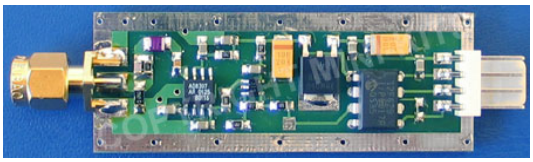
LTC5508 POWER HEAD KIT

SPECIFICATIONS: EME151-7G KIT

Frequency Range:	0.3 to 7GHz LTC5508 (Usable to 10GHz)
Dynamic Range:	-27.5 to +12.5dBm into 50ohms
Maximum Input:	+20dBm Maximum without damage
Output:	DC voltage or I2C bus
Output Resolution:	0.25dB minimum (PIC 12F675 A-D 1024 bit)
Power:	+7 to +15vdc (12vdc @ 35mA)
Size:	PC Board 60 x 22mm
Kit Webpage:	**www.minikits.com.au/eme151.htm**



DESCRIPTION: The notes and software description have reference to a Power Meter, which is the combination of the Power Head Kit, and DDS VFO Kit using the SWEEP software.

The Power Head is constructed on a single 60 x 22mm size PC board and takes around 1 hour to construct. The power head was designed to be used in conjunction with the DDS VFO Kit running SWEEP software, but can also be used with a multimeter for simple RF power measurements. The power head uses the Linear Technology LTC5508 RF power detector chip, that allows RF measurements up to around 7GHz. An LMV321 operational amplifier, (O/P Amp), increases the output voltage to drive the analogue to digital input, (A-D), on a PIC12F675 microprocessor. Two pins on the PIC12F675 are used for I2C bus data and clock, to communicate with the PIC processor used on the DDS VFO Kit.

INPUT AMPLIFIER: Please Refer to the circuit diagram, and data sheet for the LTC5508. A simple input matching circuit is used on the input pin 6 of the LTC5508 to match it to 50ohms. The 51ohm input resistor reduces the minimum sensitivity of the chip from –32.5 to –27.5dBm, but makes the power readings much more accurate with varying input impedance. The LTC5508 produces 0.24vdc output from pin 3 with an input of –28dBm, and an output of 1.24vdc for an input of +12dBm, which equates to an output of 25mV per dB. This means that the maximum that can be read on the output pin 3, is 1.24vdc on a multimeter with +12dBm input. A LMV321 operational amplifier IC is used with a gain of 2 to increase the DC voltage output from the LTC5508, to 2.5vdc with +12dBm input, which is 50mV per dB.

MICROPROCESSOR: Refer to the circuit diagram. A PIC12F675 microprocessor is configured to use the A-D input on pin 3, (GP4) to convert the DC voltage from the LMV321 to I2C data and clock signals on pins 5 and 7. The A-D input requires a 0 to +5vdc input for a maximum resolution of 5/1024 or 0.25dB resolution. The DDS VFO Kit when running SWEEP software ,communicates on the I2C bus, and is used to program the calibration settings inside the PIC12F675 on the Power Head. Variations due to component tolerances especially with the LTC5508, require a different calibration to be programmed for each power head. **Please refer to the LTC5508 data sheet from Analogue Devices.** The LTC5508 is not very linear with the dc output for RF input, so the software has 17 power levels from –27.5dBm to +12dBm that need to be set, for each of 5 bands of frequencies. The PIC12F675 supplied with the Kit has 5 pre-programmed frequencies with the 17 levels of power settings for 0.5, 1.2, 2.4, 3.4, and 5.8GHz. This means that you can swap the power head to a different DDS VFO Kit, and no recalibration of the Power Meter is required. **Refer to the Readme Sweep Kit PDF document on the Kit webpage.**

POWER SUPPLY: A +5 volt 78L05 SMD regulator is used for a stable supply to reduce noise to the power head circuitry. 22 ohm resistors are used to increase the decoupling of noise between the LTC5508 and LMV321 chips from the +5v supply.

CONSTRUCTION:

1. This Kit is for advanced constructors only that have some experience in using SMD components. This Kit may be a challenge for some due to a number of very small components that need to be soldered onto the board. To make construction easier, the PC Board supplied is a professionally made plated through hole board with solder mask. Plated through holes, (Vias) are used for effective grounding to the bottom of the PC board. To assist construction please refer to the PC board overlay diagram.

