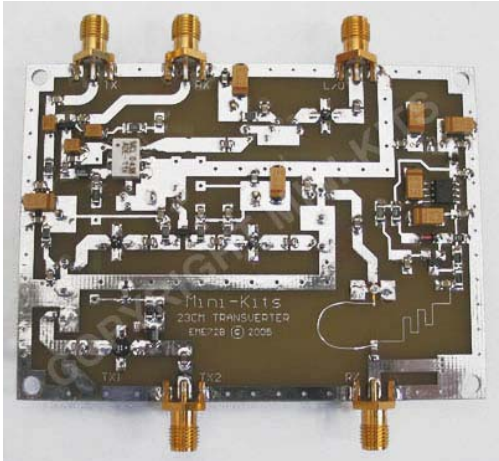
SPECIFICATIONS: EME72B-23CM KIT

Frequency Range:	1250 to 1305MHz (Helical Filters)
Bandwidth:	25MHz @ 1dB over the tuning range
RX Conversion Gain:	24dB +/- 2dB @ 1296MHz
RX Noise Figure:	<2dB (typically 1.5dB)
Local Oscillator Input:	+7dBm, (10mW) 576MHz (144MHz I/F)
TX RF Input Drive:	+0dBm (1mW) maximum 144MHz
TX RF Output:	+16.5dBm (45mW) with +0dBm input @ 144MHz.
Spurious Output:	564MHz –60dBm, 1152MHz -33.9dBm,
	2304MHz –43dBm, 2592MHz –15.27dBm
Power Supply	RX mode +12vdc @ 110mA)
	TX stages +12vdc @ 150mA
Size:	PC Board EME72B
Kit Webpage:	**www.minikits.com.au/kit-help**



DESCRIPTION: The complete Transverter is built on a single 70 x 95mm size PC Board, and should take around 4 hours to construct. A large number of surface mounted components have been used to make the Transverter compact in size, and predictable in performance. The Transverter uses pretuned Toko Helical filters which have a 1dB bandwidth of 25MHz which virtually makes the Transverter no-tune . The I/F that has been chosen for the Transverter is 144MHz, due to the performance requirements of L/O rejection, and the ready availability of transceivers and handhelds. The power and I/F switching of the Transverter is best controlled by a Transverter Sequencer e.g. EME66 Kit which will give the correct RF drive level on TX, and will allow other options to be added later, including preamplifiers or coaxial relays etc.

L/O MULTIPLIER: Refer to the circuit diagram. An ERA3 amplifier was chosen as it makes a very effective frequency multiplier up into the GHz region. The ERA3 is driven with 0 to +7dBm of 576MHz L/O, and produces a second harmonic of 1152MHz along with other higher frequency harmonic outputs. A Toko 1152MHz Helical filter is used to select the 1152MHz harmonic only, which is typically around +7 to +10dBm, which is input to the ADE11X mixers L/O input.

RF FRONT END and RECEIVE CONVERTER: Refer to the circuit diagram. The input stripline filter is a high pass from 1000MHz upwards and is incorporated to reject 432MHz Amateur and 900MHz Cellular signals. It is especially useful when also using equipment on the 432MHz band. The filter does not degrade the Noise Figure and provides a DC ground on the antenna input for static protection. The PC board has been designed to have a SMA connector soldered directly to the input of the preamplifier, and this is the only way that it should be done if you want to get the advertised noise figure and stability from the preamplifier. The device used in the front end is a NE3210S01 HJ FET with 17dB gain and is biased with a negative voltage on the gate lead. This allows the source leads to be directly connected to ground to make it stable and lower the noise figure. The input inductor L1 matches the 50ohm input to the GasFET to lower the noise figure and set the frequency range of the preamplifier. The inductor can be adjusted in length and height that it sits above the PC board to optimize for a low noise figure match in the frequency band required. The signal is then filtered by a Toko 1200MHz Helical filter which has a pass band of 25MHz wide @ -1dB, and a loss of around (-3.5dB). The filtered 1200MHz signal is then amplified around (20.5dB) by an ERA3 amplifier, and is then switched through a HSMP3824 PIN diode to another 1200MHz Helical filter, (-3.5dB). The 2nd filter further cleans up the 1200MHz signal before it passes through to the ADE11X mixers input. The ADE11X is a +7dBm double balanced mixer which has around 7dB conversion loss, and is a small surface mount package. The 1200MHz input and 1152MHz L/O signals are mixed by the ADE11X to produce a 144MHz output signal and mixing products. A simple 50ohm diplexer is used on the output of the mixer to provide a constant 50ohm load for all the frequencies produced by the mixing process. The 144MHz signal is then switched through a HSMP3824 PIN diode to the 144MHz RX I/F output connection.

