DEM Part Number 1315PACK

15Watts, 2300 to 2450 MHz Linear Amplifier Complete Kit

Specifications

Frequency range:	2.3 - 2.45 GHz
Power Out (at 1 dB compression):	15 Watts nominal
Power Out (saturated):	>18 Watts
Power Input for rated power out:	1 Watt for linear operation 1.2 Watts max.
Return Loss:	>10dB @2.3 GHz
DC requirements:	13.8 volts DC @ 4 amps. for nominal output 16 volts DC absolute maximum
Connectors:	SMA or type "N"
Size:	4.5" L x 4.5" W x 2.5" H
Active devices:	TPM2323-14 (Toshiba)
Keying Option:	PTT High or Low

Kit builders Checklist and Requirements

This kit is a simple 13 CM power amplifier but it requires some basic knowledge of FET operation and microwave principles. This amplifier will generate a minimum of 15 watts of power in the 2.3 GHz region. This amount of power could be harmful if not used correctly. Correct safety procedures must be maintained while aligning and using this power amplifier. This amplifier should never be operated into a open or un-terminated load. Quality coax and coaxial devices are required to test and align this kit. If you do not have any microwave construction experience, it is suggested that you return this kit an purchase a assembled version. Proper alignment of this kit requires a quality RF power meter that is specified to be used in the 2.3 GHz region, a accurate volt/ohm meter, a 50 Ohm load capable of dissipating 25 watts at 2.3 GHz, a 12 volt, 6 amp power supply, and a 1 watt driving source between 2.3 and 2.45 GHz. Any thing less than this will not ensure proper alignment and operation of this power amplifier kit. Improper assembly or alignment may cause premature failure of the active devices used and improper use of this product may cause harmful injury.

IMPORTANT!

The FET supplied with this kit is tested and the data is supplied with the packaging. We have had a 100% success rate with the TPM2323-14 and do not foresee any problems in the future. Therefore, because it is in a kit, we can not replace this FET if it fails for you. If it fails, we assume it is because of improper assembly or testing. If you find this statement uncomfortable, return the kit for full credit towards an assembled version. The FET is approximately 65% of the price of this complete kit. You may purchase a replacement or spare at anytime but we feel it should ***never*** be required!

Pre-Assembly

This kits is supplied as a complete kit only. Any deviation of assembly or misuse of components will void any technical assistance provided by Down East Microwave Inc. Read all assembly instruction before starting assembly. If you have a question about a procedure (assembly or test) please call for technical assistance before starting the assembly. Be sure about what you are doing first!! Check all components with the parts list and begin when ready!

Assembly

1. Prepare the PC board by installing copper foil on the ground plane side beneath the RF input and output connectors. This foil improves the ground connection of the PCB to the enclosure and RF connectors. See Figure 1 for proper assembly. Make solder connections as smooth as possible. File smooth if necessary.
2. Using the component placement guide and the parts list, install all components on PCB except for R5, Q1, L1,L2, and D3. Keep the PCB as flat as possible during assembly. Flexing the PCB during or after assembly may fracture and destroy surface mounted components. See Figures 2,3, and 4 for proper pin prepping of K1, IC1, and R2. All components are surface mounted. Do not place any ground connection leads through any via holes! Be sure of the polarity of C4. Solder them on the top surface only. After assembly is complete, inspect the bottom side of the PCB for solder that may have leaked through the via holes. Remove the excess with a knife or file. Be sure the bottom is free of any protrusions from the top side of the board and is smooth to the touch.
3. Install the assembled PCB on the heat sink using the two mounting holes located by Q1's mounting position with two 4-40 x 1/4" screws. Do not tighten. Also do not install screws in the corner holes of the PCB. Be sure the copper foil will cover the connector mounting holes on the ends of the heat sink and the machined pocket in the heat sink is aligned with the FET hole in the circuit board. Bend the copper foil down over the heat sink ends and verify that it is flush with the surface. If the circuit board has a bump in it or the foil will not fit smoothly to the heat sink, you may need to file or compress the solder by gently taping with a small hammer. Be careful!!! **NOTE:** We use the hammer in the factory!
4. Install the RCA connectors in the square housing. Do not use the ground lugs.
5. Prep the RF connectors by removing the Teflon extension and trim the pins to approximately 1/4" long if you are using the SMA connectors. The Type "N's" are short enough. Then install the RF connectors on the housing using four 4-40 x 3/16" screws. Do not tighten the screws.
6. Place the housing on top of the heat sink assembly with the RCA connectors on the K1 and IC1 side of the circuit board. Align the housing with the circuit board by centering the connector pins with the input and output connections on the circuit board.
7. If the copper foil is correct, the housing will fall into place and the bottom connector holes will line up with the mounting holes in the heat sink behind the copper. Use a sharp object and puncture the foil through the connector holes and insert the four 4-40 x 5/16" screws. Do not tighten!
8. Inspect the Q1 pocket in the heat sink and remove any debris that may have become trapped. It is extremely important that this surface is clean and flat before installing the FET. Apply a small amount of Thermal compound (heat sink grease) to the bottom of the power FET. It should be a transparent layer or the excess will migrate up to the circuit board after assembly of the FET. Install the FET in the heat sink pocket aligning the leads as shown on the component placement. The leads should line up close to the center of the microstrip on the PCB. Install two 4-40 x 1/4" screws. Do not tighten.
9. Check for alignment of the connector pins and Q1's leads. Once everything looks correct proceed to tighten the four screws that are in the housing that mount the RF connectors. This will align the housing to the heat sink laterally. Do not tighten the screws in the Heat sink !! Verify that the leads of the Q1 are on the center of the microstrip and tighten its screws along with the 2 PCB screws by Q1. Now before tightening the RF connectors that

