FLWSS MICROWAVE MARKER PROJECT ONLINE DOCUMENTATION

LAST DATE OF CHANGES of original drawings.

Page 1	Nov 27, 2009 PL
Page 2	Nov 27, 2009 PL
Page 3	Nov 27, 2009 PL
Page 4	Nov 27, 2009 PL
Page 5	Nov 27, 2009 PL
Page 6	Dec 2, 2009
Page 7	Dec 2, 2009
Page 8	Dec 2, 2009
Page 9	Dec 2, 2009
Page 10	Dec 2, 2009
Page 11	Nov 27, 2009

Contact George Presley K4RSV with any problems encountered with assembly.

NOTES:

- Those not interested in the AUX feature, do not have to do the “white wire fix” shown on old page 10 (Page 14 in this Doc). Follow the directions on schematic page 2 under note * AUX Deletion.
- AUX feature: Allows external REF other than the INT 100 Khz.
- C1 (1mF) is soldered to bottom of Oven Board (OBV).
- Don't use duct tape on the OBV or others known to turn to scum.
- Schematics will be sent out through individual Emails.

Marker

OSCILLATOR AND OVEN BOARD PARTS LIST Nov 27-09

REF	VALUE	TYPE/FP	MFGR INFO
R1	3K	SM0805	CF, 5%
R2 #	2K2	SM0805	CF, 5%
R3	3K	SM0805	CF, 5%
R4	10K	SM0805	CF, 5%
R5	**	SM1206	NTC Thermistor, AVX NC20J
R7	500K	SM0805	CF, 5%
R10	1K	SM0805	CF, 5%
R11	22K	SM0805	CF, 5%
R12	270	SM1206	CF, 5%
R13	270	SM1206	CF, 5%
R14	270	SM1206	CF, 5%
R15	6.2K	SM0805	CF, 5%
R16	2K	THP	25 Turn Pot, PV36W202C01
R17	2K4	SM0805	CF, 5%
R29	22K	SM0805	CF, 5%
R30	22K	SM0805	CF, 5%
C1	1 mF	SM1210L	Tan, 16V
C2	.01 mF	SM0805	XR7, Ceramic
C3	.01 mF	SM0805	XR7, Ceramic
C4	1 mF	SM1210L	Tan, 16V
C17	1.5 pF	SM1206	NPO, Ceramic, Selected part
C18*	22 pF	SM0805	NPO, Ceramic, *Option not used
U1	74AC04	SO14N	Hex Inverter
U3	LMC662	SO8N	Natl Sem LM662AIM Dual Op-Amp
X1	19.2MHz	ASTX-11	Shinwoo
Q1	PZT2222A	SOT223	NPN Gen Purpose 1W SM
PWB	OVB		

R2 must be 2K2, R17 can be 2K2 or 2K4.

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MAIN BOARD PARTS LIST Nov 27-09

REF	VALUE	TYPE/FP	MFGR INFO
R18	10K	SM1206	CF, 5%
R19	100K	SM1206	CF, 5%
R20	22K	SM1206	CF, 5%
R21	270	SM1206	CF, 5%
R22	100K	SM1206	CF, 5%
R23	39	SM1206	CF, 5%
R24	10K	SM0805	CF, 5%
R25	10K	SM0805	CF, 5%
R26	10K	SM1206	CF, 5%
R27	1K	SM1206	CF, 5%
R28	680	SM1206	CF, 5%
C5	.01 mF	SM0805	XR7, CER
C6	.01 mF	SM0805	XR7, CER
C7	39 pF	SM0805	NPO, CER
C9	1.0 pF	SM0805	NPO, CER
C10	.01 mF	SM0805	XR7, CER
C11	1 mF	SM1210L	TAN, 16V
C12	10 mF	SM1812E	TAN, 35V
C13	.01 mF	SM0805	XR7, CER
C14	1 mF	SM1210L	TAN, 16V
C15	1 mF	SM1210L	TAN, 16V
C16	10 pF	SM0805	NPO, CER
C19	.01 mF	SM0805	XR7, CER
C20	.01 mF	SM0805	XR7, CER
C21	.01 mF	SM0805	XR7, CER
C22	.01 mF	SM0805	XR7, CER
L1	180 nH	SM1206	Inductor
L2, L3	Custom	#28 Wire	Hair Pin Design
D1	BAV70	SOT23EBC	Si, Small signal
D2	BAV70	SOT23EBC	Si, Small signal
D3	BAV70	SOT23EBC	Si, Small signal
D4	BAV70	SOT23EBC	Si, Small signal
D5	BAV70	SOT23EBC	Si, Small signal
D6	BAV70	SOT23EBC	Si, Small signal
D7	1N4001	D5	Si, 1A, 100V
U4	74AC00	SO14N	QUAD NAND
U5	74AC00	SO14N	QUAD NAND
U6	GALI-1	GALI1	MMIC
U7	74HC390	SO16N	DUAL DECADE COUNTER
U8	74AC74	SO14N	DUAL D F/F
U9	7809	DPAK3-4	3-TERM REG 9V

