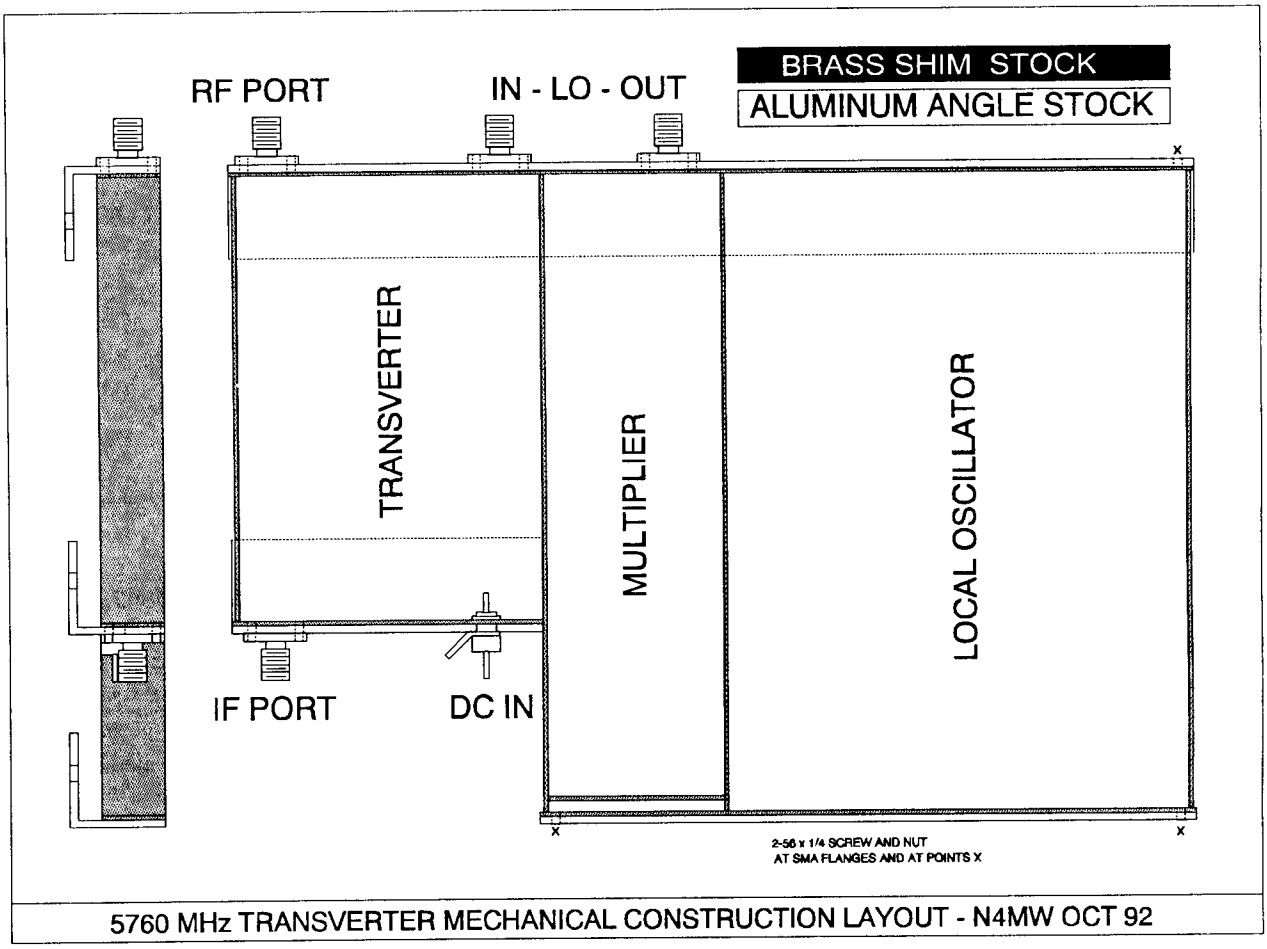
Notes on Down East Microwave 5760 MHz Transverter Assembly

by Dave Meier N4MW

I acquired two Down East Microwave 5760 MHz transverter kits at Microwave Update '92. Upon inspection of the documentation, it is evident that much of the mechanical details are left to the constructor. This paper documents my approach in hopes it might prove useful to others. Refer to the following drawing for overall layout and terminology.



5760 MHz TRANSVERTER MECHANICAL CONSTRUCTION LAYOUT - N4MW OCT 92

Construction criteria:

Unitize local oscillator, multiplier and transverter boards into a common assembly.

Surround each board with .032 in (0.8 mm) in thick brass stock 0.5 in (12 mm) wide.

Use SMA square flanged (four hole) female connectors for 4 GHz LO in/out, IF and RF.

