EME102B 5400-6100MHz RX CONVERTER

SPECIFICATIONS:	Bandwidth	5400 – 6100MHz +/- 3dB
	Gain	35dB Total MGA86576 / ERA-1 / MAR1
	Noise Figure	<2.5dB (Typically 1.8dB)
	Local Oscillator	Frequency Range Variable around 4700MHz (2350MHz x2)
	I/F Output	Typically 1100MHz Output for 5800MHz RX
	Power	12 – 18volts 180mA

DESCRIPTION & FEATURES: The complete receive converter is built on a single 55 x 78mm size PC Board & takes around 4 to 5 hours to build & test. The converter is a broadband NO-Tune design using hairpin filters that cover 5400 to 6100MHz, & uses surface mount 50ohm Amplifiers mounted on 50ohm striplines for the RF signal paths for consistency in performance, & to ensure that construction errors are kept to a minimum due to the different construction techniques used from one constructor to the next. The converter has 35dB gain & a 2.5db noise figure, & the I/F output frequency is 1000-1100MHz, and can be connected directly to the input of a Analogue Satellite Receiver. **The I/F output can be varied either way by adjusting the Local Oscillator frequency which is variable, so that local interference close to the I/F can be avoided.** The Receive Converter uses a Mini-Circuits MBA591 Mixer, & SMD Component local oscillator & multiplier.

RECEIVE SECTION: Refer to the circuit diagram. The RF input amplifier stage consists of single MGA86576 HP GaAs MMIC amplifier providing around +23dB gain & a <2.5dB noise figure at 5800MHz. Bias for the GaAs MMIC amplifier is via a 82ohm resistor from the 8volt regulator. The MGA86576 has an internal self bias network so the bias resistors value is not too critical. The RF input stripline filter has a 700MHz -3dB bandwidth from 5400 to 6100MHz with approximately –3dB loss. The signal is further amplified +11dB by a ERA1 amplifier to the input of the MBA591 mixer. The MBA591 7GHz mixer is useful to a maximum IF output of 1000MHz, so only IF's below 1000MHz are recommended for best performance.

LOCAL OSCILLATOR & PLL: The oscillator uses a tiny SMD Maxim MAX2753 VCO, (Voltage Controlled Oscillator) IC. The IC has an internal oscillator tuned circuit & varicap diode that can produce an output between 2100 & 2600MHz. The MAX2753 VCO is locked by a MC12179 PLL to 2350MHz, & produces around –8dBm output which drives an ERA3 amplifier that produces a harmonic output. A ERA3 amplifier was chosen as it makes a very effective frequency multiplier up into the GHz region. The 2nd harmonic at 4700MHz is filtered by a 3 section stripline filter to drive a ERA1 amplifier. The 4700MHz signal is then amplified +12dB by a ERA1 amplifier, & produces +7 to +10dBm suitable to drive the MBA591 mixer. Alternatively an optional MC12179 PLL & crystal can be added to lock the oscillator for high stability applications. The MC12179 is a complete single frequency div by 256 PLL with internal oscillator & charge pump cct. For a required VCO frequency of 2350MHz, a 9.17969MHzMHz crystal, (2350 div 256) is required as a reference for the MC12179. A portion of the 2350MHz output from the ERA3 Multiplier is fed back into pin4 of the MC12179 phase comparator.

I/F SECTION: The Mini-Circuits MBA591 7GHz mixer has a in-circuit loss of around –8dB, & is usable up to a maximum of 1000MHz I/F output. The MBA591 was used as it is low cost compared with mixers with higher I/F's greater than 1000MHz like the SKY60. Most Satellite receivers have a minimum lower frequency of 950MHz, so a I/F output frequency of between 950 – 1000MHz can only be used. The I/F output from the mixer is amplified by around +14dB by the MAR1, & passes to the I/F output connection.

CONSTRUCTION:

1. This Kit uses a Teflon PC board that can be difficult to work with, so care must be taken when drilling any holes in the board. Blunt drill bits seem to be the best if done by hand. A power drill or press should never be used as it will tend to rip the board.