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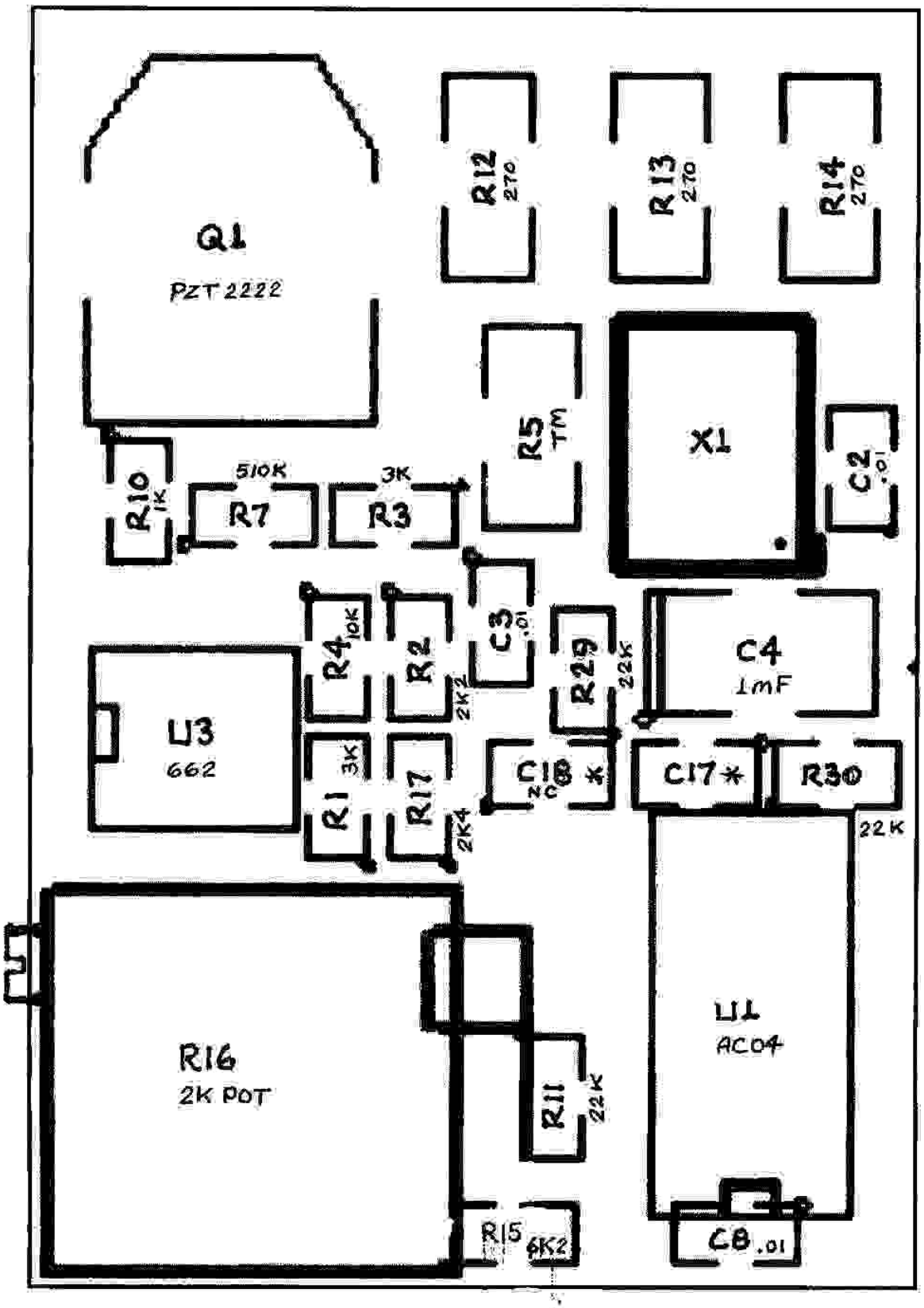
U10	7805	DPAK3-4	3-TERM REG 5V
X2	10 MHZ	TXO-SER7-5	RAKON TXO700
CN1	SMA	SMA_EDGE_SMA	PWB EDGE MOUNT
CN2	SMA	SMA_EDGE_SMA	PWB EDGE MOUNT
BOARD	MAIN		

