DEM Part Number L3-3PACK

3 Watts, 10 GHz Linear Amplifier Complete Kit

Specifications

Frequency range:	10.0 - 10.5 GHz
Power Out (at 1 dB compression):	3 Watts nominal
Power Out (saturated):	>3.0 Watts
Power Input for rated power out:	10 mW for linear operation. 20mW maximum
Return Loss:	>10dB @10.368 GHz
DC requirements:	13.8 volts DC @ 2.5 amps. for nominal output 15 volts DC absolute maximum
Connectors:	SMA(F) only
Size:	3” L x 2” W x 2.5” H
Active devices:	FMM5061VF (Eudyna or Sumitomo)
Keying Option:	PTT Low

Kit builders Checklist and Requirements

This kit is a simple 3 CM power amplifier but it requires some basic knowledge of FET operation and microwave principles. This amplifier will generate 3 watts of power in the 10 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 and purchase a assembled version. Proper alignment of this kit requires a quality RF power meter that is specified to be used in the 10 GHz region, a accurate volt/ohm meter, a 50 Ohm load capable of dissipating 5 watts at 10 GHz, a 12-15 volt, 3 amp power supply, and a 10 mW driving source between 10 and 10.5 GHz. Anything 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.

INPORTANT!

The FET supplied with this kit is tested. We have had a 100% success rate with the FMM5061VF and do not foresee any problems in the future. Therefore, because it is in a kit, we cannot 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 60% 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 kit 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. Place the circuit board on a flat surface to prevent flexing and using the component placement guide and the parts list, install all surface mount components on PCB. Be sure of the polarity of C5 and C7. This should leave IC1, IC2, R3, R6 and K1 to install. Keeping the PCB as flat as possible during assembly is important. Flexing the PCB during or after assembly may fracture and destroy surface mounted components. Now install IC2, R3 and K1 utilizing Figures 1, 2, and 3 for proper pin prepping of K1, IC1, and R3. Be sure that all leads are flat as possible to the circuit board. After assembly is complete, inspect the bottom side of the PCB for solder that may have leaked through the via holes and “puddled”. Remove the excess with solder wick. It is important for the board to be mounted flat in the enclosure.
2. Prep the length of the Teflon of the RF connectors. Use the wall of the enclosure to establish the cut point of the Teflon and with a sharp razor knife remove the excessive Teflon only. Then cut the center pins to extend approximately 1/8" longer than the Teflon. First verify the pin length by installing the SMA connectors in the enclosure. The PC board will fit exactly in the housing.
3. Drop the PCB in the housing and align it with the mounting holes. It will only fit one way. Then install the thirteen 3-48 x 3/16 screws. Do not tighten. Install the SMA connectors with 8 more 3-48 screws. Tighten them. Now, align the PCB so that the connector pins are exactly on the input and output RF lines of the board. Snug the thirteen 3-48 screws and check for pin alignment. If off center, try again! It is important to have a perfect alignment. Do not solder the pins.
4. Install IC1 using Figure 4 as a guide. Pin #2 of IC1 is the input pin (angle cut lead) and should be aligned with C1. Use a light coating of thermal compound and apply to both the enclosure and IC1. Then attach with two 3-48 screws. Center the input and output pins on the RF lines. There should be enough tolerance in the mounting holes to achieve a perfect alignment. If not, verify that the pins are not bent out of position in IC1. If alignment cannot be achieved, loosen the PCB mounting screws and align as a complete assembly, connector pins, board and IC1. BUT-- we do not expect it to be this difficult unless a machining process was incorrect. When all lined up, solder connector pins and the pins of IC1. Apply slight pressure down on IC1's pins with a small flat blade screwdriver or other tool to be sure of flat positive contact to the PCB.
5. Next install R6 with two screws and begin wiring. Select one of the ferrite beads on a wire and make the connection between D1 and C11. You can put any type of bend or not just do not let the wire or bead touch the PCB. You may trim the length if you feel it is too long. Next select the other FB and install as shown. Make these leads as short as possible and still be able to solder to the pads. Keep the excessive leads that were cut off. Then install D3. It is the overvoltage protection diode. Insert one end into the hole of RG and solder the other to the PCB ground in the general area shown on the component placement document.
6. Use the supplied Teflon wire to make the connection from K1 to VR1. Adjust the length so that the wire does not touch the PCB. Then connect R6 to the circuit as shown using the Teflon wire making the length as short as possible.
7. Install the 8-32 feed through connectors with the ground lugs in the enclosure. The pins will extend inward and align with the two pads they will be connected to. Using the cutoff wire for the FB that was saved, make the short connection from the feed through to the PCB at the PTT-L and +13.8VDC connections. It is now ready to test.

