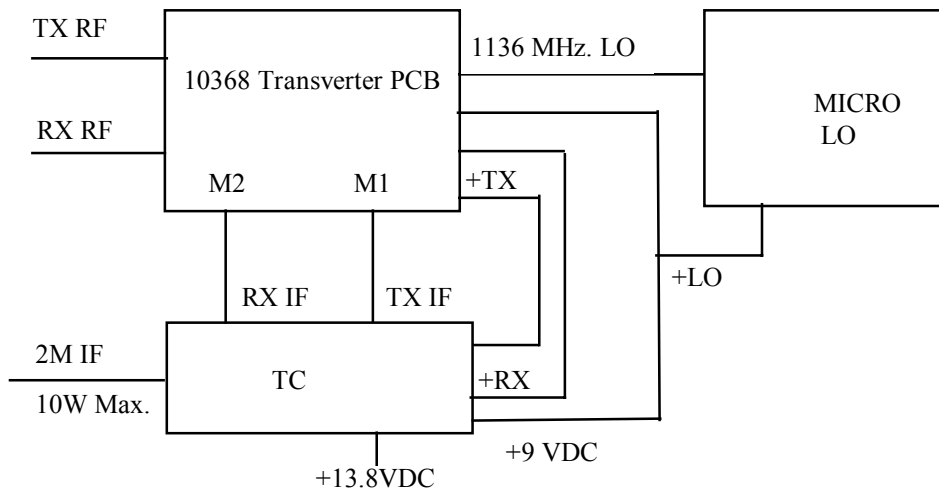
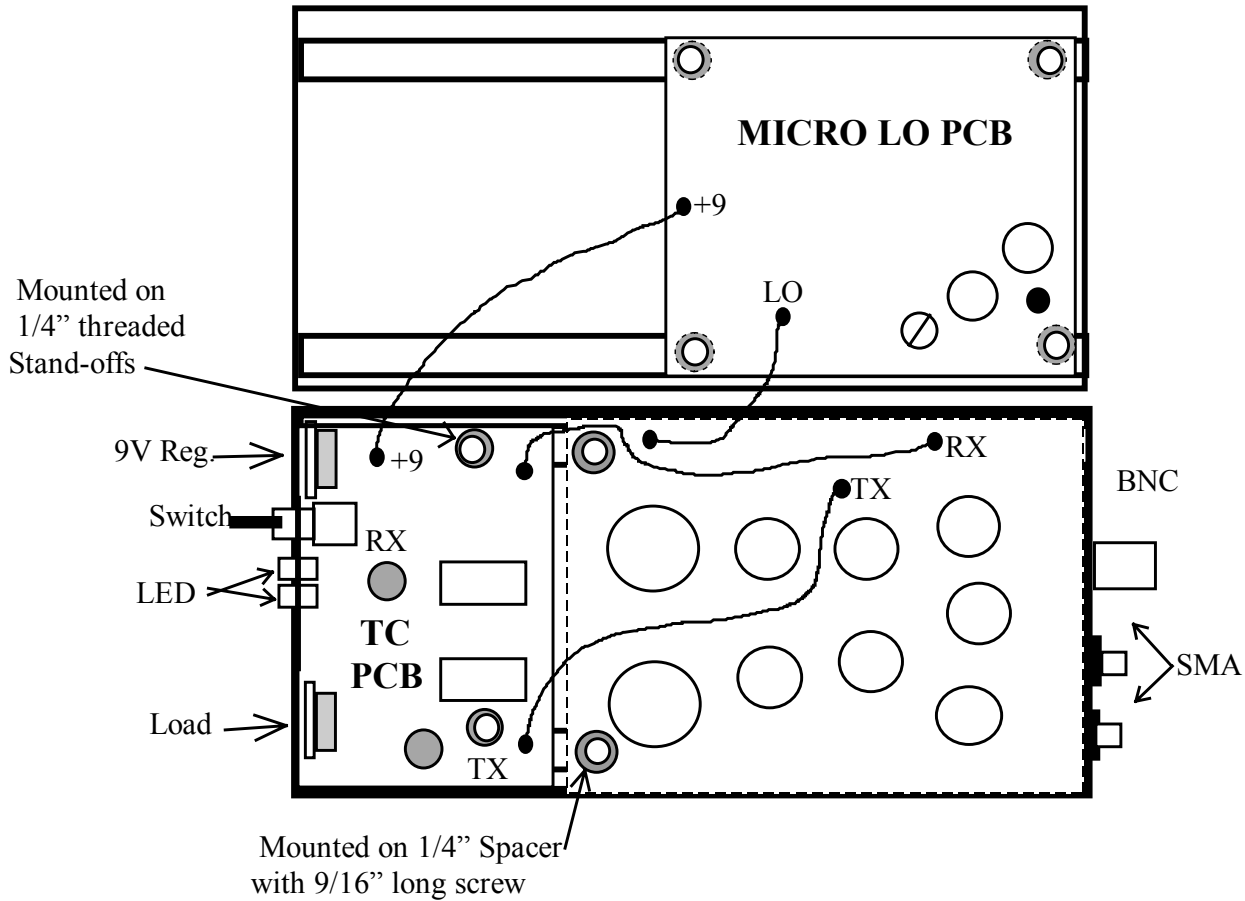
Complete Portable System

If your plans are like many, an average power, easy to use system is the goal for portable use. We have found that at the 2 watt level with a simple 2 foot dish (0.6M), the transverter seems to be capable of working every station it hears. The low established noise figure of the transverter (<1.5dB NF) is more than adequate to complete many QSO's easily if the transverter is kept close to the antenna feed point. This will eliminate the need for external LNA's, elaborate switching systems, and sequencing schemes to ensure the reliability of your system. Nevertheless, as the hobby goes, and anything you see fit to do! You can get as crazy as you want!

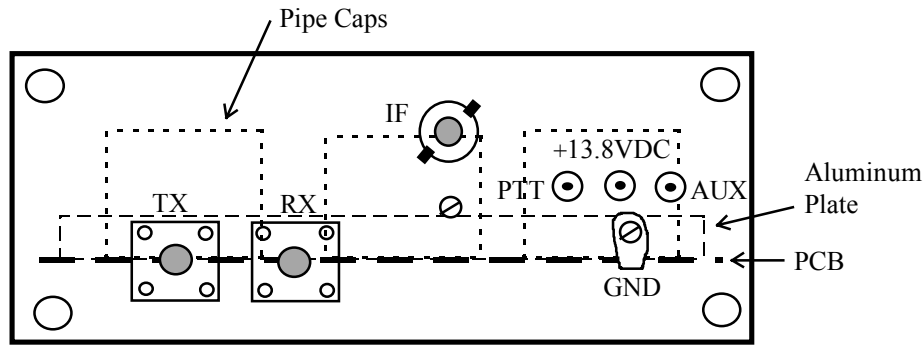
Conclusion

This transverter provides the compact convenience of a single enclosure unit that operates from a single 12 Volt source without compromising performance. With the WTR option, the delicate nature of switching signals at 10 GHz. has been simplified. Yet, this transverter is versatile enough to be integrated into any elaborate system conceived! What ever you chose, have fun and enjoy the 10 GHz band in what ever fashion you desire!

Internal view of LP version enclosure layout.



Wiring Block diagram



End Plate connectors assembly.