Use 0.75 in (19 mm) aluminum angle stock with 0.625 (1.6 mm) web thickness to strengthen sides containing SMA connectors and provide a means for mounting the unitized transverter.

Interconnect 558 MHz LO and multiplier with small coax, with provisions for SMA connectors if later required.

Make DC interconnects on the back of the boards through small drilled holes.

Provide a single feedthrough capacitor/ ground lug for external DC supply.

Populate boards after mechanically securing to minimize damage to chip capacitors through flexure of the boards.

Mount the crystal on the backside of the local oscillator board for lower profile and improved temperature stability.

Note. As used here "locate" means to scribe where a hole will be using a sharp pointed scriber, "mark" means to centerpunch the location using a very small punch and light pressure (a spring loaded automatic centerpunch is OK) and "punch" means to make the sized hole preferably using a hand operated punch.

RF port wall layout: Starting from the transverter RF port, use two pieces of 0.032 brass stock and the transverter board to mark the location of the SMA connector center on the longest brass strip. All SMA fittings are centered on the strips. Next mark the LO in port center, using the transverter board as a guide. The multiplier LO output is similarly located using one additional brass strip between the transverter and multiplier boards. Punch the center 0.125 in (3 mm) holes. using an SMA fitting as a guide, mark four mounting hole locations for each SMA fitting. Mark one location at the opposite end of the strip for another screw (location not critical so long as LO board and end wall are cleared).

IF port wall layout: Using the transverter board as a guide, mark the location of the IF port on the appropriate brass strip, referencing the corner of the board adjacent to the multiplier and punch the center hole. Locate and mark the four connector mounting holes. Locate and mark a location for the feedthrough capacitor (locate so as to clear board on bottom side).

LO/multiplier wall layout: If SMA fitting are required, these can be layed out using the process described above. I chose to mark and punch the centers, but to not use connectors. 558 MHz LO power can be transferred using a short length of miniature coax between and under the boards. Locate and mark for two holes to be used for screws which will attach the brass wall to the aluminum angle mounting flange (location not critical so long as boards and end walls are cleared).

Aluminum angle mounting flanges: For each of the three aluminum angle pieces, locate, mark and punch 0.125 in (3 mm) mounting holes centered on one angle web and 0.25 in (12 mm) from each end. These holes will be used for mounting the transverter assembly after construction and checkout. The mounting holes can be inside (underneath) or outside the transverter assembly. I place mine inside as shown in the drawing. On the other web of each piece, align the corresponding brass strips along the outside edges, clamp (hemostat clamps work ok) and transfer holes in the brass strips to the aluminum web by punching carefully. At this time punch the top SMA flange 3/32 in (2.4 mm) holes (my punch would not reach the remaining flange holes. Assemble the brass strips to aluminum angles using SMA fittings and 2-56 X 1/4 screws and nuts. Check carefully that each SMA fitting is properly centered in its hole and correct now if required.

Board assembly (transverter): The three transverter boards are assembled on a temporary base, a scrap of PC board (or whatever) large enough to accommodate the entire transverter assembly. Assemble the longest aluminum angle piece on one edge of the base. Use 6-32 screws and nuts through the aluminum angle mounting holes and base, punching required holes in the base. Next position all cut brass strips and boards, starting with the transverter board. The SMA connectors should align perfectly with the board traces with the IF port aluminum angle flush with the board edge adjacent to the multiplier board. When you are sure everything lines up, punch holes in the base matching the IF port aluminum angle mounting holes. Begin tack soldering the brass strips in place in proper alignment. When three outside walls are in place, the board can also be tack soldered in place. Be very careful to align the SMA centers with the board traces.

Board assembly (multiplier): Place the remaining aluminum angle piece in position, align using brass pieces and the LO board, then locate, mark and punch holes in the base for mounting. Position the multiplier board against the wall with the output SMA fitting, align the brass strip between the multiplier and transverter boards, and tack solder the strip. Position the opposite wall strip and tack solder. Position the short filler piece (nibble out to clear screw if necessary) and tack solder. Carefully align the board with the SMA fitting and tack solder the board to the brass walls.

Board assembly (LO): Position the LO board and remaining brass end wall and tack solder.