Testing

1. First, disconnect the wire from R6 to the C6 pad. This removes the Drain voltage from the IC1. If the PTT circuit misfires, the IC1 will not be damaged. With an ohm meter, check for solder shorts and review all solder connections. The leads of IC1conneced to the FB will be a very low resistance to ground. It may be less than 1ohm. Be sure to Zero you meter before checking this connection. If all is OK, proceed to step #2. If not make the various corrections to you work as required.
2. Prolonged testing will cause the enclosure to get "HOT". It is recommended to mount the amp to a heat dissipating device as you would with normal use. Short 30 second key down periods to verify operation are fine but the enclosure will become warm to the touch. Understand that R6 generates the majority of the heat.
3. The amplifier requires a single 13.8 volts DC supply with a minimum 3 amp rating. 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 15.0 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 IC2. Measure the circuit for negative 5 VDC (± 0.5 VDC) at the junction of C7 to ground. This may swing lower in voltage (a higher negative number). Then, check the positive 5 VDC at the junction of C11 to ground. This may also float higher. Then measure the voltage on the gate lead (Pin 1 of IC2) directly and adjust R3 for maximum negative voltage (-5VDC ± 0.5 VDC). If OK, key the PTT by making a connection to ground and listen for the relay to click. Then measure the voltage at C6 to be around the supply voltage. Un-key the PTT and verify that the voltage drops to zero at C6. Remove the DC power supply connection and reconnect R6 to C6. Now terminate the input and output connections with a 50-ohm load of some type. The output requires a load capable of 5 watts. The input may be connected to the drive source but be sure the RF source is off. If using a RF power meter, be sure of its power handling capability.
4. Connect the power supply to the amp. Remember to un-limit the current or readjust it to 2.5 amps. The next step needs to be understood before attempting. The idle current of the amplifier is controlled by the negative gate voltage. Be sure it is set for the maximum negative voltage possible. If it is too low, IC2 may over dissipate and damage it. This is done by the adjustment of R3 which was done previously. To verify proper operation an accurate current meter on the power supply is required OR-- measure the voltage drop across R6 and use ohms law to calculate the current. If you need to measure the voltage across R7, use good clip leads connected to your voltmeter. Key the PTT line and quickly verify that the current drain is not more than 2.5 amps. That would be more than a 7.5-volt drop across the 3 ohm resistor. If more release the PTT line immediately and check the gate circuit voltage or a short on the drain circuit. Most likely it will be less than 6 VDC drop of which is an idle current between 2.0 and 2.2amps is good. Verify this with any method.
5. After the idle current is verified, remove the DC power before removing the clip leads that may be attached, then reconnect the DC source. With a RF power meter that is rated for 10 GHz and capable of measuring 5 watts. 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 3 watts with only 10 mW of drive. The current drain at the maximum power output level will be less than 2.5 amps. Do not exceed a drive level of 20 mW

or whatever drive level saturates the power amplifier. If power output is low or non-existent, check all series RF components first, then re-check measurement, calibrations and voltages without the RF drive applied. Do not poke around with your finger with the PTT keyed and drive applied or you may experience a 10 GHz RF burn and R6 will also get hot to the touch!

6. If you have lower than 10 mW of drive, the gate voltage may be made less negative to increase the gain of the amplifier. You may adjust it for more output power but do not let the idle current exceed 2.5 amps. When the amplifier checks out correctly and is set to your requirements, attach the lid with the four 4-40 x 1/4" screws and you are done!

Instructions for Use

1. To achieve maximum performance the amplifier should be mounted in a well ventilated area with heatsink of sort in the vertical position for optimum cooling. A cooling fan is required for 100% duty cycle operation.
2. 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.

L3-3PA Component List

All resistors and capacitors are chip components unless specified.
The white band is positive on the Tantalum chip capacitors.

C1 1.0ρF	C9 4.7μF Tant	R6 3 Ohm, 10 Watt
C2 1000ρF	C10 0.1μF	VR1 78M05
C3 1.0ρF	C11 4.7μF Tant	D1 MMBD 914
C4 4.7μF Tant	C12 0.1μF	D2 MMBD 914
C5 4.7μF Tant	C14 1000ρF	D3 CZ5348B
C6 0.1μF	R1 51 ohm	K1 G5V-5
C7 4.7μF Tant	R2 51 ohm	IC1 FMM5061VF
C8 47μF Tant	R3 200 POT	IC2 NMA0505S

Hardware Parts

1	Enclosure and lid	2	Ferrite Beads
2	SMA connectors	23	3-48 x 3/16” screws
2	Feed thru Capacitor & #8 Lug	4	4-40 x ¼” screws
1	Teflon wire	1	Thermal compound

