SPECIFICATIONS:	Bandwidth	5450 – 5900MHz +/- 3dB
	Gain	>34dB 5450 – 5900MHz
	Noise Figure	<3.0dB (Typically 2.9dB @ 5750MHz)
	Local Oscillator	PLL VCO 4700MHz (2350MHz x2)
	I/F Output	950 – 1200MHz Output for 5650 – 5900MHz RX
	Power	12 – 18volts 230mA

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 5450 to 5900MHz. 50ohm striplines with Monolithic Amplifiers, (MMICs), & SMD components are used 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. A Mini-Circuits MBA591 Blue Cell Mixer has been used , as it is low cost & has good performance. The local oscillator uses a Phase Locked Loop (PLL) for minimal drift & requires no tuning. The converter has 34dB gain & a 2.9db noise figure, & the I/F output frequency is 950-1200MHz, and can be connected directly to the input of a Analogue Satellite Receiver.

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 450MHz -3dB bandwidth from 5450 to 5900MHz 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 has a loss of around 9dB & is specified as a 1000MHz maximum IF, but is used in this design up to 1200MHz without degradation. An ERA2 wideband IF amplifier follows the mixer with around 15dB gain. A 1/4 wave open stub made from 50ohm cable is used on the output of the mixer to attenuate the 4700MHz local oscillator signal from being amplified in the ERA2 & appearing on the IF output.

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 ERA1 amplifier to around +3dBm output. This level is then suitable to drive an ERA3 amplifier that is used as a frequency multiplier & produces a harmonic output. The 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. The MC12179 PLL IC is a complete single frequency divide by 256 PLL with an internal reference oscillator & charge pump cct. For the required VCO frequency of 2350MHz, a 9.17969MHz crystal, (2350 div 256) is required as a reference for the MC12179. A portion of the 2350MHz output from the ERA1 multiplier driver is fed back into pin 4 of the MC12179 phase comparator.

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 20mm, (3/4 ") wide brass strip around the outside of the board to form a box. Mark & bend the brass until it fits correctly, & solder

the joint to form a box. Next using a ruler, align the board to approximately half way down the inside of the brass strip box. Next mark the positions for holes that are required for the Antenna & IF output connectors. drill holes in the brass to mount suitable connectors for the Antenna & I/F output connectors. Only SMA connectors are recommended for the Antenna & IF output connections. A F type socket could be fitted on the IF output, but these are difficult to solder to the board. Use a ruler to mark the position of the holes in the brass to be 1mm above the top surface of the PC board. This will suit the small diameter of SMA connector pins. Start with a small 1mm drill bit & drill through the brass to mark the position of the holes. Next open the holes up with a 3mm diameter bit. **Be very careful here as the drill bits can tend to grab on the brass & could cause a serious injury. Make sure that you clamp the assembly in a vice when drilling.** Next align the board in the Brass box with the holes slightly above the top of the striplines. Check the height of the board with the ruler & tack solder the board to the inside of the brass box. When you are happy with it, solder it all the way around on both sides of the board. Fit the SMA connectors. The center pin of the connectors need to be shortened & filed to suit the striplines. Align the SMA connectors & solder the center pin to the stripline.