2. The first part of construction is to carefully round the edges of the board with a sharp knife, & fabricate some thin 25mm wide brass strip around the outside of the board to form a box. Mark & bend the brass until it fits correctly. Next using a ruler to check the height of the board, tack solder the board to the brass strip. When you are happy with it, solder it all the way around on both sides. Next drill holes in the brass to mount suitable connectors for the Antenna & I/F output connections. Only an SMA connector is recommended for the Antenna connection. **Be careful here as the drill can tend to grab on the**

brass & could cause a serious injury. Make sure that you clamp the assembly in a vice when drilling. For the output connector, an F connector socket is suggested as it will suit connection to RG6 cable for use with a Satellite Receiver.

3. The Circuit Board supplied is not a plated through hole board, so 0.7mm TCW links will have to be used to connect the top ground plane earth connections to the bottom groundplane side of the board. These holes are shown as black dots on the component overlay diagram.

4. Drill all holes for the ERA, MAR & MGA amplifiers. For the location of the hole for the ERA1 between the mixer & filter, refer to the component overlay diagram. Start with a small PCB drill & work your way up to a 2.5mm diameter bit. **Be very careful with the hole size for the MGA86576. If you drill it any larger than the components diameter, then you will have problems with its short earth legs & stability.** A slightly blunt bit is better as it doesn't tend to rip the board material. **All drilling should be done by hand, don't use electric drills etc unless you want to destroy the board.**

5. Follow the component overlay diagram and circuit carefully, by checking the components and placing them onto the board. All components except the 7808T, & MMIC amplifiers, are mounted on the top track side of the board. Most components are SMD, which makes it easy to build the downconverter without having to make sure that leads on components are kept short as with conventional components. **The ATC chip capacitors should be mounted with the writing on the side, not the top.** It is best to build the kit in stages starting with the smallest components, followed by the larger ones. To solder in the chip resistors & capacitors, a pair of tweezers are used to hold the component in place, soldering one side first then the other side. **A fine solder like 0.45mm to a maximum of 0.7mm should be used to solder the components into place. Don't use too much solder on the ends of the surface mount components as this can cause extra mechanical stress.**

6. Before soldering in the MMIC amplifiers, use a sharp scalpel to scrape around the edges of the drilled mounting holes on the track side of the board to clear away any copper that may still be present from drilling. The copper will also have to be cut away on the bottom groundplane side of the holes using a sharp scalpel, where the input & output leads of the MMIC amplifiers go. When soldering in the MMIC amplifiers, the in & output connections are bent up 90 degrees, & passed up through the mounting hole from the bottom groundplane side of the board, & bent out on the other side, & soldered to the striplines. The input & output legs can be left long, but the earth legs must be kept as short & direct to the groundplane as possible for stability. **This is especially important with the MGA86576 as it has very short leads which makes it very difficult to mount.** Make sure that you put the amplifiers in the right way around, MAR devices have a painted dot near the input lead. The MGA86576 has a black dot near the input lead**. The MGA86576 needs to be mounted from the groundplane side of the board with the ground leads soldered directly to the groundplane.**

7. Mount the 7808T regulator on the grounplane side of the board. Refer to the correct polarity as shown in the component overlay diagram. **Remember to solder the center pin to the groundplane for earthing.** Depending on the voltage level that is input to the converter, will depend on whether the regulator may need some form of heatsinking. In most cases the metal tab of the regulator can just be soldered to the copper groundplane.

8. Connect a short lengths of insulated hook up wire on the groundplane side of the PCB, to connect points A to A as indicated on the component overlay diagram.