TRANSMIT CONVERTER: Refer to the circuit diagram. For a –7.5dBm 144MHz input signal the transverter typically produces +10dBm (10mW) output from the MAV11 amplifier on 1200MHz. Maximum input to the ADE11X mixer on TX should not exceed 0dBm (1mW), which produces +16.4dBm (45mW) output. Driving the mixer harder causes spurious output and could damage it. A -7.5dBm 144MHz signal is

input to the TX I/F input and is switched through a HSMP3824 PIN diode and passes through the 50ohm diplexer to the ADE11X mixer. The 144MHz signal is mixed with the 1152MHz L/O signal producing a 1200MHz signal and mixing products out of the mixer. The output of the mixer, (–14.0dBm) is filtered by a 1200MHz Helical filter (-3.5dB) which passes only the 1200MHz signal and rejects the 144 and 1152MHz signals and mixing products. The 1200MHz signal (-17.5dBm) is then switched through a HSMP3824 PIN diode to the input of an ERA3 driver amplifier. The signal is then amplified around 20.5dB by an ERA3 to around +3dBm, and then is further filtered by another 1200MHz Helical filter (-3.5dB) to mainly get rid of the 1152MHz L/O signal so that it doesn't appear on the output of the transverter. The filtered signal is then amplified around +10.5dBm by a MAV11 amplifier to produce around +10dBm, (10mW) output @ 1296MHz.

PIN DIODE I/F SWITCHING: Has been used to lower the cost of the design by using a common Mixer and Helical filter for both the RX and TX 1200MHz sections. Two HSMP3824 PIN diode pairs are used to switch the 144MHz RX and TX I/F connections to the mixer, and the 1200MHz signals two and from the 1200MHz RX and TX stages to the 1200MHz Helical filter. Both diode pairs are switched by the RX and TX +12volts power to the transverter depending on what mode the transverter is in**.**

CONSTRUCTION:

1. The PCB supplied is a professional plated through hole board, so no grounding wires are required to connect the top and bottom ground planes together. The plated holes are shown as dark colored pads on the PCB overlay diagram. **It is suggested that you look at the images of the prototype on the Mini-Kits web site (www.minikits.com.au/ eme72b.htm).**

2. The first part of construction is to clean any swarf that may be left around the mounting holes on the PC board for the ERA / MAV amplifiers.

3. Follow the PCB overlay diagrams and circuits carefully, by checking the components and placing them onto the PCB. All component are SMD types ensuring that mistakes cannot easily be made with poor UHF construction techniques. **The Helical Filters, PCB Pins, and 78L08 Regulator are the only components mounted on the bottom ground plane side of the board**, all other components are mounted on the top track side of the PCB. **Do not mount the NE3210S01 onto the PC board until construction stage 6.** The small surface mounted 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. Before fitting the ERA / MAV 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 scalpel cut away any copper that may still be present. When soldering in the ERA / MAV amplifiers you need to first identify the input lead. The input connection on the ERA3 has a (white dot and beveled lead), and the MAV11 input connection is also a beveled lead but is the opposite lead to the white dot marking on the MAV11. Refer to the PCB overlay diagram for the component pin outs and fit the amplifiers in the mounting holes and solder the leads into place.
board.