Required materials (other than provided with kit):

SMA female connectors	four hole flange type
2-56 X 1/4 screws and nuts	19 sets, available from Radio Shack
6-32 X 1/4 screws and nuts	6 sets, for base plate mounting
Temporary base plate	1/16 in (1.6 mm) PC board stock approximately 6 X 8 in (150 X 200 mm)
Feedthrough capacitor	Value not critical, threaded, through hole type
Teflon insulated hookup wire	approximately 10 in (250 mm)
Miniature coax	50 ohm, approximately 2 in (50 mm)
Brass stock	0.5 in (12 mm), see below
Aluminum angle stock	3/4 in X 3/4 in X 1/16 in (18 mm X 18 mm X 1.5 mm), see below

Rercommended tools (or equivalent):

Layout ruler
Marking gauge
Scriber
Automatic centerpunch
Paper cutter (for trimming brass stock)
Saw with fine carbide nonferrous metals cutoff blade (for cutting aluminum stock - *observe safety precautions*)
Hand punch set
Drill and various bits (for both sized holes and reaming)
Soldering station (I use Weller WTCP with PTA7 tip) and solder
A vise to hold assembly (Panavise with wide jaws or equivalent)
Hemostat clamps (2 minimum)
Scissors (to trim copper foil ground straps and IF bridge)
Exacto knife (for chip cap wrangling and board scribing)
Screwdriver and needlenose pliers (for 2-56 hardware)
Double sided foam tape, approximately 1/2 in (12mm) square, for mounting crystal

Construction procedures:

Verify board dimensions (in case yours vary significantly)

Length of local oscillator board	L_{lo}=5.11 in (130 mm)
Width of local oscillator board	W_{lo}=3.66 in (93 mm)
Length of multiplier board	L_m=4.99 in (127 mm)
Width of multiplier board	W_m=1.39 in (35 mm)
Length of transverter board	L_t=3.55 in (90 mm)
Width of transverter board	W_t=2.43 in (62 mm)

Cut aluminum angle stock, allowing for board widths and slight overhang at ends

LO and Multiplier	$W_{lo}+W_m+(5*0.032)$=5.21 in (133 mm)
LO, multiplier and transverter	$W_{lo}+W_m+W_t+(6*0.032)$=7.67 in (195 mm)
Transverter IF side	$W_t+(2*0.032)$=2.49 in (63 mm)

Cut .032 thick X 0.5 wide brass stock, except as noted

LO and multiplier	5.21 in (133 mm) (1 piece, calculated above)
LO, multiplier and transverter	7.67 in (195 mm) (1 piece, calculated above)
LO & multiplier long sides	5.11 in (130 mm) (3 pieces, gage with LO board)
Multiplier filler	1.39 in (35 mm) (1 piece, gage with multiplier board)
Transverter IF side	2.43 in (62 mm) (1 piece 0.625 in (116 mm) width, gage length with transverter board)
Transverter long side	3.55 in (90 mm) (1 piece, gage with transverter board)

Final mechanical assembly: When you are sure that everything lines up properly, solder all board edges and brass wall junctions on the exposed (top) side of the entire assembly. Turn the assembly over, remove the base plate and solder board edges and brass wall junctions on the bottom of the assembly. Solder the LO board into position at the at the same height as the multiplier and transverter boards (dictated by the SMA center pins). Drill and deburr 3/32 in (2.4 mm) holes for 2-56 X 1/4 screws in the lower SMA flange holes. Remove the SMA connectors and aluminum angle flanges temporarily to reach the board edges.

Board population (LO): I built the LO first and verified its output and frequency before moving on to the multiplier. I mounted all chip capacitors, then resistors, then the regulator, transistors and MMIC and finally the coils. I substituted MRF 901 style transistors for the metal can ones supplied. I mounted the 93 MHz crystal on the underside of the LO board. This requires drilling two #72 holes and reaming the groundplane clear with a 1/8 in bit. Use a small piece of double sided foam tape to attach the crystal to the board.

Board population (multiplier): Mount the grounding copper strips two places at each MMIC hole, being careful not to short the MMIC inputs or outputs. Then mount capacitors, MMIC, resistors and coil. Connect the LO output to the multiplier input using a short piece of miniature coaxial cable. This can be accomplished on the back of the boards by drilling a small hole and reaming the backplane clear on both boards. Reassemble aluminum angle along multiplier output and transverter RF port. Solder the SMA center conductor carefully. Also cut away a strip of copper at the input board trace to prevent shorting to the brass filler if necessary. Jumper between the two MMIC DC power source areas by drilling/reaming two holes. Similarly connect between one of these pads and the LO power trace nearest the inside wall. Verify +7 dbm 4 GHz output from the multiplier. Reassemble LO/multiplier aluminum angle.

Board population (transverter). Mount chip caps, MMIC, diodes and resistors. Connect between MMIC power source pad and LO power trace. Reassemble transverter IF port aluminum angle. Solder SMA center conductors carefully. Connect between power trace and feedthrough capacitor. Verify transverter operation. My first effort draws 300 ma at 14 volts and produces 0.4 mw at 4 mw drive.

David H. Meier