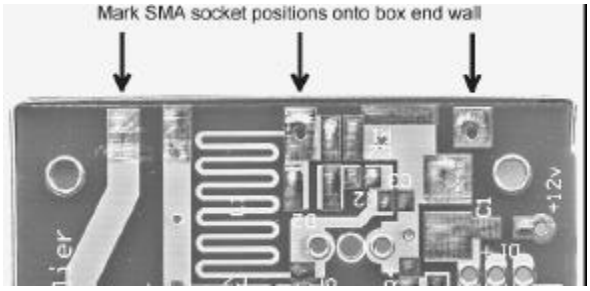
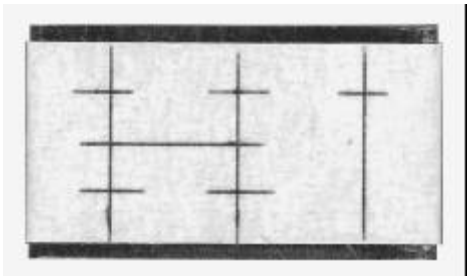
Assembling and Testing the G8ACE Multiplier

Making up the Tin Plate Box

Drilling the box walls for sockets should be done before assembly of the box.
The PCB has two opposite corner cutouts which align with the corner seams of the tin plate box. Place a length of masking tape, to facilitate marking out, across the outside end of one sidewall section of the box. Place the empty PCB into the wall section so the cut out is to the top right aligning with the joining corner flange of the box. Mark the positions for the sma centre pins (3) onto the masking tape. Using a set square mark these across the tape.





The centre pins are marked in the centre of the box height. The third sma (right) is not normally used, this marking is used for the 12v supply feed thro'. This can be above or below the PCB and aligned with the sma fixing screw hole position. Two hole sma sockets must be used so there is enough space between the fixing screw and centre pin for the PCB to be placed. Holes to suit the feedthro' and 2.5mm clearance for the sma fixings and 4.2mm for the sma centre pin clearance. Once the holes are drilled place both side walls onto a lid. Place the PCB into the box so it is central and level. Place the other lid onto the box so it becomes a rigid assembly and then solder the two outside corner seams. Solder the centre part only taking care not to allow the solder to touch the lids. Remove the lid first one side only then the other to complete corner soldering to the box edges. The PCB may now be pushed out of the assembled box.
The third sma position is for a 23cm LO source in which case the 2.5 GHz output socket is unused (left) and the supply feed thro' may be position here instead either above or below the pcb.
Unusually the module may provide two LO outputs for double conversion in which case all three sma are used and the dc feed thro' must be re-positioned elsewhere.

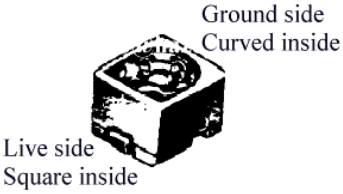
PCB Component Assembly

The PCB smd parts assembly is eased by the PCB printed legends however double check exact positioning before soldering where the density is high. Start with the smallest components leaving the trimmers until last. Three components only are placed on the back of the PCB. The very small parts used on this PCB are likely to 'ping' from pliers whilst being placed, take care to work so that escaping parts are easily found again. Use a very fine tip iron and fine gauge solder. A small amount of solder placed on one pad will allow the part to be soldered down one side followed by the other. If a part needs removal or re-positioning then two irons are helpful so both ends can be heated aiding removal. The regulator is best fitted after the PCB is soldered into the box due to the restricted space between regulator and box for soldering.

Variable capacitor connection details.

Connect CV8 so the rotor, ground side, is connected towards ST1 and TR4.
CV6 & 7 maybe the same style as CV8
CV2-5 have three pins. Each pair of adjacent trimmers share one common ground hole.

CV1



CV 6 & 7

CV8

The Farnell Spectrol Trimtool 145-507 or RS Trimtool 543- 434 will adjust all trimmers but works better with CV1 if the metal blade is pulled out slightly and secured with super glue in an extended position thereby reaching the rotor more easily through the housing.