2. If you are constructing the Power Head for reading a DC analogue output only on a multimeter, then the PIC12F675 and IC socket are not required, so can be left off the board. There are four resistors that should not be fitted to the bottom side of the board, and a wire link that needs to be

added on the top side of the board. **Please refer to the PC board overlay diagram.**

3. Follow the PCB overlay diagram and circuit carefully, by checking the components and placing them onto the board. Most components are SMD types, ensuring that mistakes cannot easily be made with poor RF construction techniques. All components except a small number are mounted on the top side of the board. The small SMD components should be mounted first, followed by the larger types. To solder in the chip capacitors and resistors, a pair of tweezers are used to hold them in place, soldering one side first then the other side.

4. The LTC5508 comes pre-soldered to the board. When soldering in the 78L05, you need to first identify Pin 1 on the chips. The 78L05 has either a small indent mark, or has a printed stripe on the Pin 1/8 end of the component. Refer to the PCB overlay diagram for the component pin outs, and fit them with the writing on the components the same orientation as the PCB overlay diagram.

5. The PIC12F675 is preprogrammed, and an 8 pin IC socket is supplied to make removal easy, should it ever need to be reprogrammed.

HARDWARE:

1. The power head should be mounted inside an enclosure to protect the circuitry from stray RF and noise. Any noise will decrease the dynamic range of the LTC5508 with low level signals. It is recommended that the power head is mounted inside something like a Hammond 1590 diecast enclosure, or you could construct a more professional looking enclosure using a length of copper tube and end caps.

2. The board has been designed to use a SMA female soldered directly to the RF input of the board. If the board is mounted into an enclosure, then it is suggested to use the SMA39 female with a washer and nut to secure it. For the best impedance matching over a wide frequency range, only flange mount SMA connectors should be used.

3. If you are mounting the power head into an enclosure, then small 4 pin mini XLR, or microphone connectors could be used on the enclosure, for easy changing of different Power Heads. Shielded multi conductor alarm or data cable could be used to connect the I2C bus and power connections. Alternatively you may want to keep the costs down, and just use 4 way ribbon cable directly on the output of the board to the DDS VFO. I found very little radiation of the I2C clock and data from the ribbon cable, so it seems suitable for short up to 1 metre lengths.

TESTING:

1. Testing of the board should always be done using a current regulated power supply set at very low current. Connect +12vdc to the board and check that it draws less than 35mA. **Noise on the +12vdc supply can cause interference to the circuitry resulting in errors with power meter readings, so only clean non switch mode power supplies should be used.**

2. If you are using the power head on the DDS VFO Kit, unfortunately the EME170 control board connector A4 only has +5vdc and not +12vdc available on the connector. Either the track could be cut to the A4 pin 1 connection, and +12vdc connected from A2 pin 2 to A4 pin1, or connect the power head board directly to A2 pin2.

3. Using a current regulated +12vdc power supply, connect power to the DDS VFO KIT and confirm that the LCD shows **PowerMtr v1.00** briefly on the display. This confirms that the Power Head has been detected by the Sweep software, and has an I2C bus connection. Soon after the display will show VFO frequency, and at the top right hand side of the LCD the power being read by the power head is displayed.

CALIBRATION:

Refer to the Readme Sweep Kit PDF document on the Kit webpage for the Calibration procedure for the power head.

1. The calibration is much easier if you have access to a calibrated RF signal generator, and or calibrated RF Power Meter. Alternatively you could use a known signal source, and quality attenuators to calibrate the power head. The pre programmed PIC12F675 supplied with the Kit has 5 sets of power settings that have been made at 0.5, 1.2, 2.4, 3.4, and 5.7GHz, but Its up to you where you want to calibrate the meter, and it is even possible to set power readings at 10GHz that can be programmed into one of the 5 memories. As the LTC5508 is not very linear, most readings at all frequencies and power levels, will not be accurate and will require calibration.

NOTES: Chip components crack easily so if you have problems getting the kit going properly, check for broken chip capacitors throughout the signal paths, or poor solder joints. The basic operation of the power head through to the PIC12F657 A-D input can be checked using a multimeter on the TP, (Test Point) connection on the board.