are in the heat sink, it is suggested to place the assembly in a vice or a clamping device. The idea is to compress the housing down onto the heat sink, sandwiching the PCB completely around the amplifier. Once compressed in a clamping device, loosen the 4 connector screws in the housing without removing the amplifier from the clamp and then compress the amplifier a bit more. This insures a complete interface between the housing, PCB and Heat sink. Now while the amplifier is still in the clamped position, tighten all eight connector screws. This will now lock the housing into position. If a vice is not available, place a block of wood or similar object on top of the amplifier and exert downward pressure on the amplifier to simulate a vice while tightening the connector screws. Trim off excess copper foil after the connectors are tight. Inspect for gaps between the connectors and or PCB, housing and heat sink.

10. Use buss wire to make connection from RCA connectors to the indicated points on the PCB. One is for +13.8VDC and the other is for the PTT (push-to-talk). You should at this time decide if you want a PTT to ground or a PTT high and wire it appropriately.
11. Solder the RF connectors and Q1's leads to the circuit board. Install D3 as shown.

Testing

1. At this time, the only missing component from the assembly should be R5, L1 and L2. With a Ohm meter, verify that Q1 is correctly installed and not shorted during installation. The gate (or input lead) should be in the Mega-ohm region to ground. The drain (or output lead) should measure only a few tenths of an ohm to ground. It is difficult to verify if it is shorted so measure a few times to be sure. If the ohm meter test are OK, install L1 and L2 as shown on the component placement diagram and Figure 5.
2. The amplifier requires a single 13.8 volts DC supply with a minimum 6 amp rating for the next test. Connect the power supply to the 13.8VDC connector. If you have a current limiting power supply limit it to 500 mA. All measurements are referenced to ground. Measure all +13.8VDC connections. If your power supply is less or more than 13.8VDC, all of the +13.8VDC voltages points will be your power supply voltage. Do not exceed 16.0 VDC or attempt to operate with less than 11 VDC. Now measure VR1 and confirm it is operating at 5 volts (± 0.3VDC). Then check IC1. Measure the gate circuit for negative 5 VDC (± 0.5 VDC) at the junction of C4 to ground and measure positive 5 VDC at the junction of C12 to ground. If OK measure the voltage on the gate lead (L1) directly and adjust R2 for -2.5VDC. Then measure the output of the relay (C8)and verify that there is +13.8 VDC (or the power supply voltage!) when the PTT circuit is keyed. You will need to energize the PTT circuit and should hear the relay click. When the PTT circuit is released, the voltage will drain down slowly. This will not happen after R5 is installed.
3. Now terminate the input and output connections with a 50 ohm load of some type. The output requires a load capable of 25 watts. The input may be connected to the drive source but be sure the RF source is off. Remove the power supply connection and install R5 as shown on the component placement. Form the leads as shown in Figure 6. Connect the lead to the pad of CR3 first then fit the resistor in place before making the final connection at C8 as shown in Figure 7. Verify that the solder connection is not shorted to the CR3 pad. Remove L2 if necessary.
4. Connect the power supply to the amp. The next step needs to be understood before attempting. The idle current of the amplifier needs to be adjusted and set. If it is too high, it will over dissipate the Q1 and damage it. If it is too low, the amp will have low gain and power output. To adjust it correctly you need a accurate current meter on the power supply or

measure the voltage drop across R5. If you need to measure the voltage across R5, use good clip leads connected to your volt meter. Key the PTT line and quickly verify that the current drain is not more than 3 amps. That would be 3 volts or less drop across the 1 ohm resistor. If more release the PTT line immediately! Then increase the gate voltage (more negative) by adjusting R2 and try again. If less than 3 amps or a 3 volt drop across R5 , adjust R2 until the 3 amps of current drain is obtained.