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

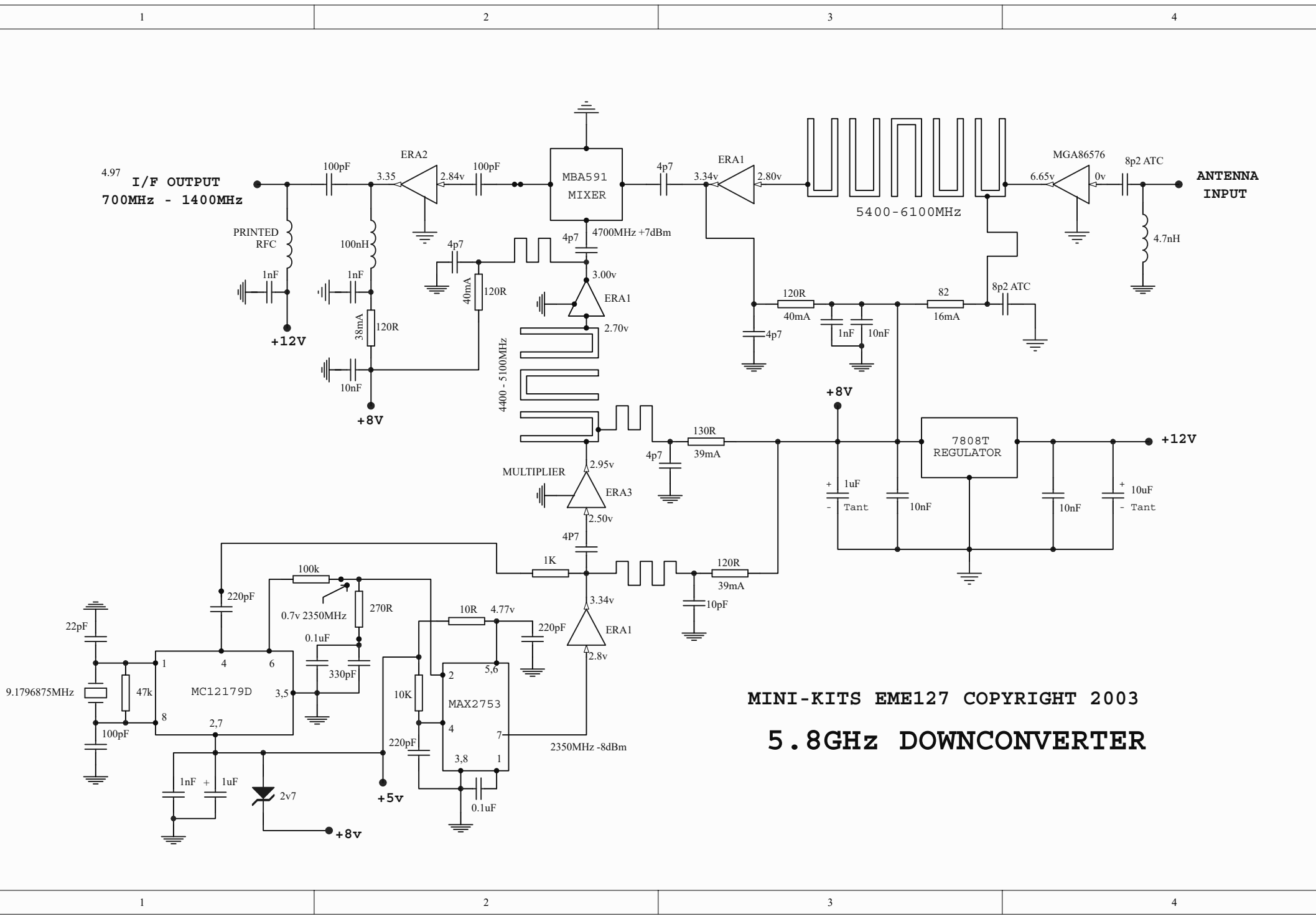
4. Drill all holes for the ERA & MGA amplifiers. Start with a small PCB drill & work your way up to a 2.5mm diameter bit. **Be very careful with the hole size for the MGA86576. If you drill it any larger than the components diameter, then you will have problems with its short leg connections & stability.** 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, Crystal, & 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 8.2pF 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, ERA devices have a faint 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 length 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.


4.97
I/F OUTPUT
700MHz - 1400MHz
100pF
ERA2
3.35
2.84v
100pF
MBA591
MIXER
4p7
ERA1
3.34v
2.80v
5400-6100MHz
MGA86576
6.65v
0v
8p2 ATC
ANTENNA
INPUT
4.7nH
PRINTED
RFC
1nF
+12V
100nH
1nF
38mA
120R
10nF
+8V
4p7
40mA
120R
4p7
4700MHz +7dBm
3.00v
ERA1
2.70v
4400 - 5100MHz
120R
40mA
1nF
10nF
82
16mA
8p2 ATC
4p7
+8V
130R
39mA
4p7
MULTIPLIER
2.95v
ERA3
2.50v
7808T
REGULATOR
+12V
+ 1uF
- Tant
10nF
10nF
+ 10uF
- Tant
4P7
1K
120R
39mA
10pF
100k
220pF
0.7v 2350MHz
270R
10R
4.77v
220pF
3.34v
ERA1
2.8v
22pF
0.1uF
330pF
1
4
6
9.1796875MHz
47k
MC12179D
3,5
8
2,7
100pF
10K
MAX2753
2
5,6
4
7
3,8
1
2350MHz -8dBm
220pF
1nF
+
1uF
2v7
+5v
0.1uF
+8v
MINI-KITS EME127 COPYRIGHT 2003
5.8GHz DOWNCONVERTER

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 1050MHz. 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 5750MHz signal. Some slight adjustment of the Satellites receivers IF frequency may be required.