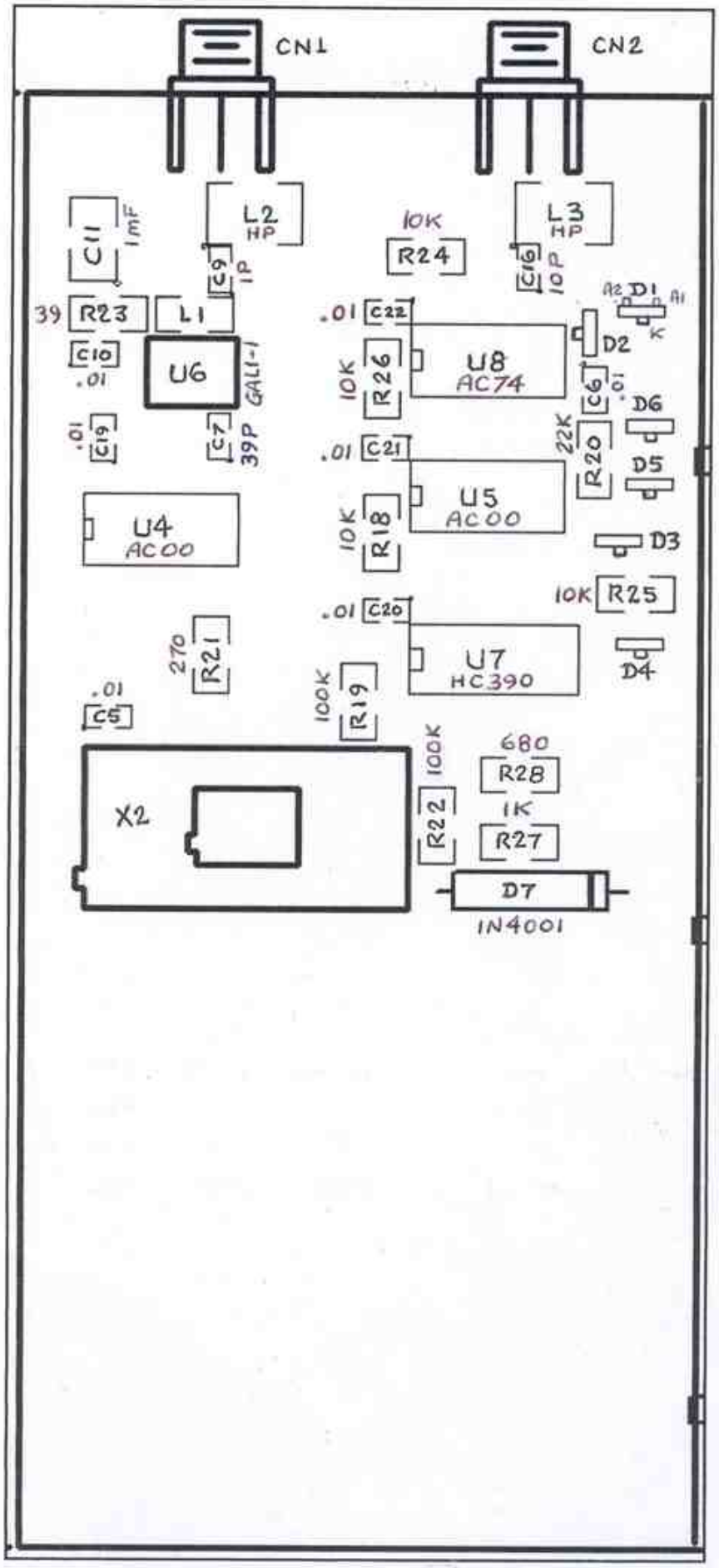
QUANITIES IN TOTALS	CHECK LIST
(1) 39 OHM 1206	[ ]
(4) 270 OHM 1206	[ ]
(1) 680 OHM 1206	[ ]
(1) 1K OHM 1206	[ ]
(1) 1K OHM 0805	[ ]
(2) 3K OHM 0805	[ ]
(1) 2K POT	[ ]
(2) 2K2 OHM 0805	[ ]
(1) 6K2 OHM 0805	[ ]
(1) 10K OHM 0805	[ ]
(4) 10K OHM 1206	[ ]
(3) 22K OHM 0805	[ ]
(1) 22K OHM 1206	[ ]
(1) 510K OHM 0805	[ ]
(2) 100K OHM 1206	[ ]
(1) 6.8K THERMISTOR	[ ]
(1) 1.0 pF 0805	[ ]
(1) 1.5 pF 0805	[ ]
(1) 39 pF 0805	[ ]
(1) 10 pF 1206	[ ]
(11) .01 mF 0805	[ ]
(5) 1 mF 1210L	[ ]
(1) 10 mF 1812	[ ]
(6) BAV70	[ ]
(1) 1N4001	[ ]
(2) 74AC00	[ ]
(1) 74AC04	[ ]
(1) 74AC74	[ ]
(1) 74HC390	[ ]
(1) LMC662	[ ]
(1) 7805	[ ]
(1) 7809	[ ]
(1) PZT2222	[ ]
(1) 19.2 MHZ OSC	[ ]
(1) 10 MHZ OSCX	[ ]
(2) PWB	[ ]
(3) INDUCTORS	[ ]
(2) SMA	[ ]
(1) GALI-1	[ ]