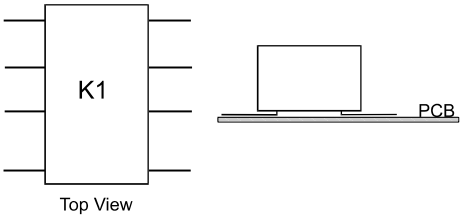


Figure 1

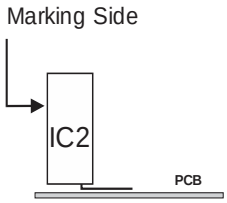


Figure 2

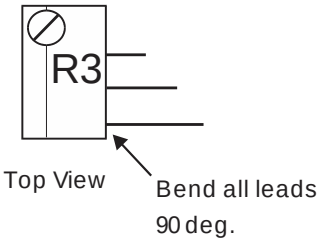


Figure 3

Pin Out:

1	**VGG**
2	**RF in**
3:	**N.C.**
4:	**VDD**
5:	**RF Output**
6:	**VDD**

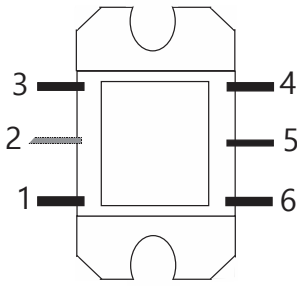
