

SPECIFICATIONS:	Output Frequency	1/2" Pipecap 10GHz, (Approx 9.5 To 13GHz) 3/4" Pipecap 5GHz (Approx 4 To 7GHz)
	Input Frequency	1100 To 1300MHz 0 to +10dBm
	Spurious Output	Refer to www.minikits.com.au/eme107.htm
	Output Power	10GHz > +3 to +7dBm (Depends On Input Drive & Construction)
	Power Supply	10GHz +9Volts 190mA

DESCRIPTION & FEATURES: The complete Multiplier is built on a single 80 x 65mm size PC board & takes around 1.5 Hours to construct. The Multiplier has been designed as an add on module for the 1250MHz FM ATV Transmitter Kit, as a low cost way of building a transmitter for 10GHz. Alternatively the Multiplier can be modified to produce a 5GHz output by changing the output Pipecap for a 3/4" one, & omitting the second ERA3 Amplifier. Refer to the circuit diagram. An example is described of how to produce a 10350MHz output from a 1293.75MHz input. An ERA3 amplifier was chosen as it makes a very effective frequency multiplier up into the GHz region. For good harmonic output, the optimum drive to the Input ERA3 is around 0 to +3dBm @ 1293.75MHz. The fourth harmonic at 5175MHz along with other harmonic outputs, is effectively filtered by a 3/4" Pipecap tuned to 5175MHz. This then drives another ERA3 followed by an NLB310 to produce a second Harmonic of 5175MHz at 10350MHz. The 10350MHz along with other higher frequency harmonic outputs, is effectively filtered by a 1/2" Pipecap tuned to 10350MHz. The 10350MHz signal is then amplified by an NLB310 to approximately > +7dBm, output suitable to directly feed an Antenna or to drive a Power Amplifier.

CONSTRUCTION:

1. The PCB supplied is a professionally made plated through hole board & requires no drilling of holes for components, which saves considerable time with construction. A good quality RF connector is required on the output of the Multiplier to minimize any loss. The input connection can be connected directly with mini 50ohm Teflon coax to save cost. I used **SMA09** connectors with the 4 legs cut off on both input & output & soldered them directly to the Tinline, or Brass to make it easier for testing. A Feedthrough capacitor was fitted close to one of the +9volt power connections on the board.
2. The first part of construction is to solder 3/4" wide thin Tinline or Brass strip around the PC board to form the sides of a box. This minimizes flexing of the PC board, & also allows connectors to be easily soldered to the board. **It is suggested that you look at the images of the prototype on the Mini-Kits web site (www.minikits.com.au/eme107.htm), to give an idea on how to do this.**
3. Next drill any holes for mounting of the SMA connectors & feedthrough capacitor starting with a small 1mm drill bit & working up in size. Try to mark the holes for the SMA sockets pin so that pin will sit just above the PCB stripline. This will avoid any damage to the stripline when drilling through the box. **Be very careful here as drill bits tend to grab & can cause the tinline or brass to grab which can cut fingers etc. I recommend either a small vice to hold the work, or if you don't have a drill press then use a canvas glove to hold the work flat on the edge of a bench.** The drill press can also be manually rotated with larger drill bits to avoid any accidents.
4. Next fit the 4 PCB Pins used as probes for the Pipecap Filters, (**Groundplane side of the board**) make sure that the Pins are a tight fit before soldering into place on the track side. The distance between the holes for the 5GHz filter is 12.5mm, while the 10GHz filter is 7.94mm. Cut the 4 pins on the track side of the board just above where the pins are soldered. Check to make sure that the PCB pins do not short out on the groundplane side of the board. Next using sharp sidecutters & a vernier caliper, cut all the Filter Pins on the groundplane side of the board to a length of 6.35mm being careful not to cut them

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too short. A fine file may have to be used once the length is close. For narrower band applications refer to Kent Britains article on Cheap Microwave Pipecap filters.