OVEN BOARD TOP



C1, BOTTOM SIDE (1mF)

* C17 1206 SIZE
BRIDGE ACROSS C17 & C18



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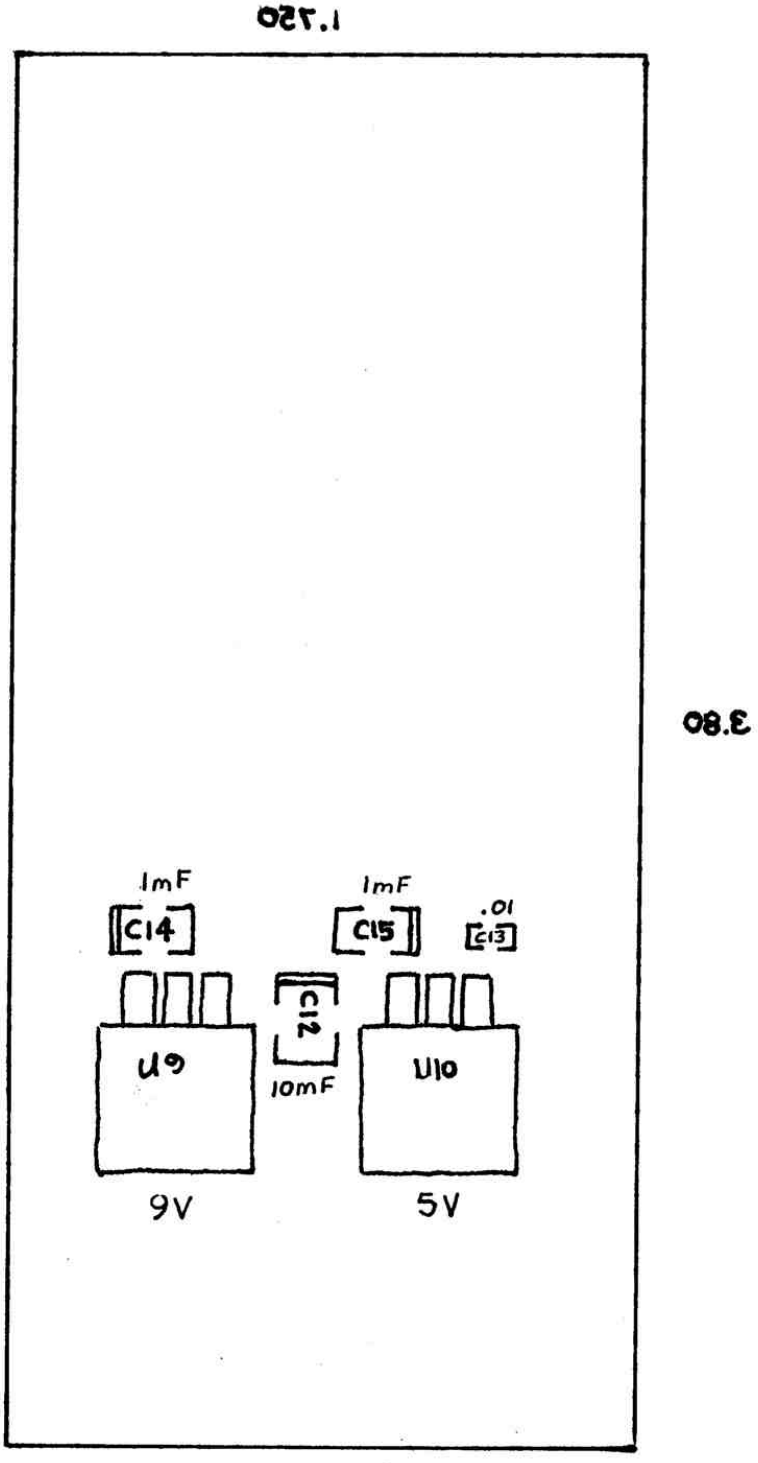
MAIN BOARD TOP VIEW