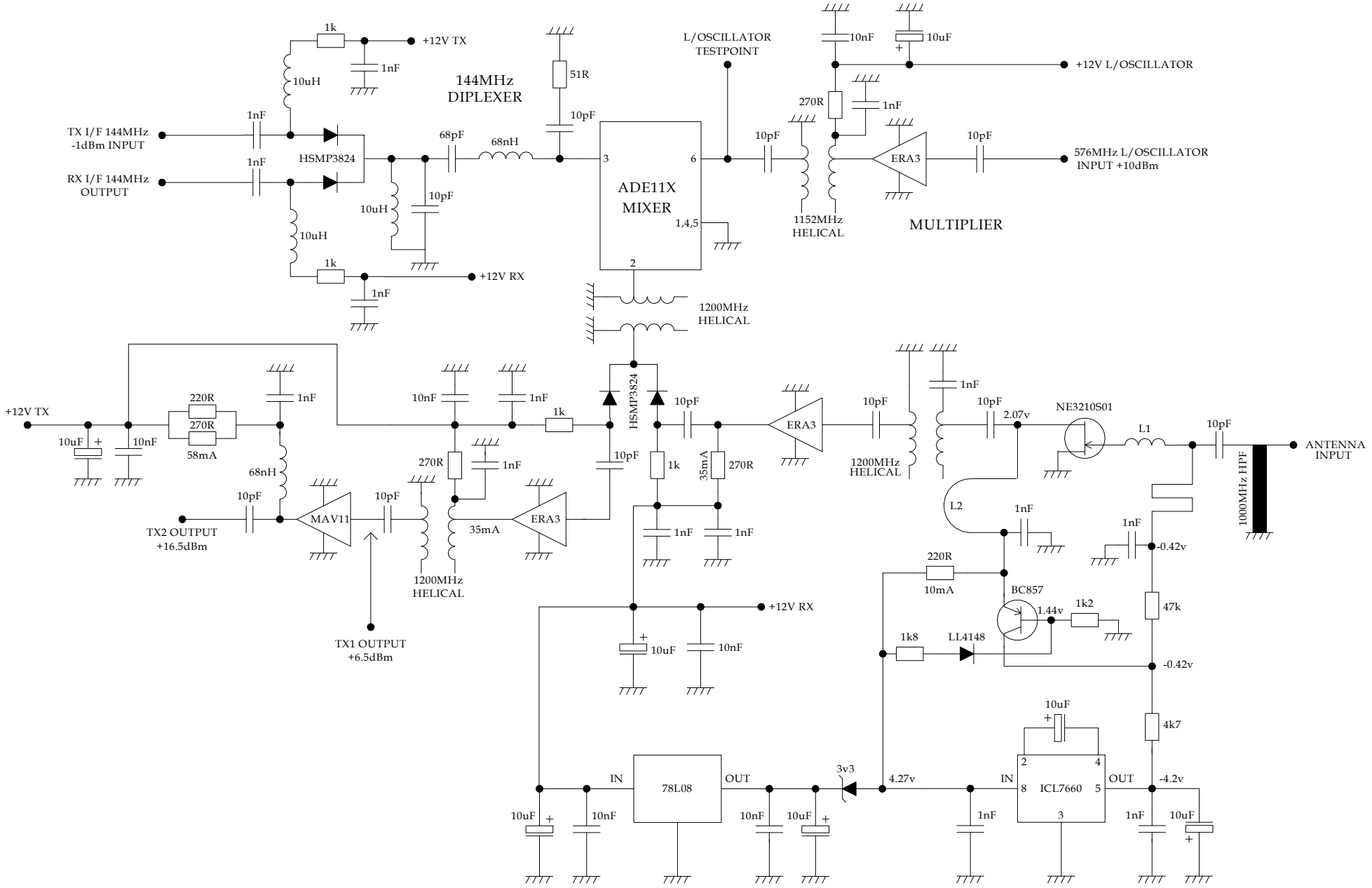
5. Next install the Toko Helical filters on the ground plane side of the board. The markings on the helicals don't match the part numbers, but you will find there are 3 of one type, (1300MHz) and one other (1152MHz). The two types have different pin outs, so they cannot be installed into the wrong positions on the board. The helicals outer metal can be soldered to the ground plane of the board but is not a requirement as the board is plated through.

6. Mount the NE3210S01 GasFET onto the PC Board. When installing the NE3210S01, lift the device from the static safe packaging with some fine pointy nose pliers or similar, and place it into position on the board. **The NE3210S01 leads are quite short so please refer to the PCB overlay diagram that shows where the device is to be aligned with regards to the circuit board connections.** The input lead is left un-connected until fitting the input inductor L1.