Assembling the PCB into the Box

The sma sockets should be assembled into the box. The PCB is then inserted between the sma centre pins and fixing screws. Push the board tightly to the sma centre pin. If the sma has the solder bucket type spill ensure this is facing upwards. Ensure the board is central within the side walls. Place the lid onto the top side of the pcb. Turn the box over and spot solder the corners to hold the PCB into position. Remove the sma fixing screws on the ground plane side of the PCB so that the PCB ground plane can be soldered full width to the inside of the box end for adequate grounding against the smas. The remaining three sides can either be soldered all around or at spot points no more than 2.5cm spacing. Ensure the top lid is in place whilst all the above assembly takes place. Once finished remove the lid and solder the sma centre pins to the tracks. The feed thro' is soldered into the box threading it thro' a suitable earth tag to facilitate the –ve dc connection wire. Join the feed thro' wire to the +12v point on the PCB or use a wire link. Assemble the 9v regulator to the ground plane side of the PCB with an M3 screw and solder the connections. Both lids should be a snug fit using this assembly method. The module can be fixed to equipment by using two or four pillars, one or two either side of the module and flat metal strap(s) placed across the top of the module. Tightening the screws down will compress top and bottom lids to the side walls to provide adequate screening but allow easy subsequent access inside if ever required.
If module testing is preferred before assembly into the box this can be done by attaching short coaxial in/out connections and dc supply wires. The circuit is stable in this configuration and will provide similar output level.

DC Testing
TR1 and TR2 are conventionally biased and emitter volts can be measured at TP1 and TP2. TR3 is biased in class B and only a few mV will normally be measured with no input signal at TP3. TR4 is drive biased with the emitter directly grounded. Drive voltage is measured at TP4. Apply 12volts and check voltages according to the following table without input signal.

Regulator	Output 9v ± 4%		
TR1	TP1 0.95v	Base 1.7v	Collector 7.2v
TR2	TP2 1.05v	Base 1.8v	Collector 7.7v
TR3	TP3 12mv	Base 0.85v	Collector 9v
TR4	TP4 0v	Base 0v	Collector 9v