Marker



MAIN BOARD REAR VIEW

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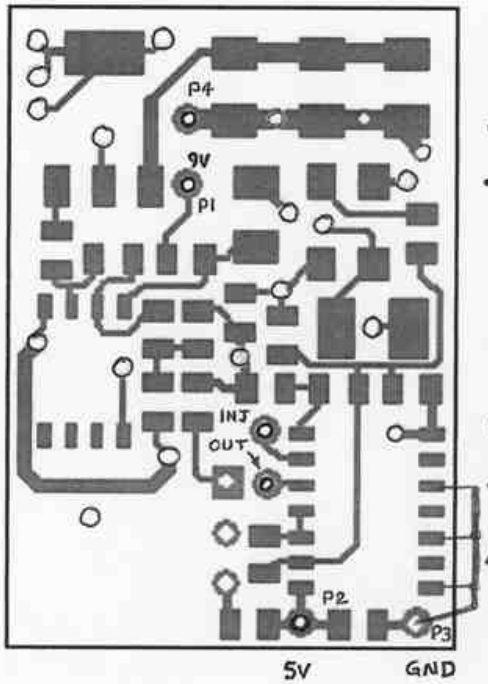
OVEN BOARD TOP VIEW

NOV 24-09

WIRING



* TWISTED PAIR, BLUE WIRES SOLDERED TO GROUND PLANE.

Δ WHITE WIRE PWB FIX. CONNECT PINS 1, 3, & 5 TO GROUND.

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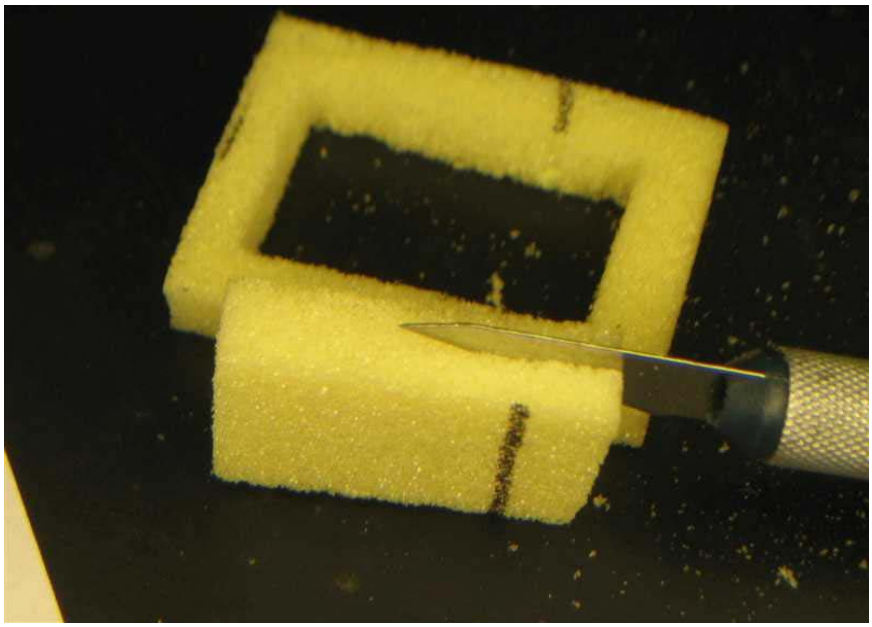
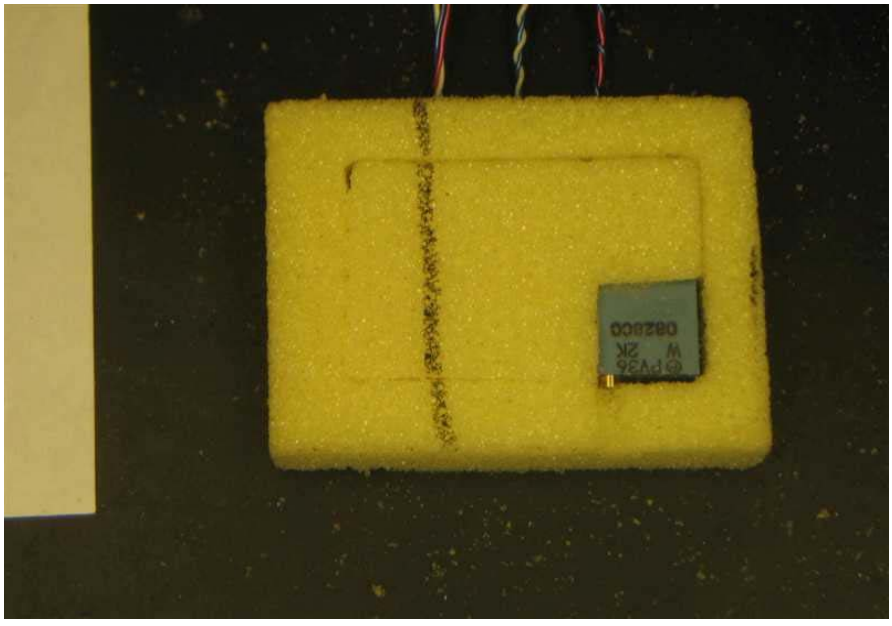