10368-144LP Transverter Board Parts List

All components are Surface Mount. All resistors are 1206 size unless indicated. All capacitors are 1206 size except for 1.0pF are ATC. All others are as indicted

C1 47 pF (0603)	C15 0.1μF	C29 1.0 pF	R7 36 Ω	R21 36 Ω
C2 6.8 pF (0603)	C16 0.1μF	C30 0.1μF	R8 51 Ω	U1 ERA-2
C3 0.1μF	C17 1000 pF	C31 0.1μF	R9 36 Ω	U2 ERA-1
C4 1000 pF	C18 1.0 pF	C32 1.0 pF	R10 51 Ω	U3 N6
C5 0.1μF	C19 1.0 pF	C33 1.0 pF	R11 51 Ω	U4 N6
C6 0.1μF	C20 1.0 pF	C34 1000 pF	R12 51 Ω	U5 N6
C7 1000 pF	C21 1000 pF	D1 MA4E2054B	R13 36 Ω	U6 N6
C8 6.8 pF (0603)	C22 0.1μF	D2 MA4E2054B	R14 51 Ω	U7 N6
C9 6.8 pF (0603)	C23 1.0 pF	R1 51 Ω	R15 36 Ω	U8 N6
C10 1.0 pF	C24 1000 pF	R2 82 Ω	R16 36 Ω	U9 MGA86576
C11 1000 pF	C25 0.1μF	R3 82 Ω	R17 51 Ω	U10 N6
C12 0.1μF	C26 1000 pF	R4 51 Ω	R18 51 Ω (0603)	
C13 1.0 pF	C27 1.0 pF	R5 51 Ω	R19 100 Ω	
C14 1000 pF	C28 1.0 pF	R6 36 Ω	R20 51 Ω	

10368-144 Two watt version additions.

All chip resistors are 1206 size unless indicated. All capacitors are 1206 except for 1.0pF which are ATC. 10.0 μF are tantalum and white band is positive polarity

C35 1.0 pF	C42 1.0 pF	C49 10.0μF	Q1 ATF36077	R27 51 Ω (0603)
C36 100 pF	C43 1.0 pF	C50 10.0μF	Q2 MMBT3904	R28 R31 5.1K
C37 10.0μF	C44 1.0 pF	C51 10.0μF	R22 200 Ω Pot	R29 100Ω
C38 1.0 pF	C45 0.1μF	C52 10.0μF	R23 10 Ω (0603)	R30 1K Pot
C39 1.0 pF	C46 0.1μF	D3 MMBD914	R24 51 Ω(0603)	R31 5.1K
C40 100 pF	C47 0.1μF	IC1 TMD 1013-1	R25 100 Ω	R32 2Ω, 10 W
C41 10.0μF	C48 0.1μF	IC2 NMA0505S	R26 5.1K	VR1 78M05



DEM TC DEM TRANSVERTER CONTROL

The DEM Transverter Control (DEM TC) is the circuit board that controls all transverter functions in the DEMI 2.3 GHz. -10 GHz. transverters. It was designed with many options and depending on the configuration you have ordered (see configuration page of main transverter document), the options may or may not be enabled in your transverter. This document will cover all of the features available for understanding and make it possible to change the configuration at any time to suit your requirements.

Circuit Description: (All functions mentioned may or may not be enabled in your transverter)

The DEM TC circuit board is mounted in the front of the transverter. It includes the DC power switch and both the "Power On" and the "Transmit On" LED's. The TC contains a 1.5 amp, 9 Volt regulator that supplies the transverter with all of the regulated DC voltage it requires and allows some head room for other external circuits. The TC controls all of the IF switching functions utilizing a high isolation RF relay that is rated through 1 GHz. It allows the use of any frequency of IF up to 1300 MHz. On transmit it will allow the use of up to a maximum of 10 watts of drive depending on configuration. The TC also incorporates adjustable attenuators for both transmit and receive and has a provision for adding additional receive IF gain. The TC allows either a PTT High or Low for keying the transmit and receive circuits. Another feature included on the TC circuit board is a 24 Volt relay driver designed to operate most SMA relays used for Transmit and Receive switching of the RF frequencies. This circuit may not work with certain types of relays but will operate with any SMA relay supplied by DEMI. Other options include different auxiliary DC switching schemes, keying the transverter through the IF coax, and supplying PTT keying signals to external equipment. Connection and use of each circuit is explained below. Refer to schematic and component list for all component designations.

RXIF Gain and Adjustment:

The installation of the receive IF gain stage is the most asked about device in the transverter. If the transverter is to be installed at the antenna with a long run of coax for the IF line, you may wish to install IC1. Understand that installing this gain stage will not improve the system noise figure and in most cases it will slightly degrade it. If you wish to improve the system noise figure, you should add a LNA at the RF frequency. Then depending on the gain of the additional RF LNA, you may not need the RXIF gain stage even if the transverter mast mounted. If you wish to install IC1, refer to the component placement to determine where it is installed along with its bias resistor R9. Any low frequency MMIC may be used but select it for the correct amount of gain required. Also consider the noise figure unless you have a RF LNA in the system. Select the value of R9 for the MMIC to be used for 13.8VDC operation. To bypass the gain stage, install a leaded 120pF capacitor in place of IC1. Keep the leads short.

The RXIF gain can be adjusted with R7. There should be approximately 20 dB of range. With your system completely connected, R7 may be adjusted to an acceptable level determined by your ear. For best results, keep the gain to a minimum. Only a slight noise increase should be noticed by cycling the power switch of the transverter. If your "S" meter of your IF radio is at half scale, you have lost half of the dynamic range of your system. For the same reasoning, adding the gain stage and then adjusting the RXIF to maximum will degrade the dynamic range further.



TXIF Drive Level and Adjustment.

The TXIF drive level adjustment (R2) has approximately 20 dB of range. Depending on the configuration ordered, this adjustment range may not be acceptable. If so the fixed attenuator may need to be installed, removed, or adjusted. If you wish to use less than 50 milliwatts of IF drive power, install a short jumper wire in the R4 position and remove the large 50 ohm termination that may be installed on the front panel. If you wish to use up to 2 watts, install R4 as shown with the large 50 ohm termination. If you plan to use 1 - 10 watts of IF drive, install a 1pF capacitor in the R4 position with the 50 ohm termination. If you need to experiment with other drive levels, any combination of variable capacitor or resistor may be used in the R4 position. You may also adjust the values of R1 and R3 as needed. Input power to the TXIF adjustment is dependent on the attenuation installed on the C3 side of the K1 relay. The 50 ohm load resistor is designed to handle 35 watts with proper heat sinking. When mounted to the front panel of the transverter, it will not tolerate more than 10-12 watts reliably for a long period of time. You may experiment with external heat sinking if you desire. External attenuation may also be used in the transceive path. Remember that the added attenuation is also on the receive signal but may be overcome by the additional gain of the RXIF gain stage. The level then may be adjusted with the RXIF adjustment.

Split Transmit and Receive or Common IF Configuration:

If you wish to use your transverter with separate TX and RX ports, first remove C3 and C5. Then attach coax from the IF connectors to the corresponding TXIF and RXIF connections at the C3 and C5 locations. If you are converting a split IF to a common IF, C3 and C5 may or may not be already installed. Select the coax you wish to keep as the common and connect it to the common input of K1.

PTT-H and PTT-L

The TC has the option of either using a PTT-H or PTT-L keying circuit. The PTT-H requires +1.5 to +18VDC to activate it and will sink up to 2 mA. If using this circuit, be certain that the sink current will not exceed your transceivers rating. The PTT-L circuit requires a connection to ground to be activated. It is connected to the K1 relay and will source up to 25 mA to ground when keyed. If this exceeds your transceivers rating you may modify the TC as shown in our design note DN0?? Found in our library on our web site or call for a copy.