LTC5508 POWER HEAD KIT

Rev2

PARTS LIST

RESISTORS

1 x 51R	SMD 1206 Resistor
2 x 22R	SMD 0805 Resistor
2 x 100R	SMD 0805 Resistor
2 x 4K7	SMD 0805 Resistor
4 x 10K	SMD 0805 Resistor

CAPACITORS

2 x 10pF	SMD 0805 Capacitor **(1 spare)**
2 x 100pF	SMD 0805 Capacitor **(1 spare)**
9 x 0.1uF	SMD 0805 Capacitor **(1 spare)**
2 x 10uF	SMD Tant Capacitor 20 to 25v

SEMICONDUCTORS

1 x 78L05	SMD Regulator +5 volt
1 x LTC5508	SMD RF Detector
1 x LMV321M5	SMD O/P Amplifier
1 x PIC12F675-I/P	8 Pin DIP PIC Microprocessor

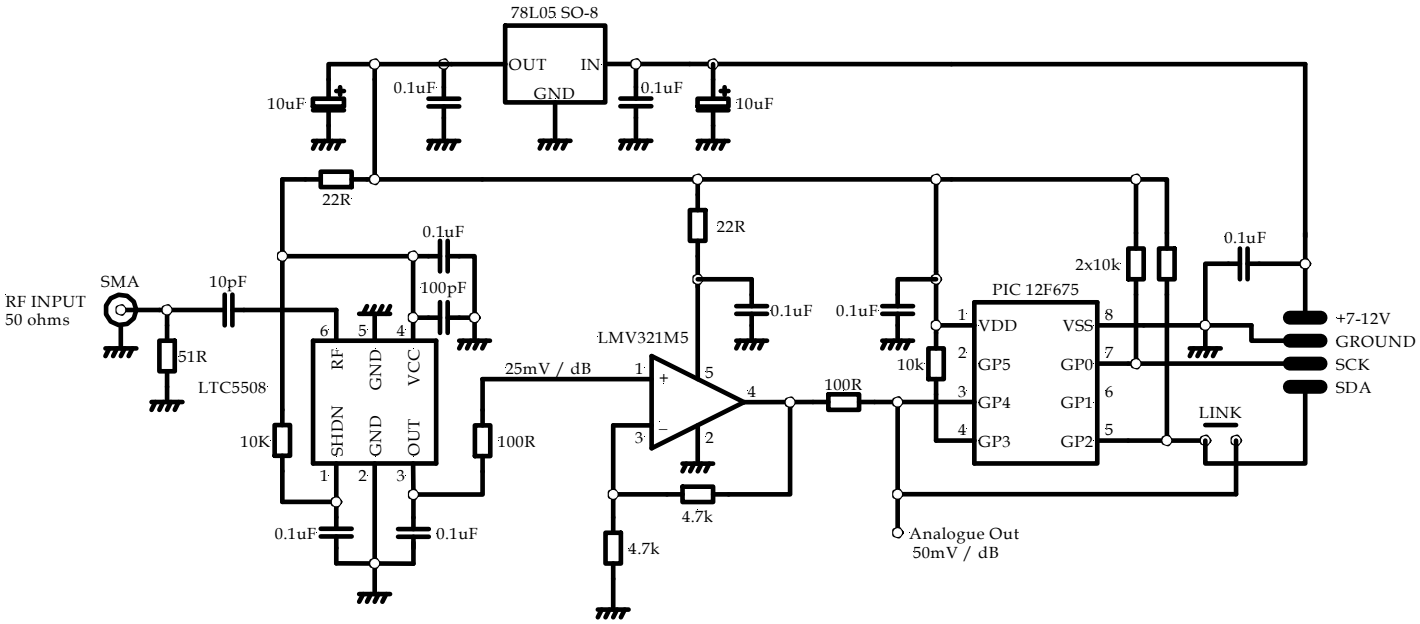
MISCELLANEOUS

1 x PC Board	EME151
1 x Instructions	EME151-7G KIT
1 x ICS8	8 Pin machined IC socket