Carefully push out the center section of the Styrofoam insulating frame. Note that the foam pieces are marked so the two can be mated back together. The cutout tool was homemade and slightly irregular.

Split the cutout in half by walking the Exacto knife blade around the edges and working to the center. Careful, it is easy to break.

Keep the opening for the POT snug. Angle cut a space for the POT leads. Notch out for the pot ADJ.



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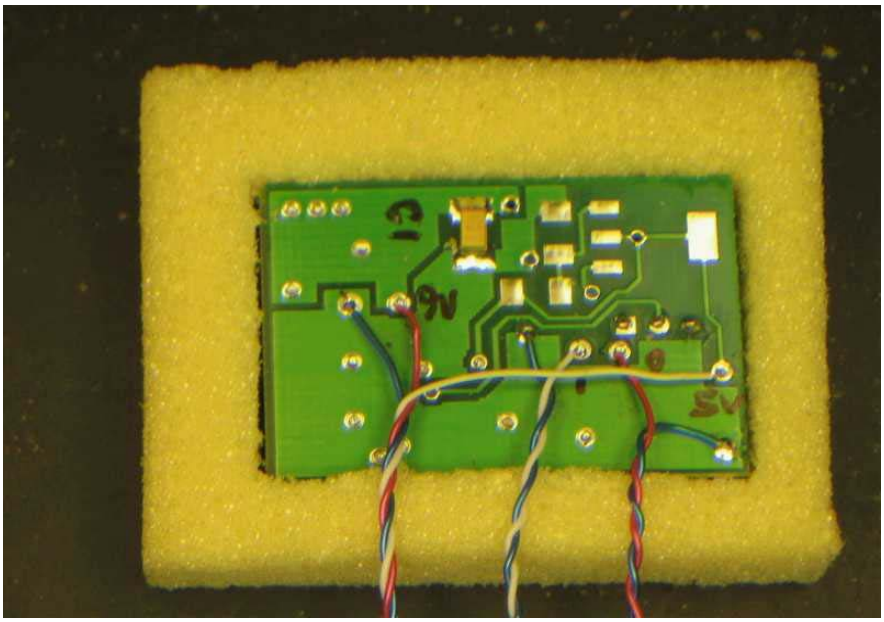
Double check the wiring and colors to the Oven Board (OVB). The powers and ground should be a tri-twist of red, white, and blue. Carefully bend all the wires into a step shape over the edge of the Styrofoam form and then straight out again. This will keep the OVB centered in the frame under the pressure of the insulation. The wire step is not shown in this view.



The GND RTN (Blue wires) can also use the two GND holes on the left and right of the blue/white twisted pair.

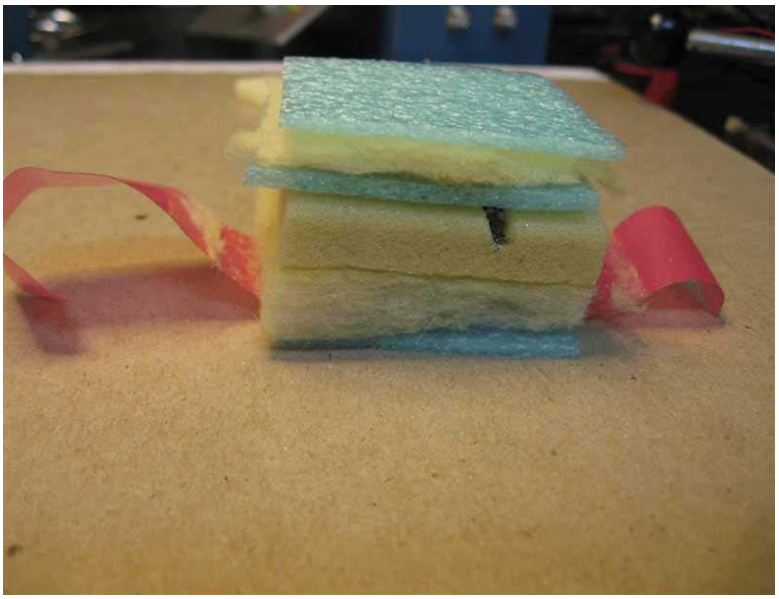
C1 is the only part on the back side of this board. Positive polarity up.