PTT Keying Through the IF Coax:

Some transceivers such as certain models of the Yeasu FT290 supply a positive voltage on it's RF output connector during transmit or receive. This voltage may be used for keying the transverter. After verifying or modifying your transceiver for this function, the transverter may have the option installed. Select a choke of 1.0 μ h or larger and install it in the L1 position of the TC. Then connect a short wire jumper from the DC side of L1 to the PTT-H connection. When the transceiver is keyed, the voltage in the coax will key the PTT-H of the transverter. This is the most fool proof connection of the PTT line that can be made with any transceiver and is highly recommended by DEMI.

If the PTT-L connection is connected to the PTT connector, it will not affect the operation of the system. Just do not key both lines at the same time! If you will never use it, it may be disconnected and the external connector may be used for any other auxiliary connections.



+DC Switching Functions:

Relay K2 controls all of the +DC switching functions in the transverter. One side of the relay switches the raw +DC supply voltage to the transverter and the other side switches the regulated +9 volts. There are extra connection holes on the PCB if you require any additional switched voltage. Be sure not to exceed the 1.5 amp limit on the 9 volt regulated supply. The transverter's current drain is listed on its configuration page and allow for some overhead when the oscillator is not warmed up.

The switched voltages may be used for external LNA's, switching circuits for power amplifiers or relays. You may need to add an extra hole for a connector if the AUX connector is used. Be sure to fuse any external connections. The relay's contacts (K2) are rated for 3 amps.

24 Volt Relay Driver:

The TC is designed with a 24 Volt relay driver. A brief explanation of the circuit is as follows. When the TC is in the receive mode, a 330 μ F capacitor is charged to the raw input voltage of the transverter (12-14 VDC). When the PTT circuit is activated, K3 switches this charged capacitor in series with the TXON voltage and outputs a brief spike of 24-28 VDC at the +R connection on the TC board. Depending on the current drain of the connected circuit (or relay), the charged capacitor bleeds off down to the raw input voltage of the transverter. The spike is enough to energize most SMA relays and the raw transverter voltage is enough to keep the relay energized. This circuit will not work with all relays but will operate with all relays supplied by DEMI in the optional WTR kit. If you wish to use a relay with a higher current drain, the 330 μ F capacitor may be increased. Just be sure that the relay being used will stay energized with +12 VDC. This circuit will not operate latching relays unless additional circuitry is installed.

PLEASE NOTE! Even though this connection will bleed down to the raw voltage of the transverter, the circuit should never be used on any electronic circuit that will not tolerate a **+28VDC input!** It will damage most +12VDC circuits. It will also not operate any circuit requiring voltage greater than the transverter's supply voltage other than a relay.

If a switched +VDC is required, move the wire from the +R connection (if installed) to either the +VTX, +RX, +9, +13RX, +13TX, or +13.8SW. Refer to the schematic for their functions.

RF Sensing Transverter Keying

The TC is not designed to be a RF sensed switch. It has 3 relays and it may be connected to external mechanical relays. If any RF sensing scheme is added to the circuit, it will cause excessive relay chatter that will not only wear out the relays prematurely, but could cause other failures to external preamplifiers and or power amplifiers if used in your system. RF sensing circuits are not recommended with any circuit the contain mechanical relays at RF frequencies!!



DEM TC Component List

C1 0.01 μ F	C10 2.2 μ F elect.	Q1 PN2222	R9 330 Ω
C2 0.01 μ F	C11 2.2 μ F elect.	R1 220 Ω	R10 5.1K Ω
C3 0.01 μ F	C13 330 μ F elect.	R2 1K pot	R11 5.1K Ω
C4 0.01 μ F	D1 -D6 1N4000	R3 220 Ω	R12 330 Ω
C5 0.01 μ F	IC 1 MAR6 ❶	R4 220 Ω ❸	2 - Red LED
C6 0.01 μ F	K1 G6Y relay	R5 1K Ω	VR1 78S09
C7 0.01 μ F	K2 G5V relay	R6 220 Ω	50 Ω load
C8 0.01 μ F	K3 G5V relay	R7 1K pot	1 pF ❸
C9 100 μ F elect.	L1 1.0 μ h ❷	R8 220 Ω	

- ❶ To by-pass IF gain stage, install 120pF in place of IC1.
- ❷ L1 is used with transceivers that have + DC voltage on RF line during transmit
- ❸ Depending on the drive level used, R4 may be replaced with a short, a 1pF capacitor, or a variable capacitor. See text for description.



DEM MICROLO Microwave Transverter Local Oscillator

Description and Operation:

The MICROLO is used in all of DEMI's line of microwave transverters (2304 and up) as the base frequency oscillator. Depending on the model of transverter you have, the table below will provide crystal information and multiplication factors for all. The frequencies listed in the Model column are the standard "Weak Signal" RF operating frequencies. Your transverter may be configured for other RF and IF frequencies than listed below but will be indicated on the configuration page of the main transverter document.

Model	Crystal	LO Output Frequency and Output Power	Multiplication	Xverter LO Frequency
2304-144 MHz.	180.000 MHz.	1080.000 MHz. +3dBm	X2	2160.000 MHz.
3456-144 MHz.	184.000 MHz.	1104.000 MHz. +3dBm	X3	3312.000 MHz.
5760-144 MHz.	187.200 MHz.	1123.200 MHz. +3dBm	X5	5616.000 MHz.
10368-144 MHz.	189.333 MHz.	1136.000 MHz. +3dBm	X9	10224.000MHz

If you encounter any problems relating to the MICROLO, refer to the DC checklist, and with a voltmeter, find the test points on the component placement and schematic. Then proceed to verify all six test points. All voltages are referenced to ground. The MICRO-LO is supplied by the +9 VDC voltage from the TC board. Verify all +9VDC connections first.

Voltage test points

Test junction point	Voltage	Test junction point	Voltage
Input of IC1 - IC4	2.0V ± 0.75	Output of IC1 - IC4	5V± 1 V
Junction of Q1 - C3	5V ± 0.2	Junction of R1-C1	1.8V± .5
Junction of R5 - Q2	0.8V ± 0.3	TP1	> 0.7V

If troubleshooting the MICROLO, be sure the voltage at TP1 is peaked by adjusting C2. This will assure the best performance of the MICROLO. If you have a frequency meter, the frequency may also be adjusted with C2. Although this is an acceptable way of "Netting" the frequency, any adjustment other than a voltage peak at TP1 may result in a oscillator that will not start when cold, drift, or have low output power.

If any of the test voltages cannot be obtained on IC1 - IC4, understand that MMICs may sometimes operate out of specification. The important thing in troubleshooting is that all MMICs draw current when working correctly and have something other than the supply voltage or a short to ground on both Input and output.



Changing the Crystal in the MICROLO:

If you decide to change the operating frequency of your transverter, install the new crystal exactly the same way as the original crystal. Before installing the Thermistor as shown in figure 1., verify that the MICROLO operates with the new crystal first. If the voltage peaks and the frequency can be "Netted", attach the Thermistor and ground wire. To assure frequency stability over time, allow the LO to operate for 1 hour with the Thermistor in place before adjusting the final frequency. In real time operation, total warm-up should be no more than 5 minutes maximum after the first hour of operation.

