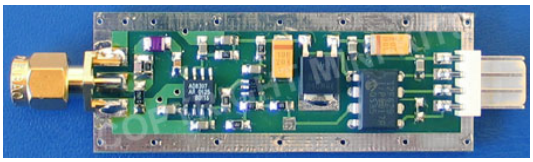
AD8307 POWER HEAD KIT

SPECIFICATIONS: EME151-500M

Frequency Range:	DC TO 500MHz AD8307
Dynamic Range:	-75 to +17dBm into 50ohms
Maximum Input:	+26.5dBm 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 @ 15mA)
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 Analogue Devices AD8307 logarithmic amplifier chip, that allows RF measurements up to around 500MHz. 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 AD8307. A simple input matching circuit is used on the input pin 8 of the AD8307 to match it to 50ohms. The 51ohm input resistor reduces the minimum sensitivity of the amplifier, but makes the power readings much more accurate with varying input impedance. The AD8307 produces 0.25vdc output from pin 4 with an input of –74dBm, and an output of 2.5vdc for an input of +16dBm, which equates to an output of 25mV per dB. This means that the maximum that can be read on the output pin 4, is 2.5vdc on a multimeter with +16dBm input. A LMV321 operational amplifier IC is used with a gain of 2 to increase the DC voltage output from the AD8307, to 5vdc with +16dBm 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 AD8307, requires a different calibration to be programmed for each power head. **Please refer to the AD8307 data sheet from Analogue Devices.** The AD8307 is quite linear but the slope of the dc output for RF input does vary with temperature, & with varying input signal levels. The Power Meter software allows for calibration of the slope, to make it linear between a 0dBm input & a –50dBm input. Once the slope is aligned, then there is a calibration offset, (intercept) to adjust the Power Meter reading to the what the power head is actually measuring. Up to 8 Power Meter memories P1 to P8, can be programmed for different frequency ranges, & are saved into the PIC12F675. This means that you can swap the power head to a different DDS VFO Kit, & 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 AD8307 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. When soldering in the AD8307 & 78L05 chips you need to first identify Pin 1 on each of the chips. The AD8307 has a small indent dot near Pin 1. 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, & 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 AD8307 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, & or calibrated RF Power Meter. Alternatively you could use a known signal source, & quality attenuators to calibrate the power head. The pre-programmed PIC12F675 supplied in the Kit has settings from a calibrated prototype power head at 10MHz. No settings for other frequencies have been pre-programmed into the microcontroller. The calibration at 10MHz should be very close, but will differ due to component tolerances at other frequencies. The measured power at low RF levels will also be inaccurate until the slope is calibrated due to tolerances between the AD8307 chips.

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.

PARTS LIST

RESISTORS

1 x 51R	SMD 1206 Resistor
2 x 22R	SMD 0805 Resistor
2 x 100R	SMD 0805 Resistor
1 x 470R	SMD 0805 Resistor
2 x 4K7	SMD 0805 Resistor
3 x 10K	SMD 0805 Resistor

CAPACITORS

2 x 15pF	SMD 0805 Capacitor **(1 spare)**
2 x 10nF	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 AD8307	SMD RF Detector
1 x LMV321M5	SMD O/P Amplifier
1 x PIC12F675-I/P	8 Pin DIP PIC Microprocessor

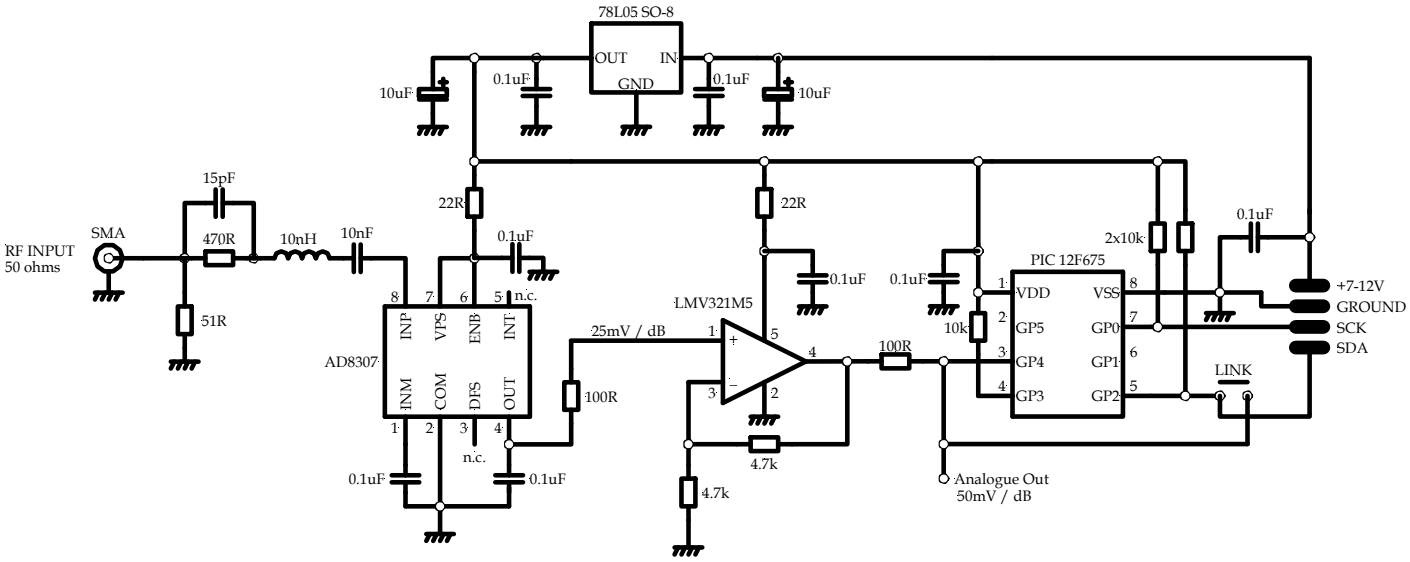
MISCELLANEOUS

1 x PC Board	EME151
1 x Instructions	EME151-500M-Rev2
1 x ICS8	8 Pin machined IC socket