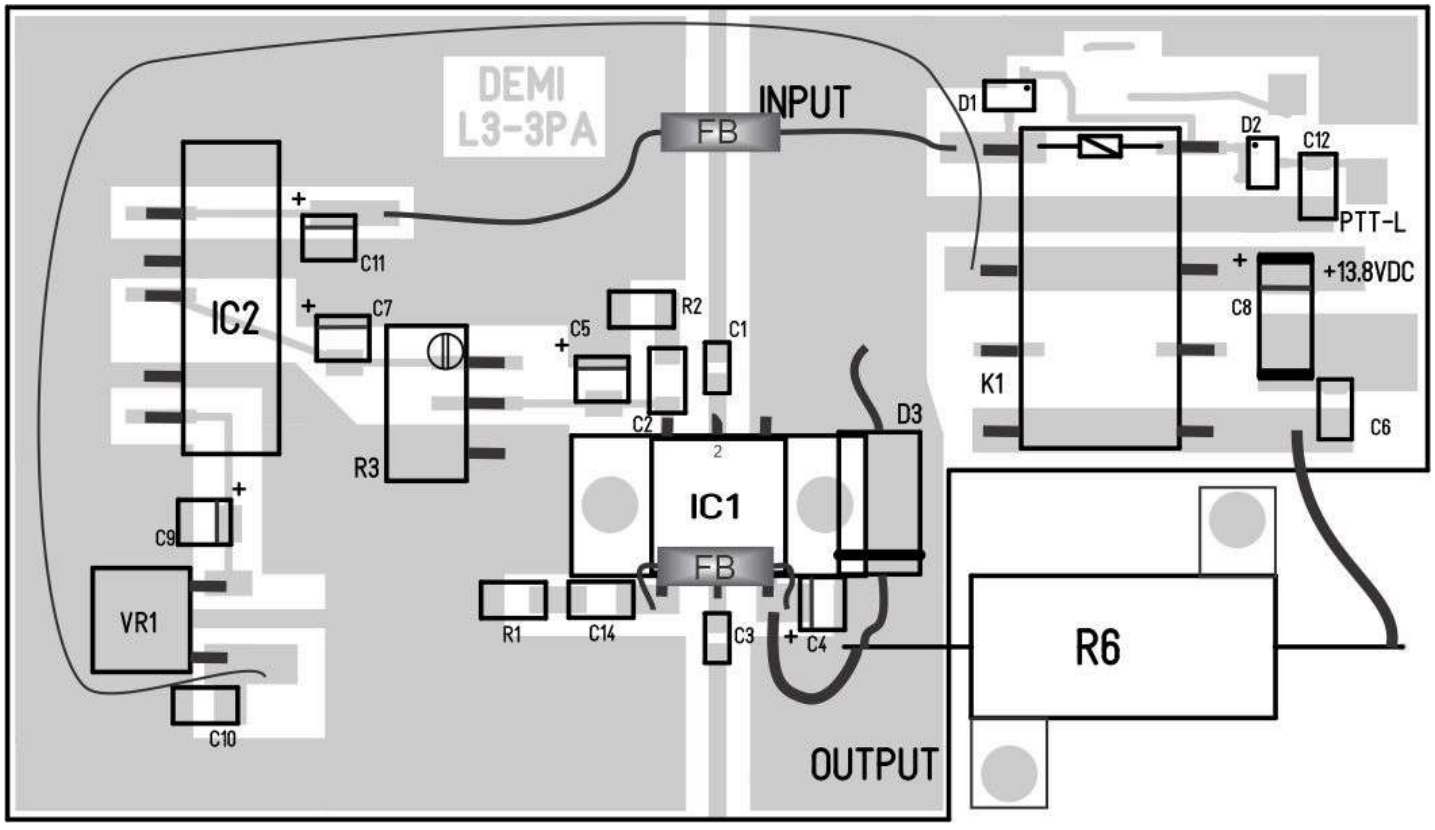
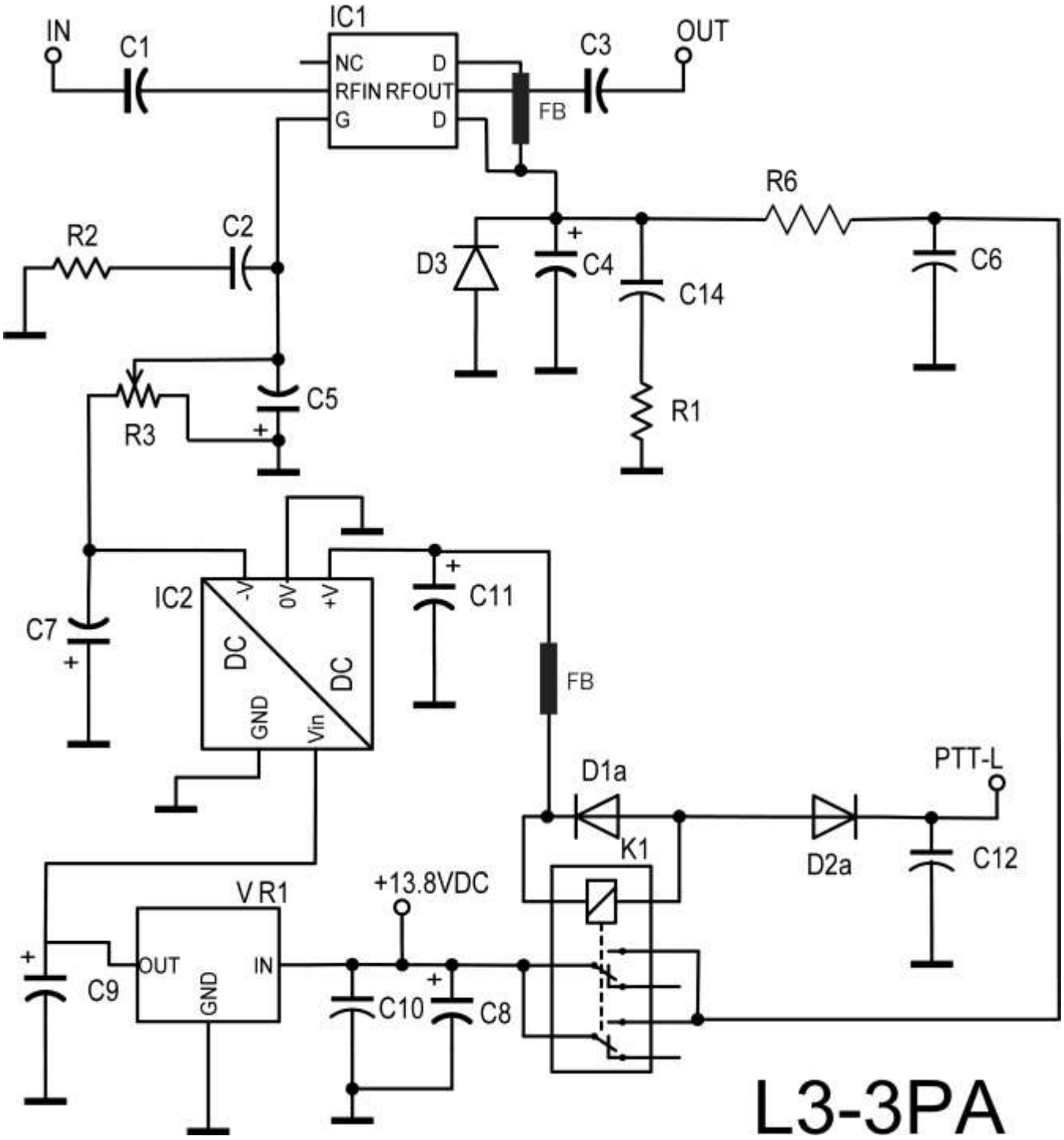


Figure 4




IN
C1
IC1
NC
D
RFIN
RFOUT
G
D
C3
OUT
FB
R6
R2
C2
D3
C4
C14
C6
C5
R3
R1
IC2
-V
0V
+V
DC
DC
GND
Vin
C11
C7
FB
D1a
PTT-L
K1
D2a
C12
VR1
+13.8VDC
OUT
IN
GND
C9
C10
C8
L3-3PA