5. After the idle current is set, remove the DC power before removing the clip leads that may be attached. Connect a RF power meter that is rated for 2 GHz and capable of measuring 25 watts. Then connect your drive source if not connected already. Reconnect the DC power source. Key the PTT circuit. The amplifier will be drawing current. Now slowly apply RF drive and notice the output power on your power meter. It is sometimes possible to obtain as much as 20 watts with 1 watt of drive. The current drain at the maximum power output level will be approximately 4 amps. Do not exceed a drive level of 1.2 watts or what ever drive level saturates the power amplifier. If power output is low or non-existent, check all series RF components first, then re-check voltages without the RF drive applied. R5 will get hot to the touch!

Instructions for Use

1. The Down East Microwave Inc. 1315PA linear amplifier is a simple gain block for the amateur 13 cm band. It will provide >18 Watts saturated output power with 1.2Watts of drive. It requires external T/R switching and can be used by itself or as a driver for a higher power amplifier.
2. The amplifier requires a single 13.8 volts DC supply at 4 amps, but will operate at reduce ratings down to 10 volts and at increased power dissipation up to 16 volts. The unit is provided with an internal negative bias supply and keying circuit for ease of use. This is the PTT circuit. It is either toggled to Ground or supply with a 1.5- 15VDC voltage to activate. See specifications for type of set up.
3. The RF drive level requirement for linear operation is 1.0 Watt maximum. When operated at full saturated output power the drive level should not exceed 1.2Watts. If the exciter cannot be turned down to this level, a attenuator pad can be used between the exciter and amplifier to reduce the drive. The amplifier has been tested at a full 1.5Watts input with no damage, but it is not recommended due to excessive power dissipation.
4. To achieve maximum performance the amplifier should be mounted in a well ventilated area with heat sink fins in the vertical position for optimum cooling. A cooling fan is required for 100% duty cycle operation.
5. It is advisable but not necessary to use circulators and band pass filters when available. This will prevent stray oscillations and needless waste of power by amplifying local oscillator frequencies or generating high power out of band spurious signals.

PCB Component List

All chips are 1206 size unless otherwise marked.

C1 12ρF ATC	C8 0.1μF	R3 1K Ω	L1 5T 0.062" 1/16"
C2 12ρF ATC	C9 0.1μF	R4 1K Ω	L2 5T 0.062" 1/16"
C3 0.1μF	C10 12ρF ATC	R6 51Ω 1206	Q2 PN2222
C4 2.2μF Electro	C11 12ρF ATC	D1 1N4000	VR1 78L05
C5 10μF Electro	C12 2.2μF Elect.	D2 1N914	
C6 100μF Electro	R1 51	IC1 NMA0505S	
C7 0.1μF	R2 200Ω Pot	K1 G5V 5 volt	

Hardware Parts and other components

1	Q1 TPM2323-14	8	4-40 x 1/4" screws
1	D3 CZ5348B	4	4-40 x 3/16" screws
1	R5 1Ω 10W	4	4-40 x 1 1/4" screws
2	3/4" Flange Connector	4	Screw type Rubber Feet
2	RCA Connectors	1	Box with lid
1	PC Board	1	Heatsink