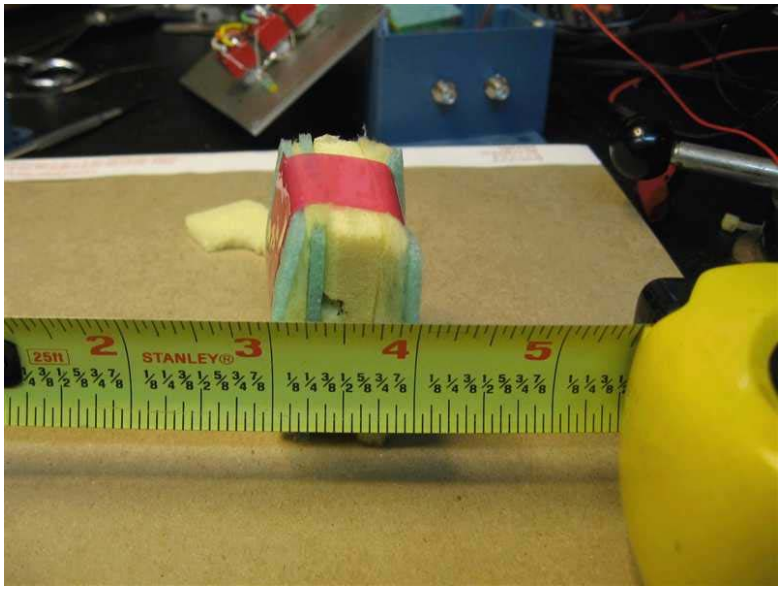
SOME TESTING CAN AND SHOULD BE DONE BEFORE INSULATING THE OVB. See testing and calibration section. This will save you a re-wrap.

Next is the INSULATION STACK UP from bottom to top. Foam pad, fiberglass, Styrofoam Frame, foam pad, fiberglass, and another foam pad. BEFORE doing the tape wrap, pull off a thin layer of fiberglass and place it over the components of the OVB. Just enough to fill air gaps between the board and the cutout cover. The board should still be centered and the cover comfortably flush with the top.

You can get creative here if you wish. The OVB could be put in a small rectangular plastic snap top box . Check out drug stores or fishing supplies for a item that fits the needs and doesn't cost much. Just sandwich the frame with glass insulation but not too compressed. Add your own extra foam insulation around the box inside edges to keep the frame from moving around when adjusting the pot.

Marker



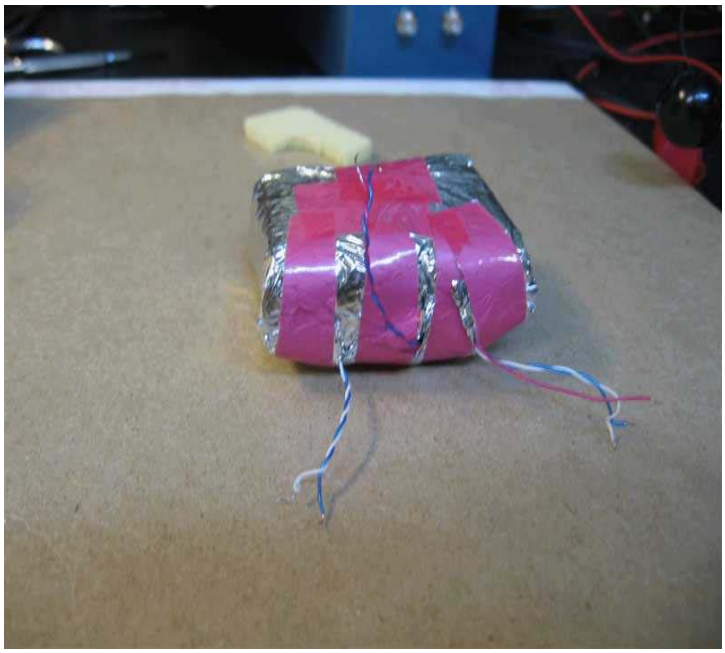


The stack should come in just under 1 inch thick. Notice the POT adjustment hole is formed between the Styrofoam and the foam pad. You won't have to poke through fiberglass to adjust.