4. Local oscillator rejection can be improved by fitting a 1/4 Wave open stub to the output of the mixer. **This is only an option & a Spectrum Analyser is required for this.** A short length of mini 50ohm coax has been supplied to make the stub. A small 0.7mm hole needs to be drilled though the output stipline from the mixers IF output. The coax is fitted from the groudplane side of the board with the center of the coax going through the hole & soldered to the stripline. The outer of the coax is soldered to the groudplane of the board**.** The output of he coax is open not shorted & is cut gradually with a sharp pair of sidecutters while monitoring the 2350MHz local oscillator breakthrough on the IF output with a Spectrum Analyser.

OPTIONS & NOTES:

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 should not be required if you have mounted the MGA device correctly as in the construction notes & used a SMA socket for the antenna connection.

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 2.9dB noise figure of the downconverter is extremely good at 5.8GHz, & 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. It is suggested that the downconverter be mounted in suitable sealed plastic box. Instability could

be a problem when using some dicast boxes due to waveguide effect within the box requiring microwave absorb material to absorb RF reflections.

5. For maximum noise figure performance from the downconverter, it needs to be connected directly to the antenna with a very short length of coaxial cable. An offset feed dish could be used with the downconverter being mounted out on the LNB mounting arm in a box. A suitable feed can then be constructed & connected with a short length of UT141, or Quick Form 141 cable to the converter. For a TX RX system including a downconverter, TX power amplifier & other circuitry, a SMA microwave relay would be used as an antenna changeover adding a slight loss to the noise figure. Due to the extra size of a TX RX system, it would probably have to be mounted under or behind the dish, so connection to the dish feed would then require low loss flexable LMR400 Ultraflex or similar cable.

PARTS LIST:

RESISTORS

1 x 10R	SMD 1206 Resistor
1 x 82R	SMD 1206 Resistor
4 x 120R	SMD 1206 Resistor
1 x 130R	SMD 1206 Resistor
1 x 270R	SMD 1206 Resistor
1 x 1K	SMD 1206 Resistor
1 x 10K	SMD 1206 Resistor
1 x 47K	SMD 1206 Resistor
1 x 100K	SMD 1206 Resistor

CAPACITORS

6 x 4p7	SMD 0805 Chip Capacitor
2 x ATC8p2	SMD 50mil Chip Capacitor
1x 10pF	SMD 0805 Chip Capacitor
1 x 22pF	SMD 0805 Chip Capacitor
3x 100pF	SMD 0805 Chip Capacitor
3 x 220pF	SMD 0805 Chip Capacitor
1 x 330pF	SMD 0805 or 1206 Chip Capacitor
4 x 1nF	SMD 0805 Chip Capacitor
4 x 10nF	SMD 0805 Chip Capacitor
2 x 0.1uF	SMD 0508 or 1206 Chip Capacitor
2 x 1uF	SMD Tantalum Capacitor
1 x 10uF	SMD Tantalum Capacitor

SEMICONDUCTORS

1 x 2v7 Zener	0805 SMD
1 x MGA86576	HP Amplifier
3 x ERA1	Mini-Circuits Amplifier
1 x ERA2	Mini-Circuits Amplifier
1 x ERA3	Mini-Circuits Amplifier
1 x MBA591	Mini-Circuits Mixer
1 x MC12179D	PLL IC
1 x MAX2753	2.4GHz VCO IC
1 x 7808T	Regulator

INDUCTORS

1 x 4.7nH	AVX 0805 Accu-L Series Choke
1 x 100nH	Choke SMD 0805
1 x 20mm length mini 50ohm coax	

MISCELLANEOUS

1 x 9.1796875MHz	HY-Q GJ05S Crystal
1 x PC Board	EME127
1 x Instructions	EME127

For Product Support www.minikits.com.au