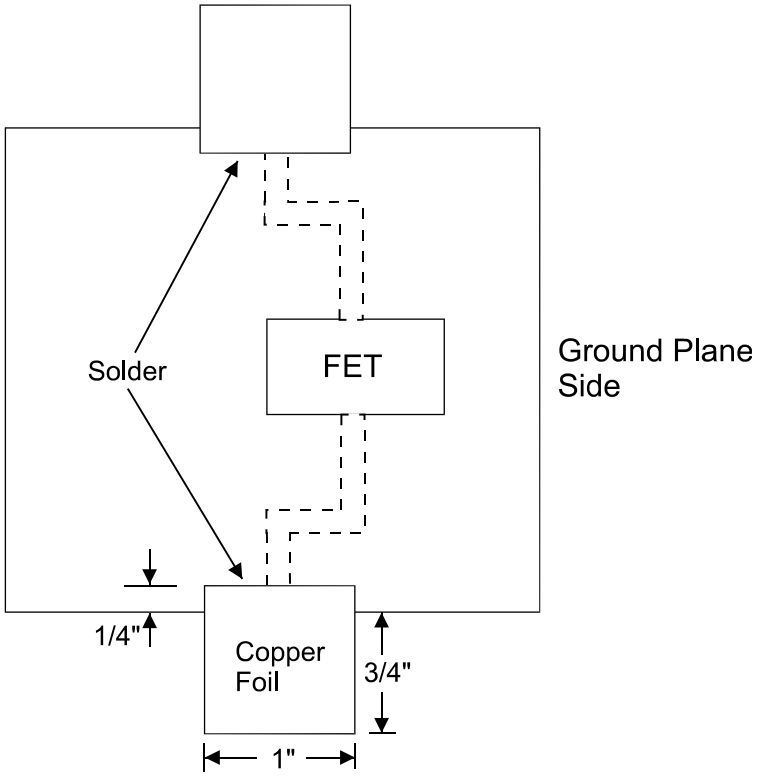


Figure 1

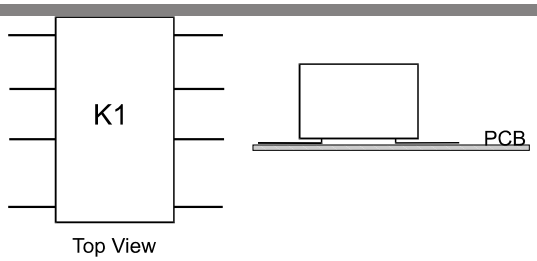


Figure 2

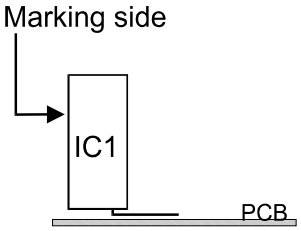


Figure 3

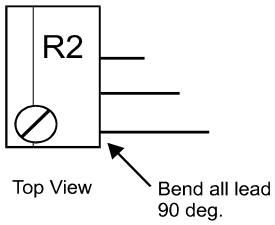


Figure 4

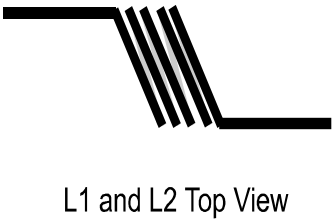


Figure 5