After a new crystal installation and a minimum of a 1 hour "Burn-In", you may encounter difficulty netting the frequency. If so, please consult our Design Note # 016 found in the Down East Microwave web site library or call for a copy. It reviews a procedure that requires a circuit modification and adding a chip capacitor.

MICROLO Parts List

All capacitors are chips and are pF unless otherwise noted. White Band is Positive on 1.0 μ F. All resistors are in ohms. The coils are formed using #24 enamel wire.

C1 0.01 μ F	C10 0.1 μ F	D1 HSMS2800	R3 1K	VR1 78L05
C2 1-8 Piston	C11 22	L1 3T 1/8" ID	R4 100	Y1 CRYSTAL
C3 0.01 μ F	C12 15	L2 0.1 μ H molded	R5 51	IC1 MAR-3
C4 18	C13 15	L3 6T 1/8" ID	R6 100	IC2 MAR-1
C5 22	C14 0.1 μ F	L4 4T 1/8" ID	R7 100	IC3 MAR-1
C6 1.0 μ F	C15 22	Q1 2N5179	R8A,B 220	IC4 MAR-3
C7 1.0 μ F	C16 0.1 μ F	Q2 2N5179	R9 180	PTC-Thermistor
C8 0.01 μ F	C17 0.1 μ F	R1 560	R10 180	Micro-LO PCB
C9 0.1 μ F	C18 22	R2 1K	R11A, B 220	

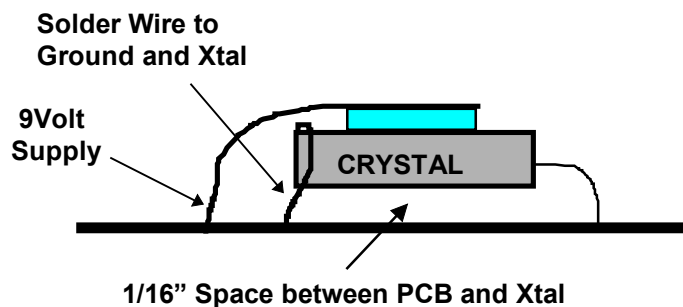
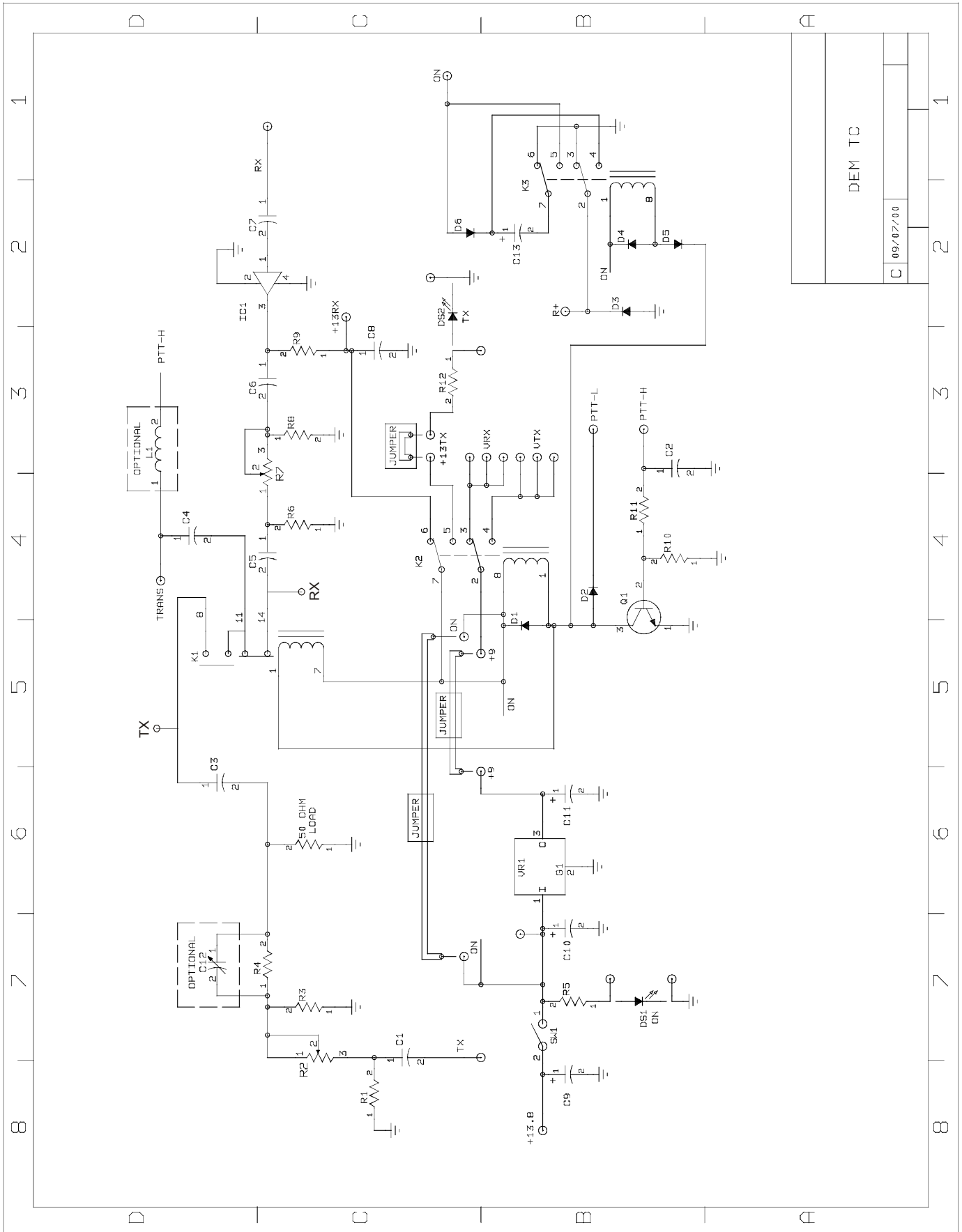
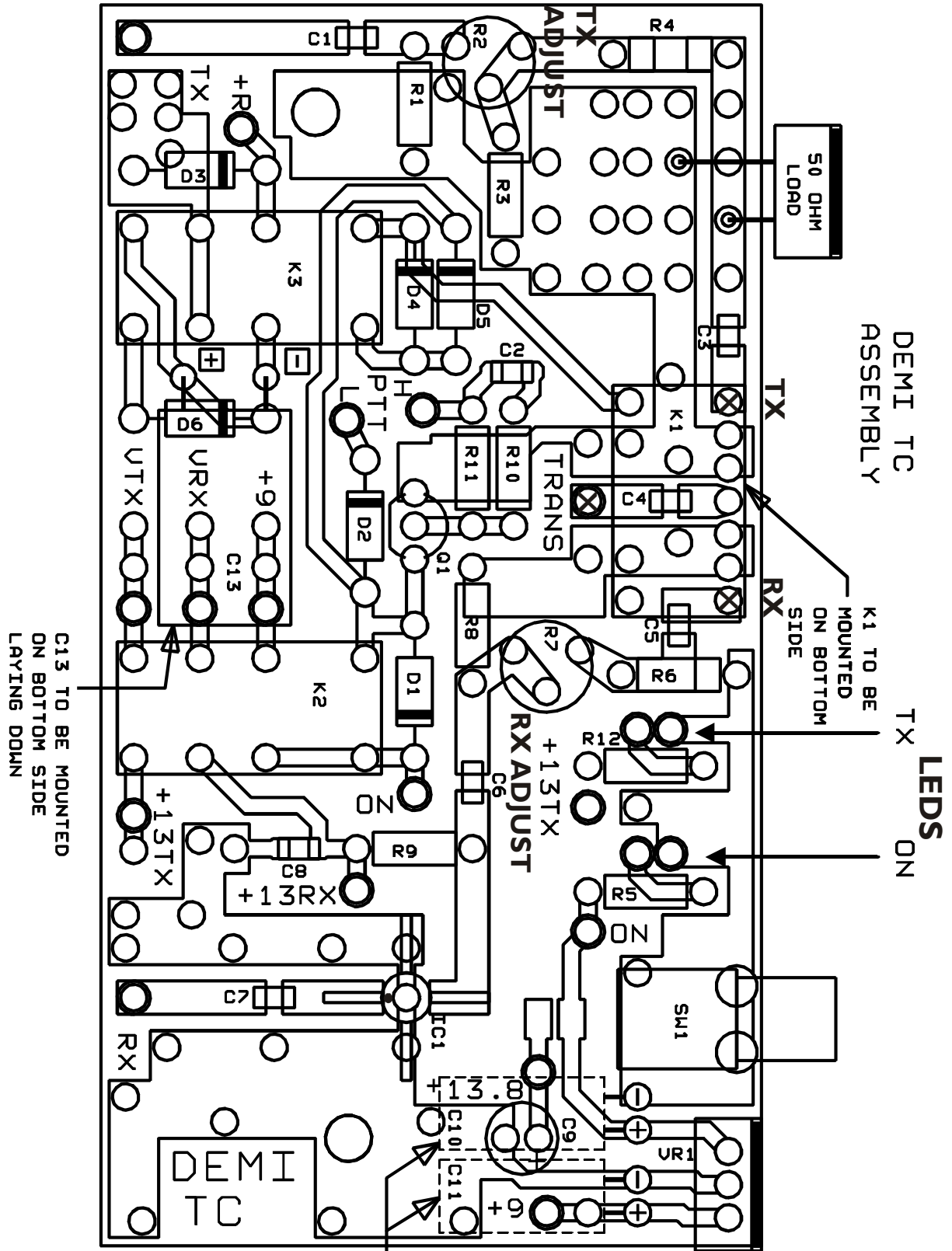