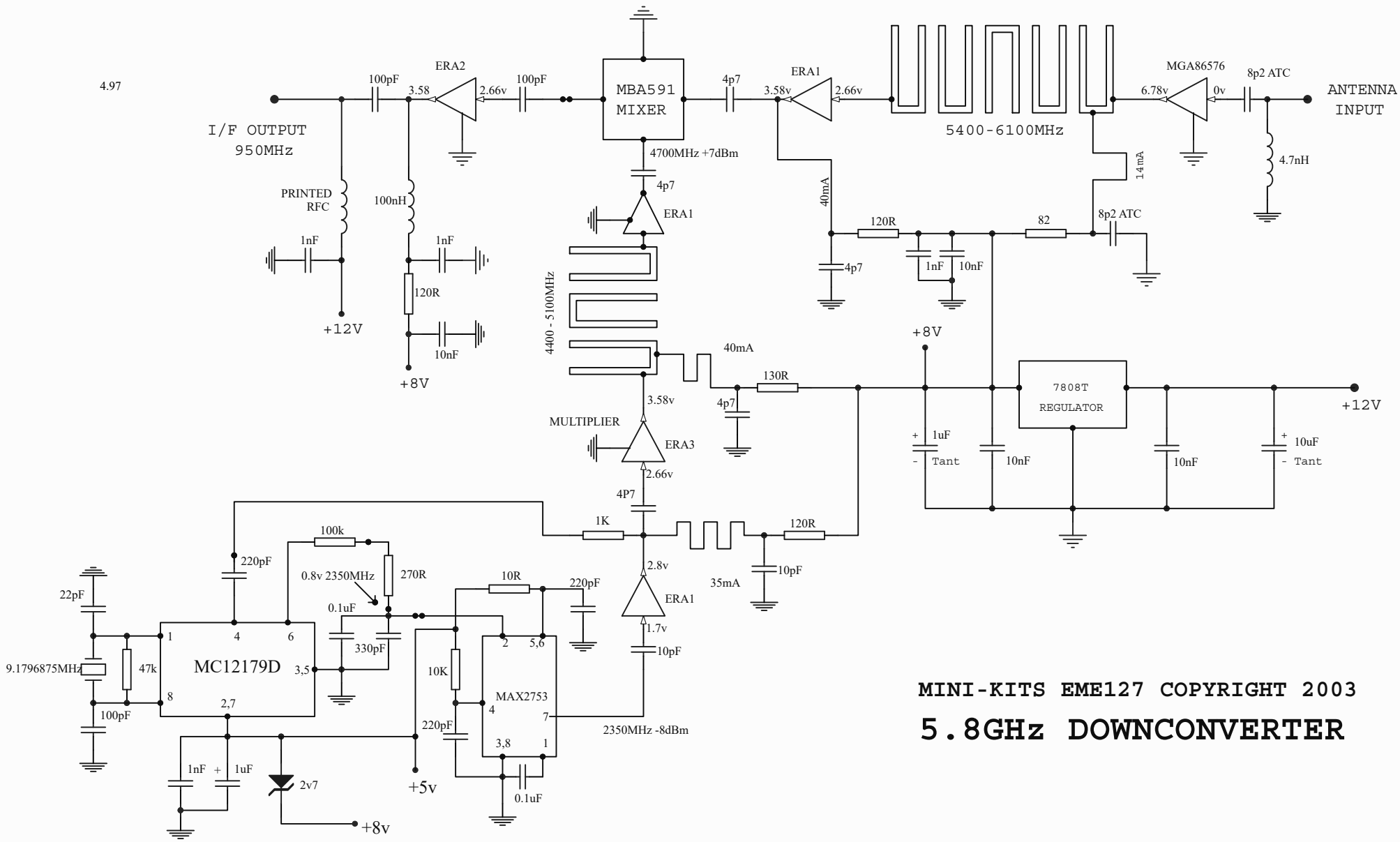
9. If the downconverter is to be powered via the coaxial cable to the I/F output connector, then a printed 1/4 wave RF decoupling Choke is etched on the PC board output as shown on the PC board overlay diagram. If the downconverter is to be powered by a separate supply, then a suitable feedthrough capacitor should be mounted on the brass box for the power connection, & the RF decoupling choke should be cut near the IF output stripling & then connected with a short length of hookup wire to the feedthrough capacitor instead of the I/F output stripline.

TUNE UP:

1. You should now be at a stage when you are ready to apply power to the downconverter. First check your construction carefully, & make sure that there are no shorts on the input & output connections of the 7808T regulator with respect to earth with a multimeter. **Also check that the regulators center pin is earthed to prevent overvoltage to the circuitry.** Apply power to the converter & check the voltages as shown on the circuit diagram**. Be careful not to short any connections on the MMIC amplifiers as it can destroy them.**

2. First check that the PLL is locked by measuring the voltage on pin2 of the MAX2753. The voltage should be around 0.7volts for a 2350MHz output.

3. Connect the downconverter to a suitable satellite receiver or module, & tune the Satellite receiver to 1100MHz. Check that the voltage from the Satellite receiver is present & around 12 to 14 volts. Attach a suitable 5800MHz antenna to the downconverter & tune in a 5800MHz signal. Some slight adjustment of the Satellites receivers IF may be required.