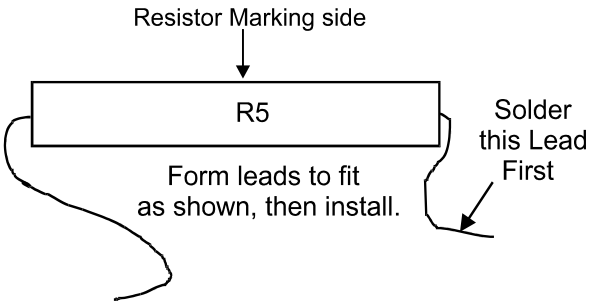


Figure 6

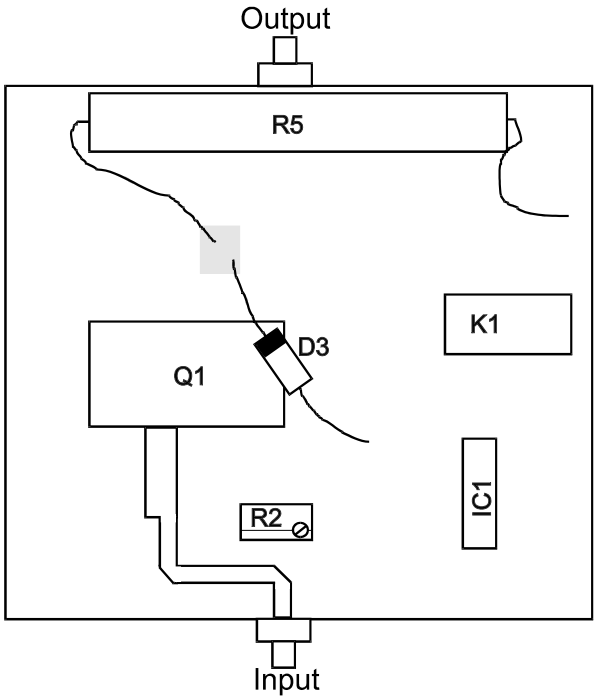
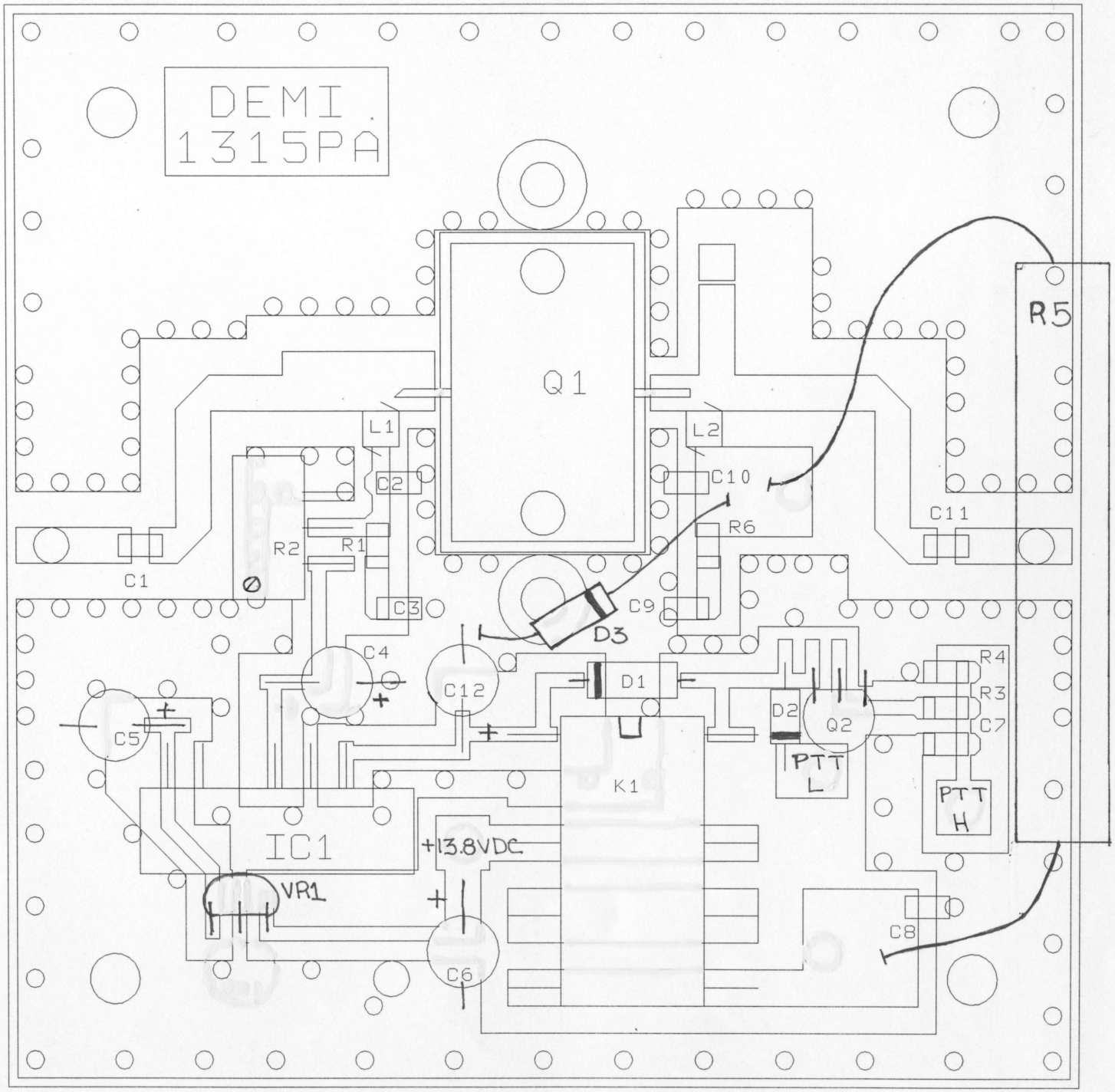


Figure 7


DEMI
1315PA
Q1
L1
L2
C2
C10
C11
R5
R6
R2
R1
C1
C3
C9
D3
C4
C12
D1
R4
R3
C7
C5
D2
Q2
PTT
L
K1
PTT
H
IC1
+13.8VDC
VR1
C6
C8

1315PA SCHEMATIC