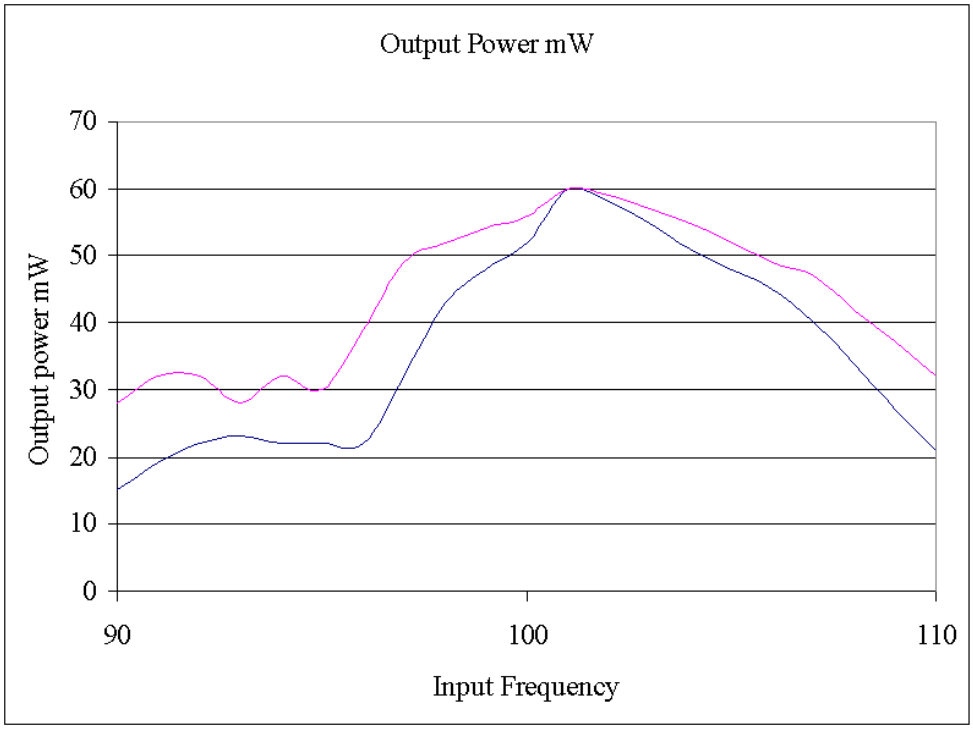
Alignment

Connect the drive signal of 0dbm (1mW) of between 98 and 108 MHz. If the signal is at a higher level use an attenuator. CV1 is aligned with a small signal to prevent D2 conducting and masking the correct tuning point. TP1 is monitored for an increase in voltage as CV1 is tuned. For input frequencies below 98 MHz 22pf should be added across C3 47pf to facilitate resonating of L1.
An alternative to measuring test points is to measure overall current consumption as each stage is tuned. Tune CV2 and 3 for a voltage increase at TP2 or overall current. The peak with least meshing of the rotor should be the correct point. Repeat for CV4 and 5. Checking correct tuning with a wavemeter or suitable instrument is recommended. L2,3 should be tuned to 3 times the input frequency. Subsequent stages all double. CV6, 7 and 8 are smd trimmers and the covering film will need piercing with the trimming tool to tune. These are a little more difficult to tune. Adjust CV6 for a voltage change at TP3. Monitor TP4 and adjust CV7. If no voltage is detected try different settings of CV8. Generally some voltage will be easily detected but 2.5 GHz output may not appear immediately. This is because CV8 forms part of the idler to TR4 multiplier. Rotate CV8 and look for output
Also monitoring TP4 ensuring some dc is maintained, peaking CV6,7 to keep it peaked. Once output is seen CV6,7 and 8 can be tuned for maximum output.
There is a possibility of a false tuning position for CV7. It should not be at minimum capacity. If it is rotate it to a similar position to CV6 and re-peak CV8. With the exception of CV1 all trimmers may be re-peaked to achieve maximum output at the desired drive level. Snow flake tuning tabs may be added to Stub 4 above 102 MHz input for maximum output and to Stubs 1 and 2 below 101 MHz. Below 94 MHz input a snowflake tab on Stub 3 will be required. These tabs should be cut 4 x 8mm and moved with a cocktail stick for optimum effect.

Then soldered down with the power off. Output power versus input frequency will be similar the the graph below measured from a prototype.
If the output power is excessive then either a potentiometer can be used at the location RV1 or a suitable value of fixed resistor may be installed in the RV1 position. Note: The smd resistor R17 must be removed and a Pot. RV1 470 (or 500) ohms added to obtain adjustable output power levels.
Typical voltages after alignment with 1mW drive level, RV1 not fitted.

TP1	1.2v		Junction of R6-L2	6.8v
TP2	2.1v		Junction of R10-L4	6.6v
TP3	0.65		Junction of R15-L8	6.8v
TP4	1.25		Junction R19 & tuned circuits	7.9v

Typical Output Power for input frequencies 90-110 MHz.



The upper curve is optimised output using snowflake tabs to the stubs. The lower curve is output from the PCB without snowflake tabs. The trimmers may be re-tweaked but its advisable to do this with minimum input drive. CV1 will only tune correctly with small input signal level this is due to the damping effect of D2 to provide drive level control.

Note on early PCBs a legend error exists. The + symbol associated with C4 is incorrectly positioned. The positive end of C4 should be soldered to be adjacent to the +9v legend. Corrected on later PCBs.

Used as a 23cm source R18 and TR4 are not used. R20 is replaced with 1p8 and C21 with 4p7. A thin flexible coaxial cable then joins TP4, the output, to the third position sma socket. Solder points exist on the ground side of the PCB to ground the coax braid adjacent to TP4 and the output sma.

Multiplier Circuit Diagram