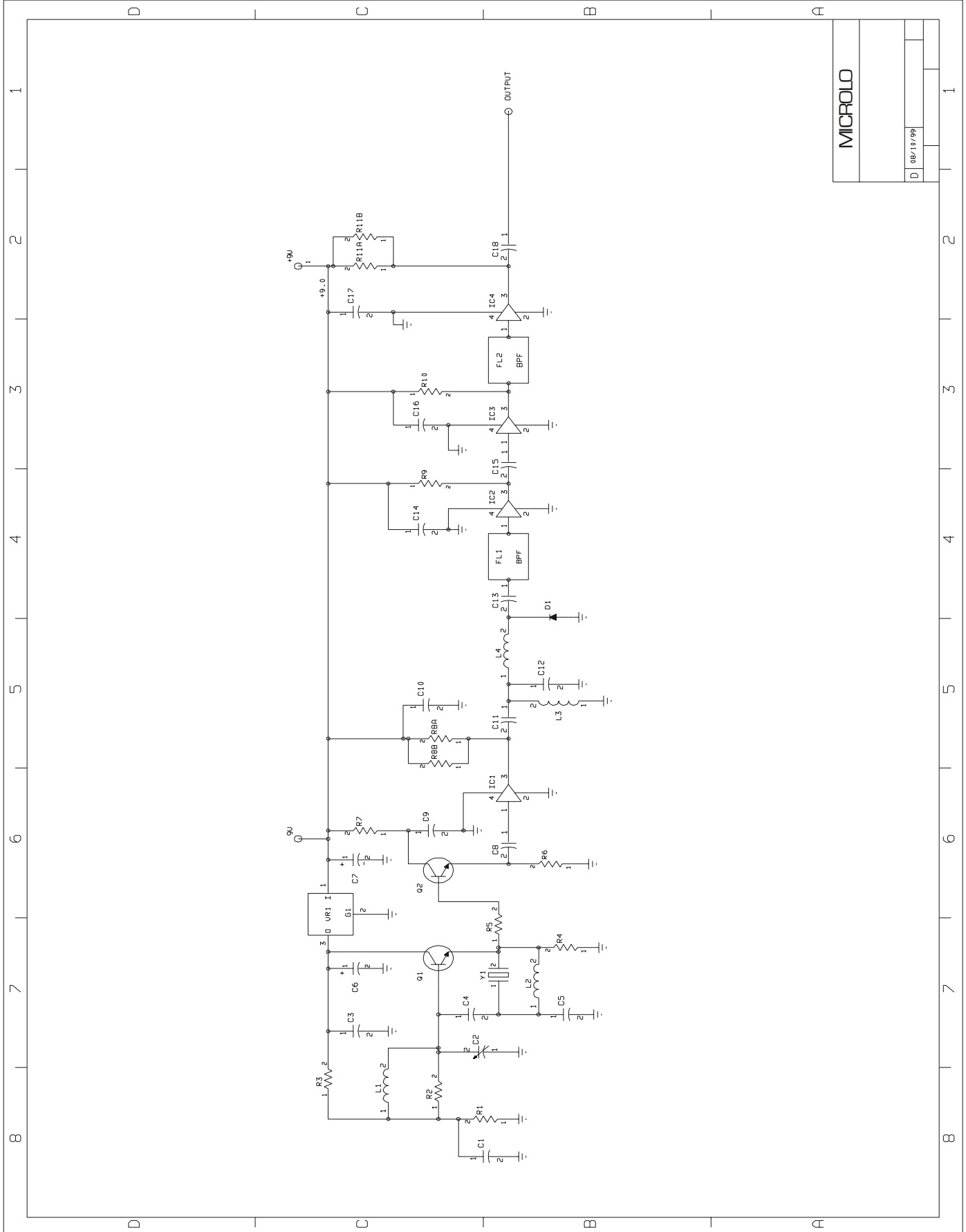
Figure 1. Crystal and Thermistor Installation details.