5. Check each of the Pipecaps outer rim edges & make sure that they are reasonably flat. Use a belt sander or similar to get them flat & then file the inner & outer edges to make them smooth. Sanding a mm or so from the pipecap lengths to make them flat, will not affect the performance. (**Make sure that the 4 Filter Pins are vertical before fitting the Pipecaps**). The Pipecaps can now be fitted. The board has 3 extra single pad location points for each Pipecap filter. Extra PCB Pins have been supplied to fit into these holes from the track side of the board to allow the Pipecaps to be easily centered over the correct location on the board. Next make sure that the bottom edge of the Pipecaps are clean for easy soldering, & place one of the pipecaps on to the board using the PCB locating pins, & using a 50Watt or higher iron with a large tip, heat the pipecap & run solder around the outside soldering it to the board. Be careful not to move the pipecap when soldering it into place. **The Pipecaps can be preheated on a hotplate before placing onto the board. Be Careful That You Don't Burn Yourself On The Pipecaps when Soldering.**

6. Before fitting the ERA & NLB amplifiers, carefully check the mounting holes in the board for any copper that may still be around the holes which could cause shorted connections. Use a sharp scapel cut away any copper that may still be present. When soldering in the ERA & NLB amplifiers, identify the input connection, beveled lead NLB-310 & (white dot & beveled lead ERA-3) & fit the amplifiers in the mounting holes & solder the leads into place.

7. Mount 4 x PCB pins to the +9volt connections on the board (**Groundplane Side**), & then wire them all together on the groundplane side of the board using hookup wire, & then connect to the feedthrough capacitor for the +9Volt connection. Solder the 10uF EXR capacitor +ve to the feedthrough capacitor & the -ve to the PCB groundplane.

8. Follow the PCB overlay diagram and circuit carefully, by checking the components and placing them onto the PCB. Most components are mounted on the track side of the PC board. To solder in the chip capacitor & resistors, a pair of tweezers are used to hold them in place, soldering one side first then the other side.

9. For better powersupply decoupling, two bias resistors have been used in series for each device. A 27R SMD type has been used on all ERA & NLB amplifiers on the track side of the board, while the other resistor is dependant on the devices current requirement. The bias resistors for the ERA, NLB amplifiers have been selected for a +9volt rail only. If you decide to either use the Multiplier on 13.8Volts or a lower voltage, then you will have to recalculate the resistor values to suit. **The voltages for the ERA devices are quite critical when using them as multipliers & amplifiers. The output Spectrum & level will change dramatically either side of the nominal 9Volts used.**

TUNE UP:

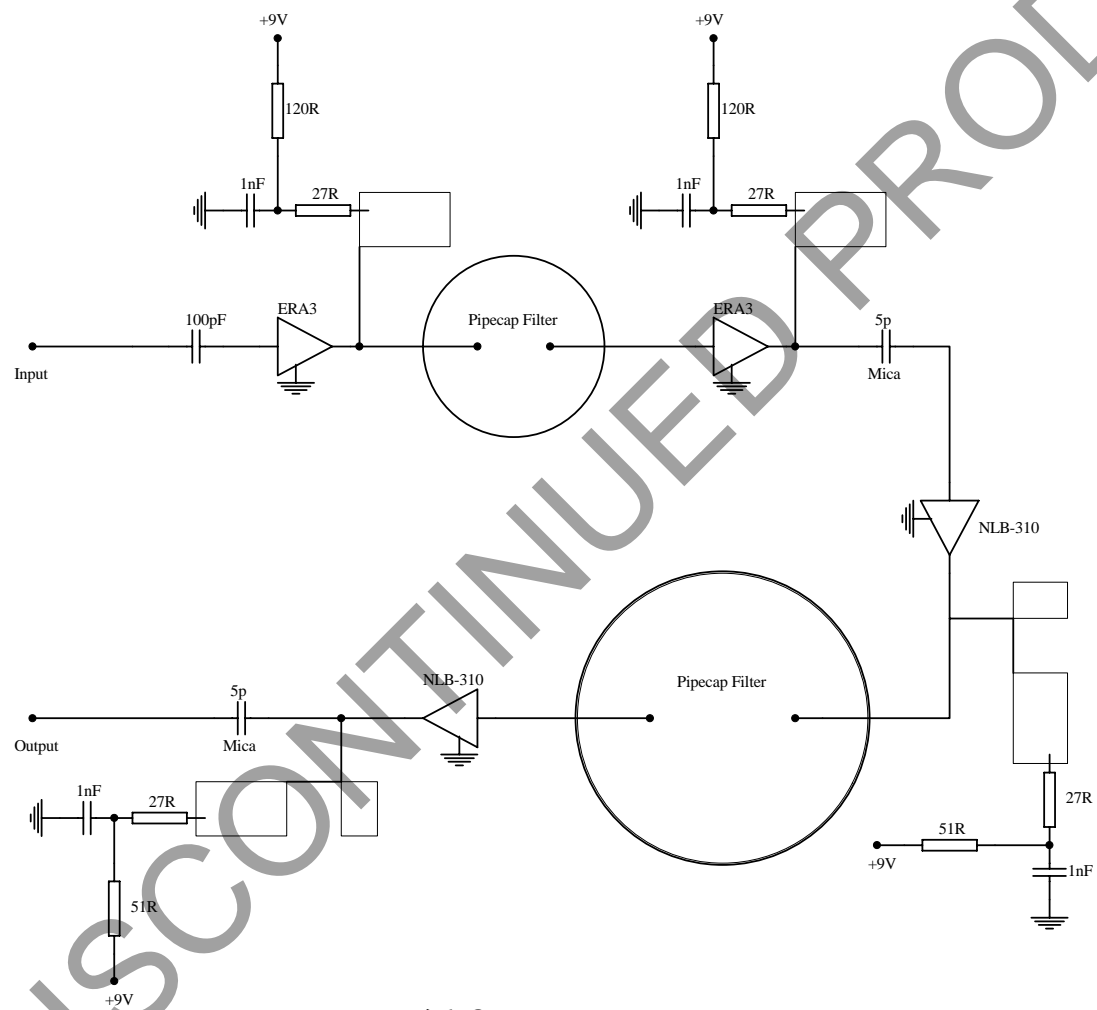
Is difficult unless you have access to a Spectrum Analyser. Initial positions of the two tuning screws are as follows. For the 5GHz filter the distance from the top of the pipecap to the bottom of the head of the bolt is 8mm. For the 10GHz filter the distance is 6.5mm. **This will only be the case when using the supplied pipecaps & tuning screws.**

1. Connect a suitable 10GHz Power Meter or Spectrum Analyzer to the output connection & apply a 1200MHz signal to the input. Adjust each tuning screw to peak the output & lock into place with the lock nut. Some readjustment will be required due to the lock nuts shifting the screw positions when tightened. Around 10mW output should be available at 10GHz when adjusted correctly.

MULTIPLIER OPTIONS:

1. The Multiplier can be used as a 5GHz output by installing a 3/4" pipecap in place of the 1/2" one, & omitting the second ERA3 amplifier. >15mW output should be possible at 5GHz. A pad is already on the stripline to mount a PCB Pin for the

DISCONTINUED PRODUCT



5/10GHz MULTIPLIER

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filter probe for 5GHz. The Pins are cut to the same length as the first 5GHz filter. The extra length of stripline from where a 10GHz filter Pin is normally connected to the 5GHz Pin position can be cut with a Scalpel & removed from the board. There is no Pipecap location pads to help with alignment of a second 3/4 " Pipecap, so it may be useful to use a compass to mark a faint circle on the board. 0.9mm holes could then be drilled to mount 3 PCB Pins to hold the Pipecap in place or alternatively it could be clamped in place. The PCB will have to be modified by cutting across the corner of the two 10GHz Stubs in the RF decoupling network (NLB Amplifiers) to disconnect them & make the 5GHz stubs active. Solder a small length of tinned wire across to connect the stielines where the second ERA3 is not required.

2. The Multiplier has not been tested with other input frequencies, but experience shows that it will work as a x10 Multiplier with possibly lower output on 5GHz. A practical example is Paul Wade, N1BWTs 5760MHz Transverter that Multiplies from 500 odd MHz up to 5GHz for a local oscillator.

3. A 9 Volt Regulator like the 7809T or LM2940CT-9 along with decoupling capacitors can be mounted on the groundplane side of the multiplier if required.