7. All inductors are constructed as per the following instructions. In version 4 Kits after August 2011, **L1** has been changed to give a better input match and lower noise figure. The coil L1 is 3.5 turns of 0.315mm ECW wound on a 2.5mm drill bit. Please refer to the EME72B Preamplifier mod section on the Kit webpage www.minikits.com.au/eme72b.htm#mods for a picture showing how the coil is fabricated and mounted to the board. The spacing between the turns is around 1.5 mm, and is not critical.

L2 is a 28mm long piece of 0.7mm Tinned Copper Wire formed into a half hoop around a 9mm diameter drill bit. **Refer to the pictures on the webpage for more details.** www.minikits.com.au/eme72b

8. The Transverter has been designed to have SMA09 sockets soldered directly to the board. The connectors are mounted diagonally as shown on the pictures on the web site. Alternatively small 50ohm coax can be used on the 144MHz RX and TX connections, but it is recommended that an SMA



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PROJECT	23cm Transverter
FILE	EME72B.SKF

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be used on all the other connections.

9. The Transverter should be mounted in a suitable shielded box. The 576MHz local oscillator needs to be shielded from the rest of the transverter circuitry. It is suggested that the L/O be either mounted in a small box or tinplate be wrapped around the oscillator board to form a box and then tinplate lids be soldered to the top and bottom. This also applies to TX driver amplifiers like the EME162-1200 or a RA18H1213G power amplifier which need to be shielded from the transverter board and L/O.

POWER CONNECTIONS: There are 3 power connections to the transverter board, +12V TX to power the Transmit section, +12V RX for the Receiver section, and +12V L/O to power the 1152MHz ERA3 Multiplier. The +12V L/O connection requires a permanent +12 volt L/O supply to power the ERA3 Multiplier. For control of the Transverters Power and I/F switching, it is suggested that the EME66 Transverter Sequencer Kit be used. The Transverter Sequencer Kit is a good option if you are planning on adding a Preamplifier, Power Amplifier, or Antenna relays etc later on.

LOCAL OSCILLATOR: There have been instability issues due to impedance mismatch on the ERA3 L/O input, please refer to the www.minikits.com.au/eme72b.htm Kit Webpage for updates. The Transverters L/O input requires a 576MHz input between 0 to +7dBm to drive the ERA3 Multiplier to produce a good 1152MHz output. **Excess drive > +13dBm (20mW) can damage the ERA3.** Using the recommended EME65 or EME175 500MHz Butler Oscillator you should get around +7dBm, (5mW) minimum, but typically +10dBm, (10mW) typical output when tuned to maximum. The L/O should be tuned up initially into a 50ohm load, but will require retuning of the 576MHz output filter when connected to the transverter board.

TUNE UP: With the correct L/O and TX drive levels, the Transverter should operate without any adjustments to the Helical filters, although it's best to optimise the tuning by peaking the Helicals for maximum gain in RX mode, and maximum output power in TX mode. The filters have a very narrow adjustment range and are wide bandwidth, (25MHz @ 1dB) so it makes it very easy to tune up the transverter with minimal test equipment.

1. Connect a suitable Power meter or Spectrum Analyzer to the 1296MHz TX2 output connection. Connect power to the TX and L/O +12volt connections and apply a –10dBm (0.1mW) 144MHz input to the 144MHz TX IF, +7dBm 576MHz L/O, and check that the transverter produces at least +6dBm (4mW) output. We are under driving the transverter to be able to measure the gain without saturating the output stages which would cause gain compression. The transverter has around 17dB TX gain and can be peaked by tuning the 576MHz L/O, 1100MHz multiplier, and the two 1200MHz helicals in the TX stages for maximum output. The output trimmers on the 576MHz L/O board will need to be peaked compared to when the board was tested separately into a 50ohm load, as cable length and connectors from the L/O to the transverter board are rarely a perfect 50ohm match. The ADE11X Mixer will work well with as little as 0dBm, (1mW) of L/O power, but typically the ERA3 and Helical filter combination produce +7dBm, (5mW) to the mixer. It is near impossible to incorrectly tune the 1100MHz Helical to another harmonic of the 576MHz L/Osc due to its narrow tuning range. Check that you get at least +16dBm output @ 1296MHz with 0dBm input 144MHz.