C13 TO BE MOUNTED ON BOTTOM SIDE LAYING DOWN

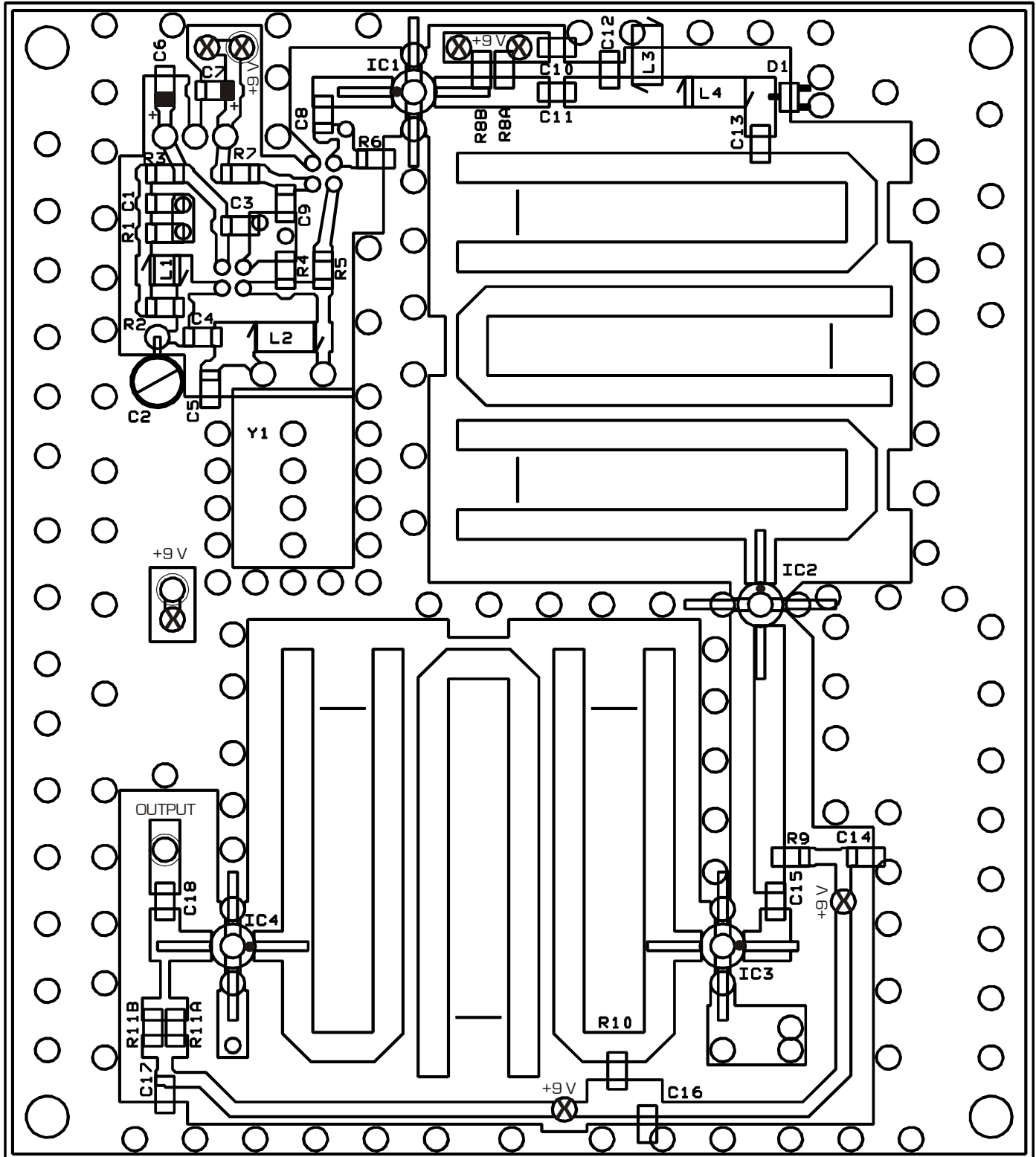
C10 + C11 TO BE MOUNTED ON BOTTOM SIDE LAYING DOWN



MICROLO	
D	08/10/99