OPTIONAL

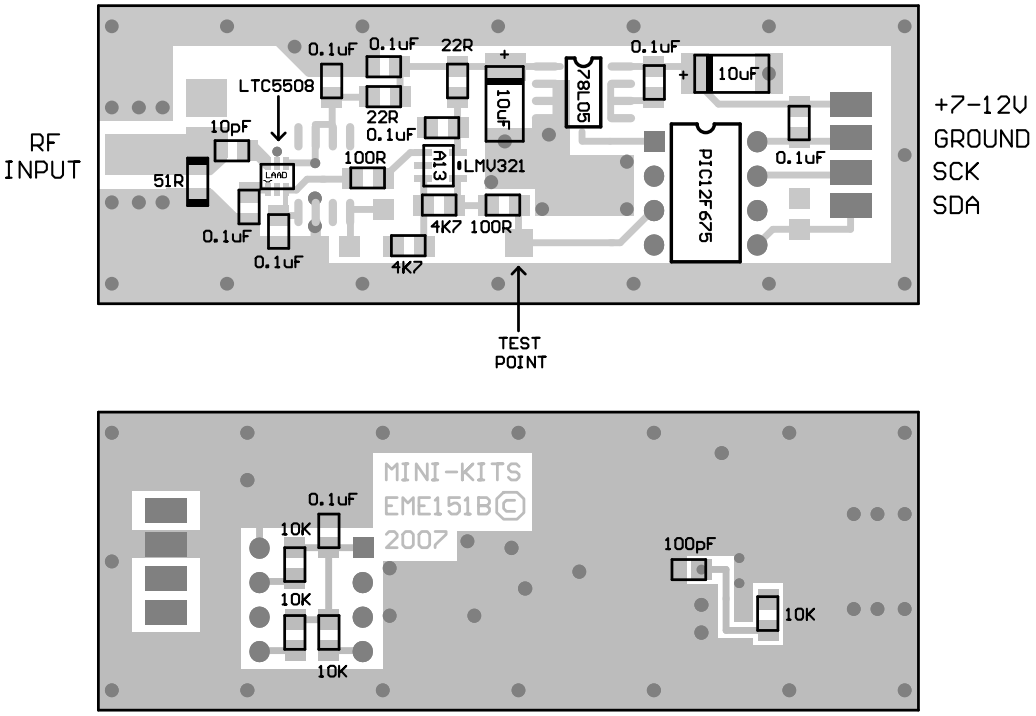
1 x SMA39	SMA Female PCB Mount
1 x ENCL01	Hammond 1590A Diecast Enclosure

For Kit support please see the www.minikits.com.au/eme151.htm and www.minikits.com.au/sweep.htm web pages.

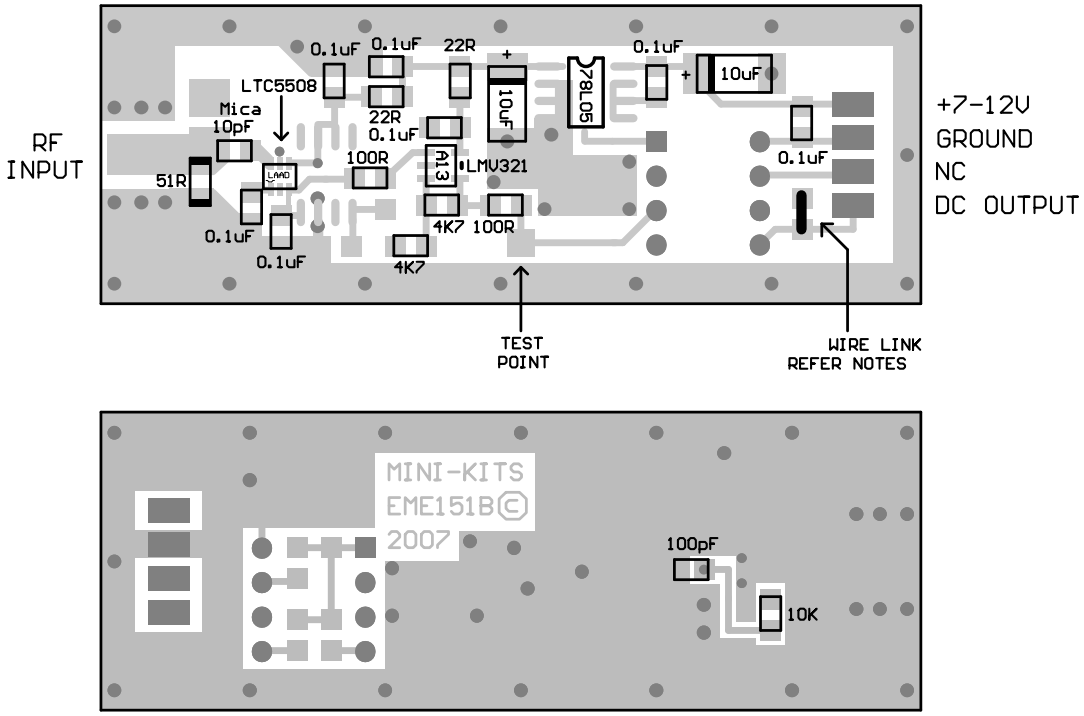


PC BOARD OVERLAY EME151-7G

PIC MICROCONTROLLER VERSION



ANALOGUE OUT VERSION



UPDATED 19/8/2015