4.97
I/F OUTPUT
950MHz
100pF
ERA2
3.58
2.66v
100pF
MBA591
MIXER
4p7
ERA1
3.58v
2.66v
5400-6100MHz
MGA86576
6.78v
0v
8p2 ATC
ANTENNA
INPUT
4.7nH
4700MHz +7dBm
4p7
ERA1
14mA
40mA
PRINTED
RFC
100nH
1nF
1nF
120R
10nF
+12V
+8V
4400 - 5100MHz
120R
82
8p2 ATC
4p7
1nF
10nF
+8V
40mA
130R
3.58v
4p7
MULTIPLIER
ERA3
2.66v
7808T
REGULATOR
+12V
+ 1uF
- Tant
10nF
10nF
+ 10uF
- Tant
4P7
1K
120R
100k
220pF
0.8v 2350MHz
270R
10R
220pF
2.8v
35mA
10pF
0.1uF
ERA1
1.7v
10pF
22pF
MC12179D
330pF
10K
MAX2753
9.1796875MHz
47k
100pF
220pF
2350MHz -8dBm
1nF
+
1uF
2v7
+5v
0.1uF
+8v
MINI-KITS EME127 COPYRIGHT 2003
5.8GHz DOWNCONVERTER

OPTIONS & OPTIMISATION:

1. If you have instability problems with the MGA86576, then a small piece of microwave absorb material can be added to the inside of the brass box near the antenna socket. This was found on two converters to be required when either a suitable antenna connector was not used, or it was poorly soldered to the PC board.

2. If you are going to use a Satellite receiver to directly power the downconverter via the cable, then check the LNB supply voltage from the Satellite receivers LNB connector before connecting to the downconverter. Some Satellite receivers allow the LNB voltage to be changed between 14 & 18 volts depending on whether Horizontal or Vertical polarization is selected. Use the 14volt position to reduce the heat sinking requirements of the 7808T regulator.

3. The downconverter requires no tuning of the bandpass filters as they have been modeled precisely to cover the frequency ranges advertised using the PCB material from our supplier. Any attempt to adjust the length of the filters printed lines will degrade the performance of the downconverter. If the PCB needs to be protected then clean the board with Alcohol, & spray on a clear PCB lacquer to protect the board. **The board should not be tinned with solder from a hot soldering iron as the heating process may burn the fiberglass dielectric & cause higher losses in the filters & 50ohm lines & degrade the performance of the converter.**

4. The 2.5dB noise figure of the downconverter is very good, & very little difference in picture noise level would be realized by going to <1dB or better with a preamplifier. Unlike lower frequencies, the downconverter can only be positioned at the antenna. For connection to a suitable dish feed, use only low loss flexable LDF450 or similar cable.

PARTS LIST:

RESISTORS

1 x 18R	SMD 1206 Resistor
1 x 47R	SMD 1206 Resistor
1 x 82R	SMD 1206 Resistor
1 x 100R	SMD 1206 Resistor
2 x 120R	SMD 1206 Resistor
1 x 130R	SMD 1206 Resistor
1 x 180R	SMD 1206 Resistor
2 x 330R	SMD 1206 Resistor
1 x 560R	SMD 1206 Resistor
1 x 1K	SMD 1206 Resistor
1 x 4K7	SMD 1206 Resistor
1 x 50kohm	SMD 10 Turn Trimpot

CAPACITORS

1 x 1pF	SMD 0805 Chip Resistor
2 x 4p7	SMD 0805 Chip Capacitor
5 x ATC8p2	SMD 50mil Chip Capacitor
1x 10pF	SMD 0805 Chip Capacitor
1 x 22pF	SMD 0805 Chip Capacitor
2x 100pF	SMD 0805 Chip Capacitor
4 x 1nF	SMD 0805 Chip Capacitor
4 x 10nF	SMD 0805 Chip Capacitor
1 x 3.3uF	SMD Tantalum Capacitor
1 x 10uF	SMD Tantalum Capacitor

SEMICONDUCTORS

1 x MGA86576	HP Amplifier
2 x ERA1	Mini-Circuits Amplifier
1 x ERA3	Mini-Circuits Amplifier
1 x MAR1	Mini-Circuits Amplifier
1 x MBA591	Mini-Circuits Mixer
1 x BFR93A	Transistor
1 x BB405B	Varicap Diode
1 x 7808T	Regulator

INDUCTORS

1 x 10nH	SMD Choke
1 x 1uH	SMD Choke
1 x 50mm length	0.4mm ECW for RFC1
1 x 50mm length	mini 50ohm coax

MISCELLANEOUS

1 x PC Board	EME102A
1 x Instructions	EME102A