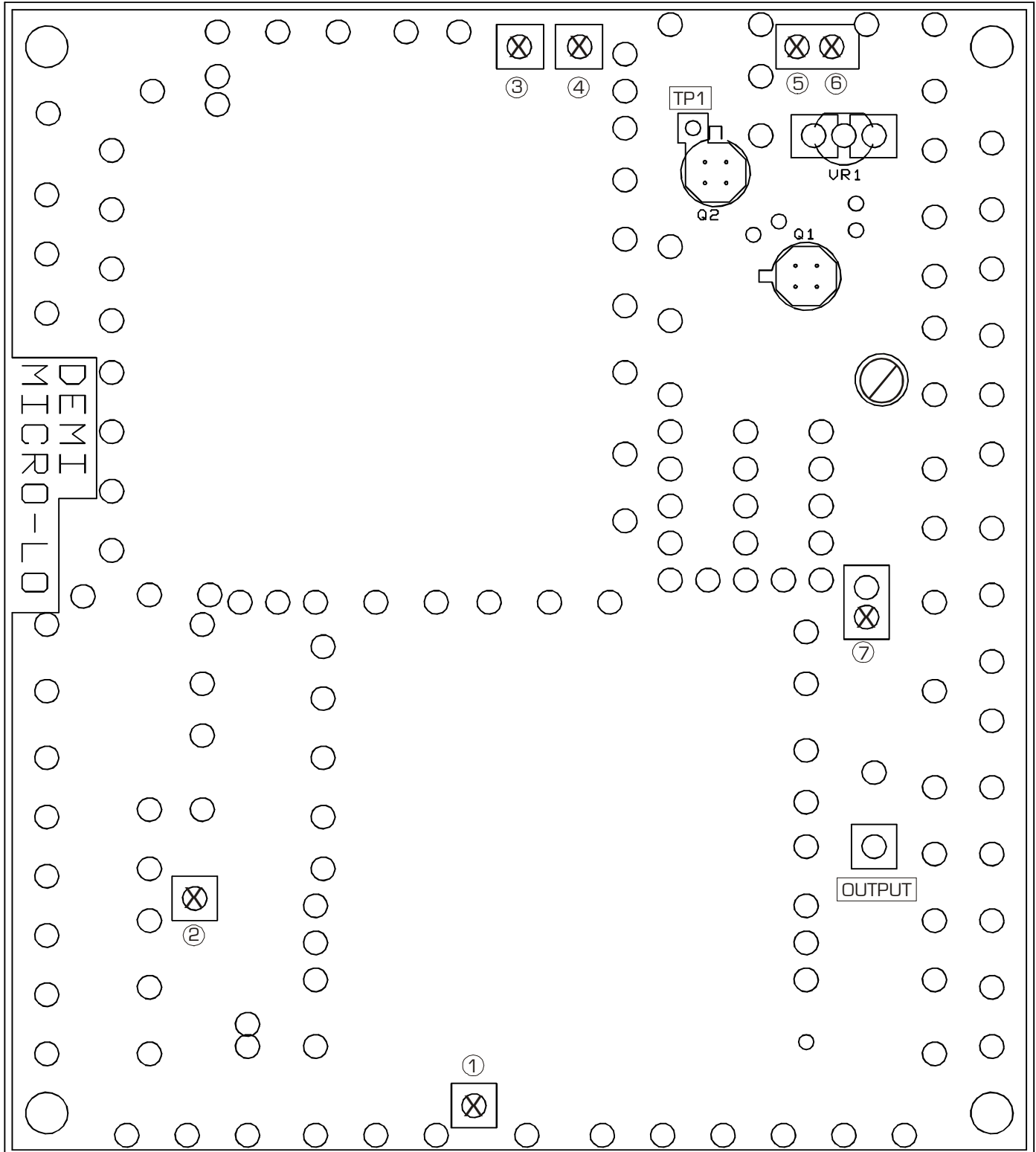


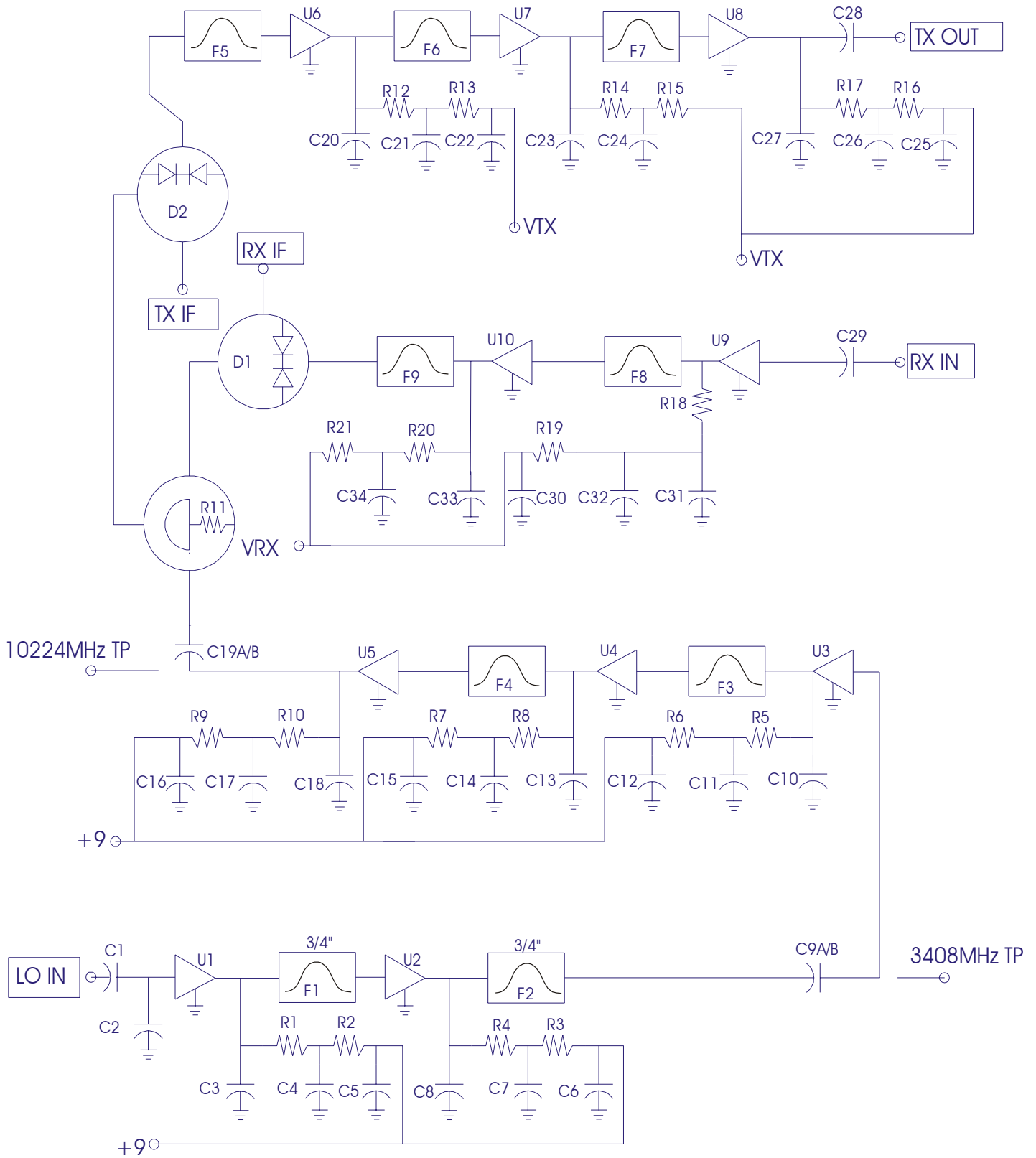
DEM MICRO LO TOP SIDE ASSEMBLY



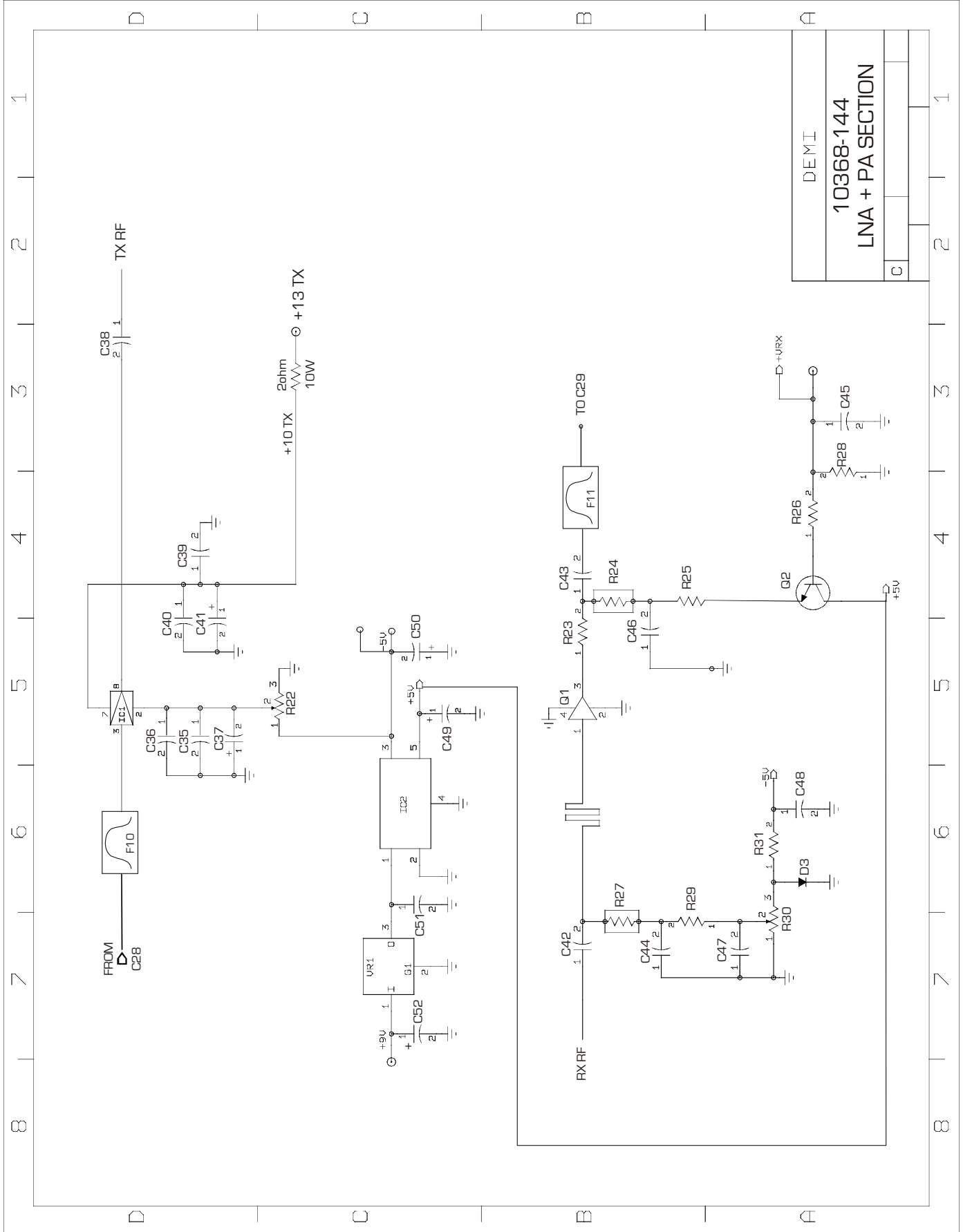


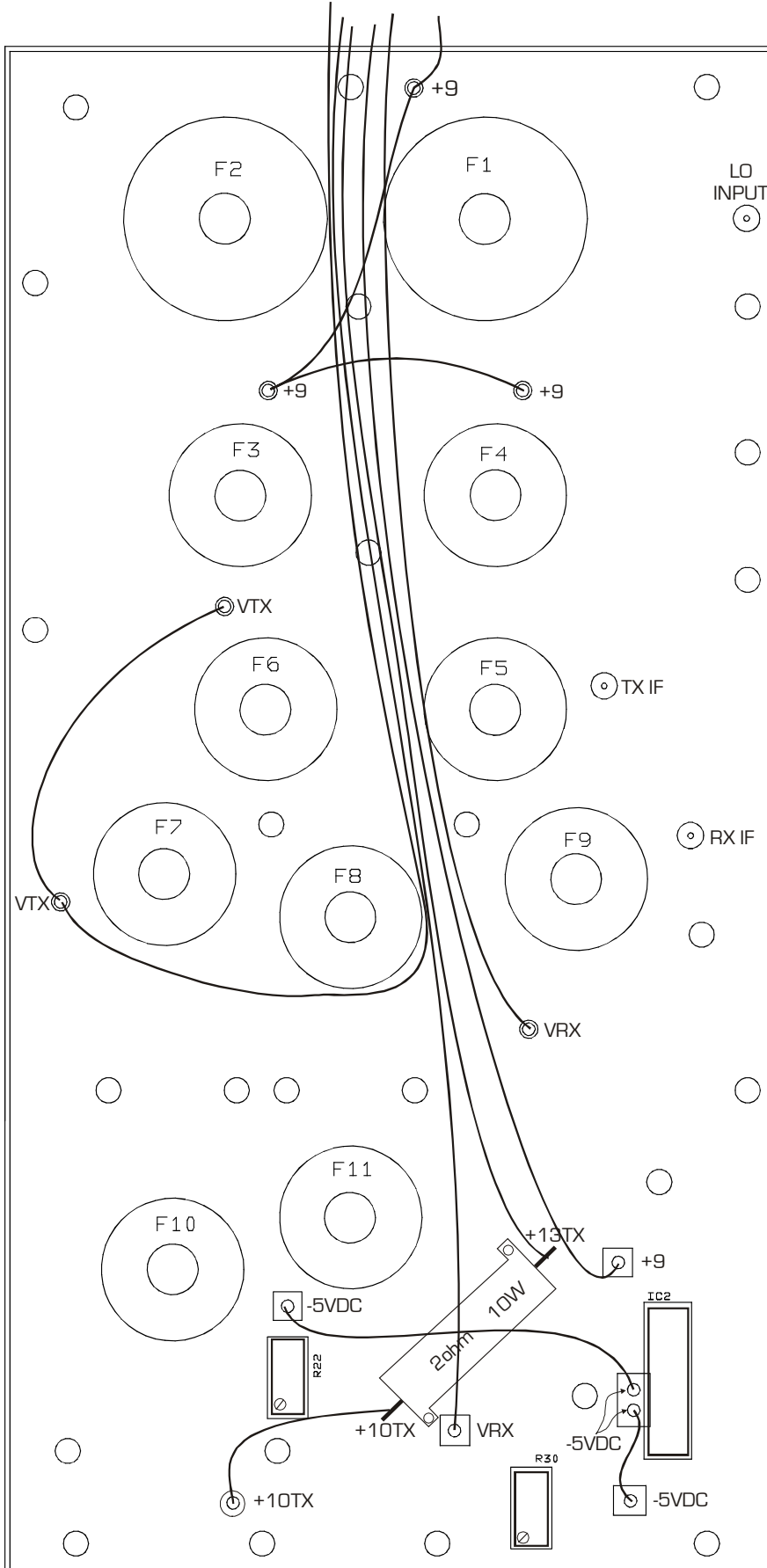