2. No alignment of the NE3210S01 preamplifier should be required if it is constructed as per the instructions. If you have access to a Noise figure meter the input coil L1 can be adjusted by bending the loops slightly or moving it above the board to optimize the performance. **Prototypes have shown that if constructed carefully the Noise figure will be under 1.5dB without tuning.** The RX helical can be peaked for maximum signal strength on a beacon and has little effect on noise figure.

3. Net the Local oscillator frequency by adjusting the coil on the 576MHz local oscillator board on a known beacon frequency in RX mode, or into a 1200MHz frequency counter in TX mode. If you are using a new Krystaly 60 degree crystal and the EME177 heater Kit, then the crystals are pre aged and can be adjusted onto frequency without needing further ageing.

NOTE: Chip components crack easily so if you have problems getting the kit going properly, check for broken chip caps on the antenna input etc and throughout the signal paths. Also check the Kits website www.minikits.com.au/kit-help for any possible faults or modifications.

PLEASE NOTE: These notes mention products that may no longer be available or manufactured.

RESISTORS

1 x 51R	SMD 1206 Resistor
2 x 220R	SMD 1206 Resistor
4 x 270R	SMD 1206 Resistor
4 x 1k	SMD 1206 Resistor
1 x 1k2	SMD 1206 Resistor
1 x 1k8	SMD 1206 Resistor
1 x 4k7	SMD 1206 Resistor
1 x 47k	SMD 1206 Resistor

CAPACITORS

13 x 10pF	SMD 0805 Chip Capacitor
1 x 68pF	SMD 0805 Chip Capacitor
16 x 1nF	SMD 0805 Chip Capacitor
6 x 10nF	SMD 0805 Chip Capacitor
7 x 10uF	SMD Electrolytic Capacitor

There are extra capacitors that have been included in the Kit incase some are lost.

INDUCTORS, RF CHOKES, FILTERS

3 x TOKO	367MN-113F Helical Filter
1 x TOKO	367MN-110A Helical Filter
2 x 68nH	SMD Coil (0.068uH)
3 x 10uH	SMD Coil **(Sub 5.6uH)**

SEMICONDUCTORS

2 x HSMP-3824	SMD Pin Diode
1 x LL4148	GP Diode (sub 1N4148)
1 x 3v3	SMD Zener Diode 3.3 volt
1 x 78L08	Regulator 100mA
1 x BC857	SMD Transistor PNP
1 x ICL7660	SMD –Ve Voltage Gen IC
1 x NE3210S01	NEC HJ FET
1 x MAV11	Mini-Circuits Amplifier
3 x ERA3	Mini-Circuits Amplifier
1 x ADE11X	Mini-Circuits Mixer