OPTIONAL

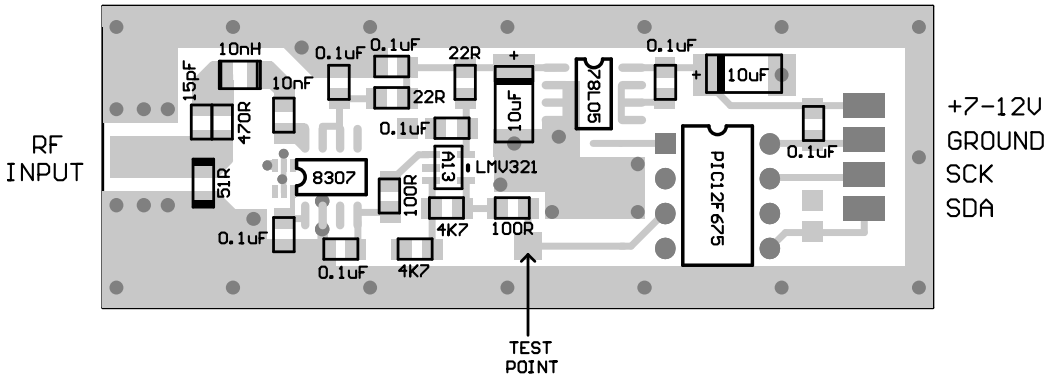
1 x SMA39	SMA Female PCB Mount
1 x ENCL01	Hammond 1590A Diecast Enclosure

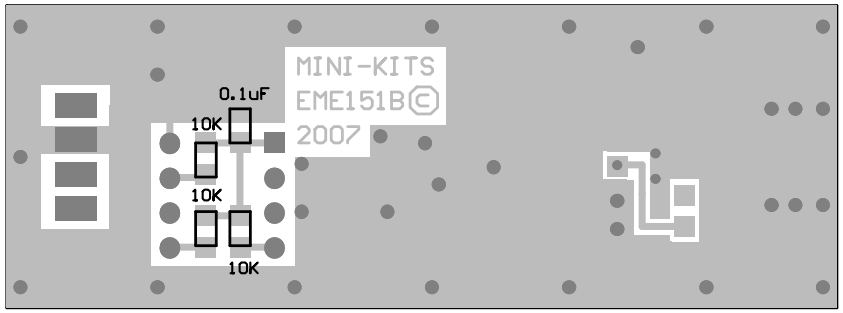
For Kit support please see the www.minikits.com.au/eme151.htm and www.minikits.com.au/sweep.htm web pages.



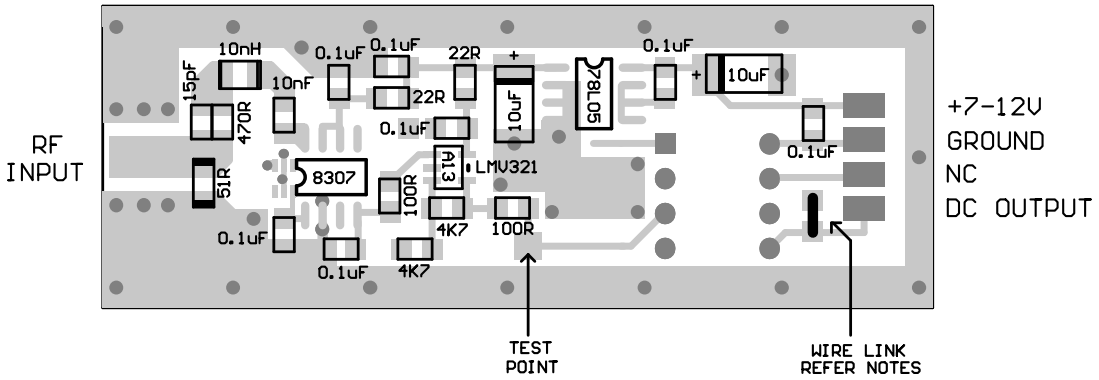
PC BOARD OVERLAY EME151-500M

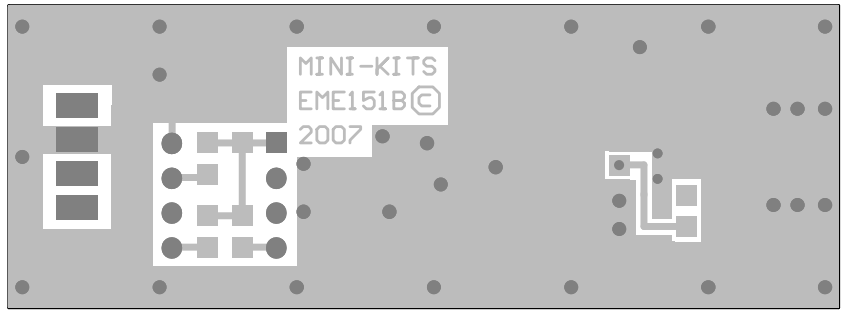
PIC MICROCONTROLLER VERSION





ANALOGUE OUT VERSION





UPDATED 28/10/15