DEM MICRO LO BOTTOM SIDE ASSEMBLY



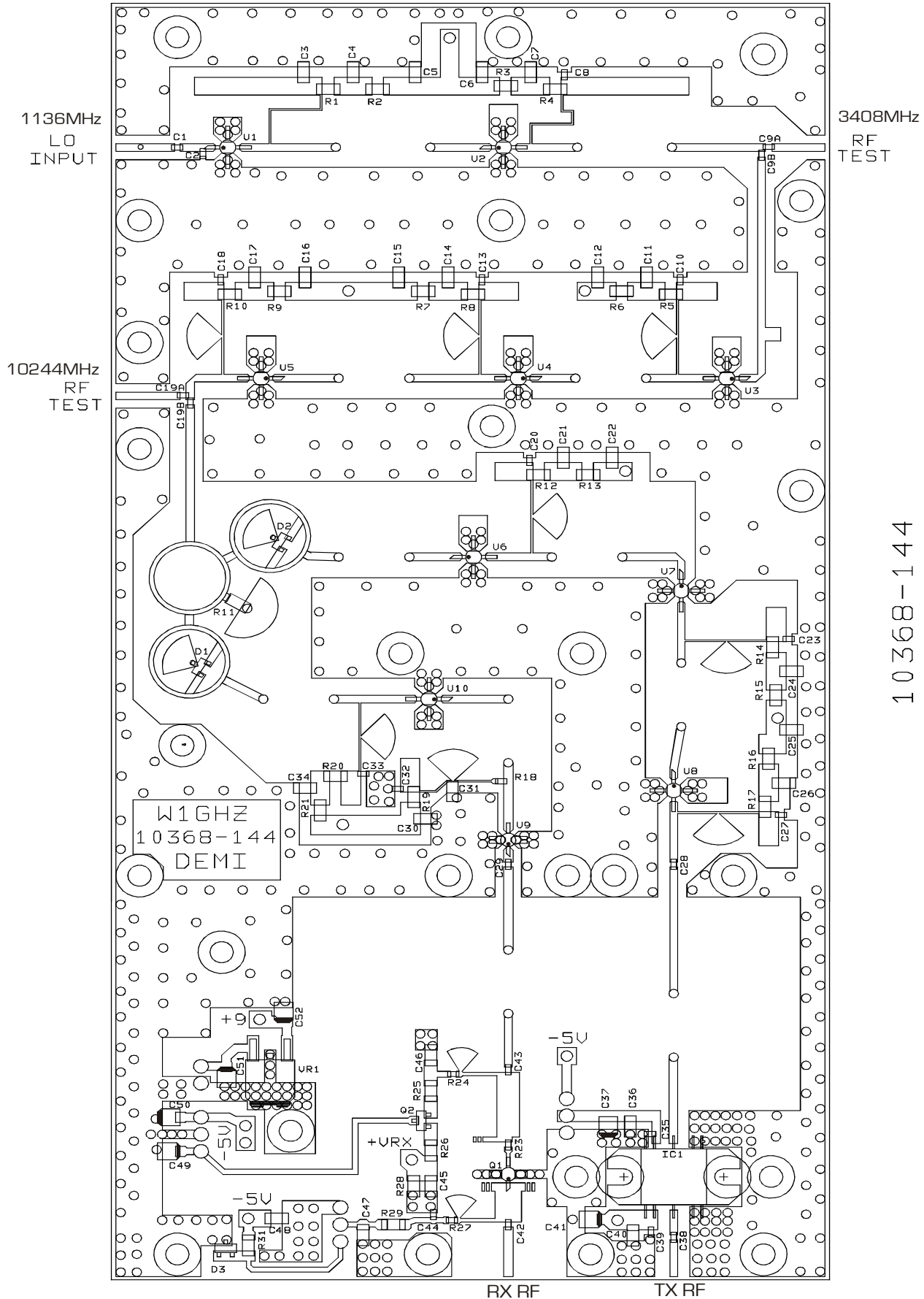


10368-1 44LP TRANSVERTER SCHEMATIC





10368-144
BOTTOM SIDE ASSEMBLY



10368-144
TOP ASSEMBLY