MISCELLANEOUS

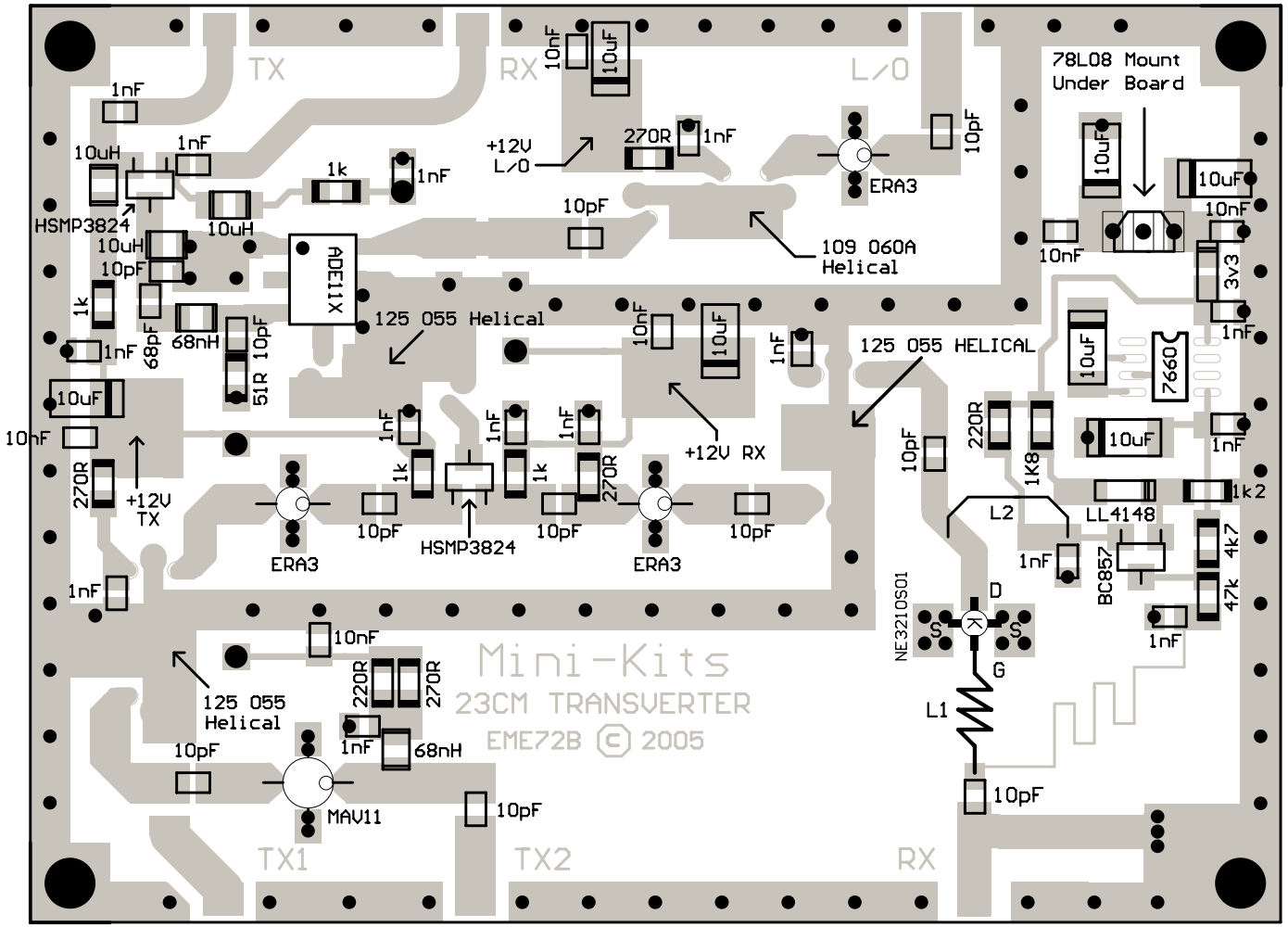
1 x PC Board	EME72B
1 x Instructions	EME72B
3 x PCB Pins	1mm

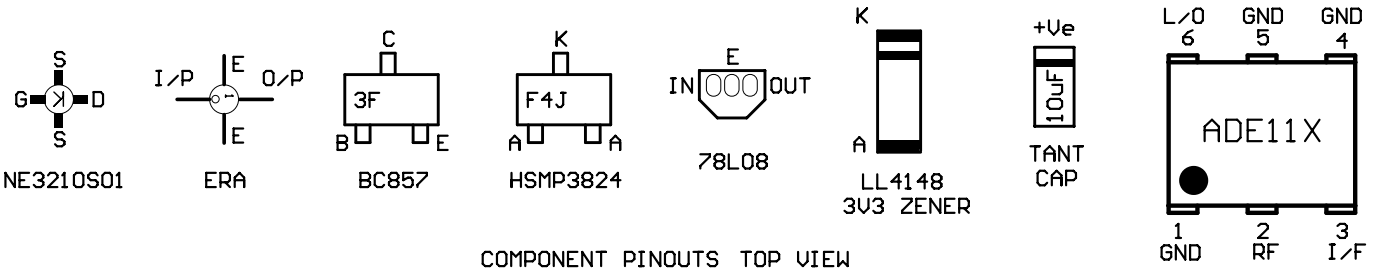
1 x 100mm length 0.315mm ECW L1
1 x 40mm length 0.7mm TCW L2

OPTIONAL
5 x SMA09 SMA Socket PCB Mount

FOR PRODUCT SUPPORT
www.minikits.com.au/kit-help

TOP PC BOARD OVERLAY





COMPONENT PINOUTS TOP VIEW