NOTE:

1. Chip components crack easily so if you have problems getting the kit going properly, check for broken chip caps throughout the signal path.

PARTS LIST:

RESISTORS

4 x 27R SMD 1206 Resistor
2 x 51R SMD 1206 Resistor
2 x 120R SMD 1206 Resistor

CAPACITORS

1 x 100pF SMD 0805 Chip Capacitor
2 x 5pF Mica RF SMD 0805 Chip Capacitor
4 x 1nF SMD 0805 Chip Capacitor
1 x 1nF Feedthrough Capacitor
1 x 10uF EXR Electro Capacitor

For Technical Support www.minikits.com.au

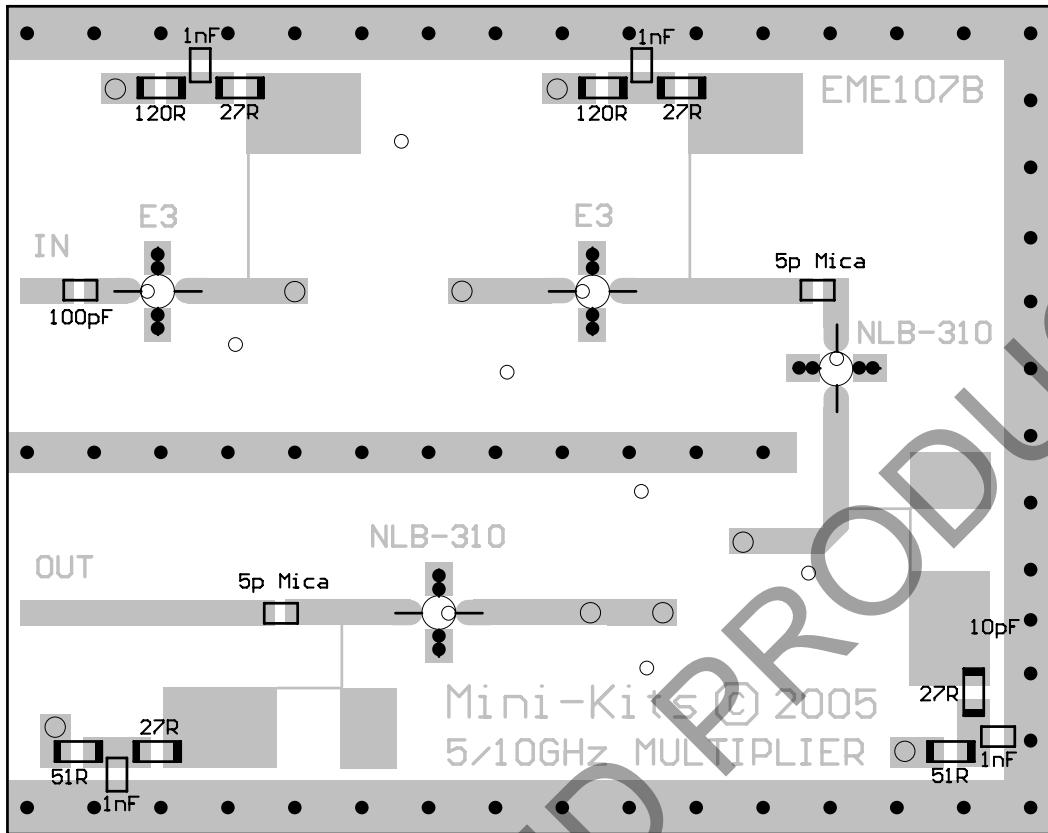
SEMICONDUCTORS

2 x NLB-310 RFMD Amplifier
1 x ERA3 Mini-Circuits Amplifier (5GHz)
2 x ERA3 Mini-Circuits Amplifier (10GHz)

MISCELLANEOUS

1 x PC Board EME107B
1 x Instructions EME107B
15 x PCB Pins Vero 0.9mm
1 x Bolt M4 x 12mm Plated Brass (1/2")
1 x Bolt M4 x 20mm Plated Brass (3/4")
2 x Nut M4 Brass
1 x Pipecap 1/2"
1 x Pipecap 3/4"

TRACK SIDE OVERLAY



GROUNDPLANE SIDE OVERLAY