Next, do the Aluminized Mylar (AM) wrap. Tape starting edge of AM to one of the foam pads and wrap snugly to have a finished thickness still just at or under 1 inch at mid section.

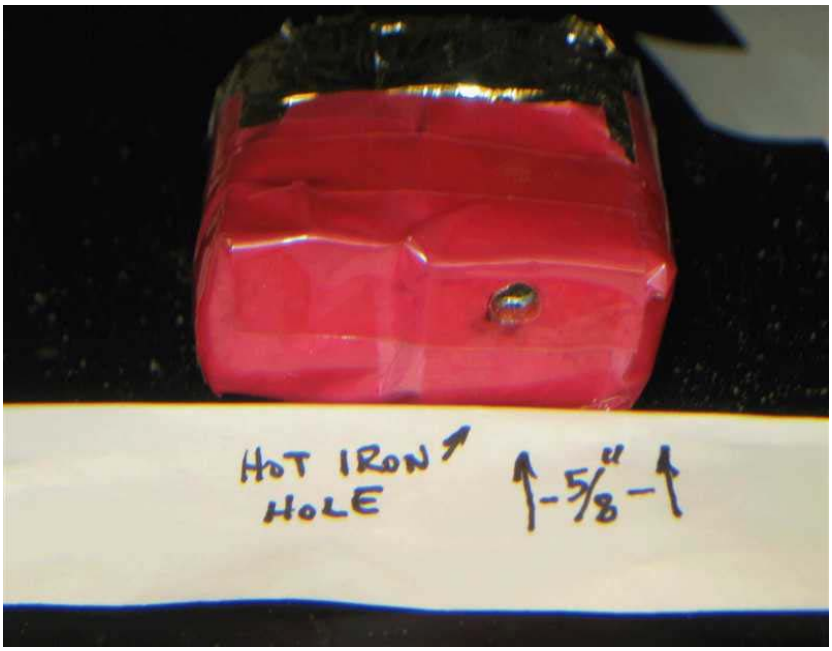
Marker

It doesn't have to be pretty. With scissors, cut off any extra AM and split end pieces enough to completely overlap the insulation and separate the wires. Notice the wires are coming out on the low side and indicating the bottom side of the OVB. This is a reference in the next step.

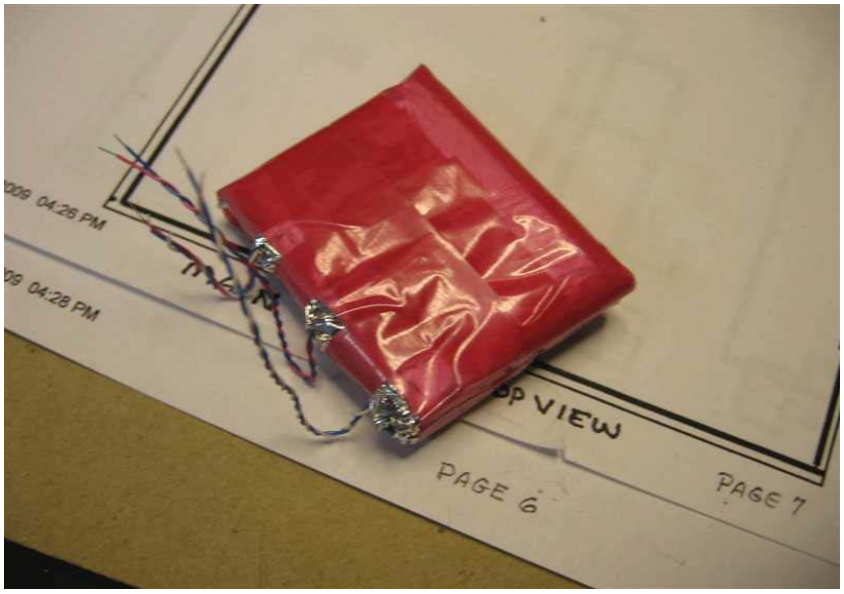


The next picture shows two things. The overlapping and taping of the FRONT end of the OVB and the access hole to the FREQ ADJ pot. I used a soldering tip that I don't use for soldering. You know why. With the wires in the rear low, the vertical location is your best fell, after learning how you put this thing together. The horizontal is pretty much 5/8. Poke and see as you go. Move the solder tip as necessary to align with the screw. As you do, the hole will get bigger and a hard plastic ring will form in the Mylar and the tape. If you create a serious hole, don't worry, just stuff a bit of fiberglass or paper in the hole. Taping over it is OK too.

Marker



FINISHED



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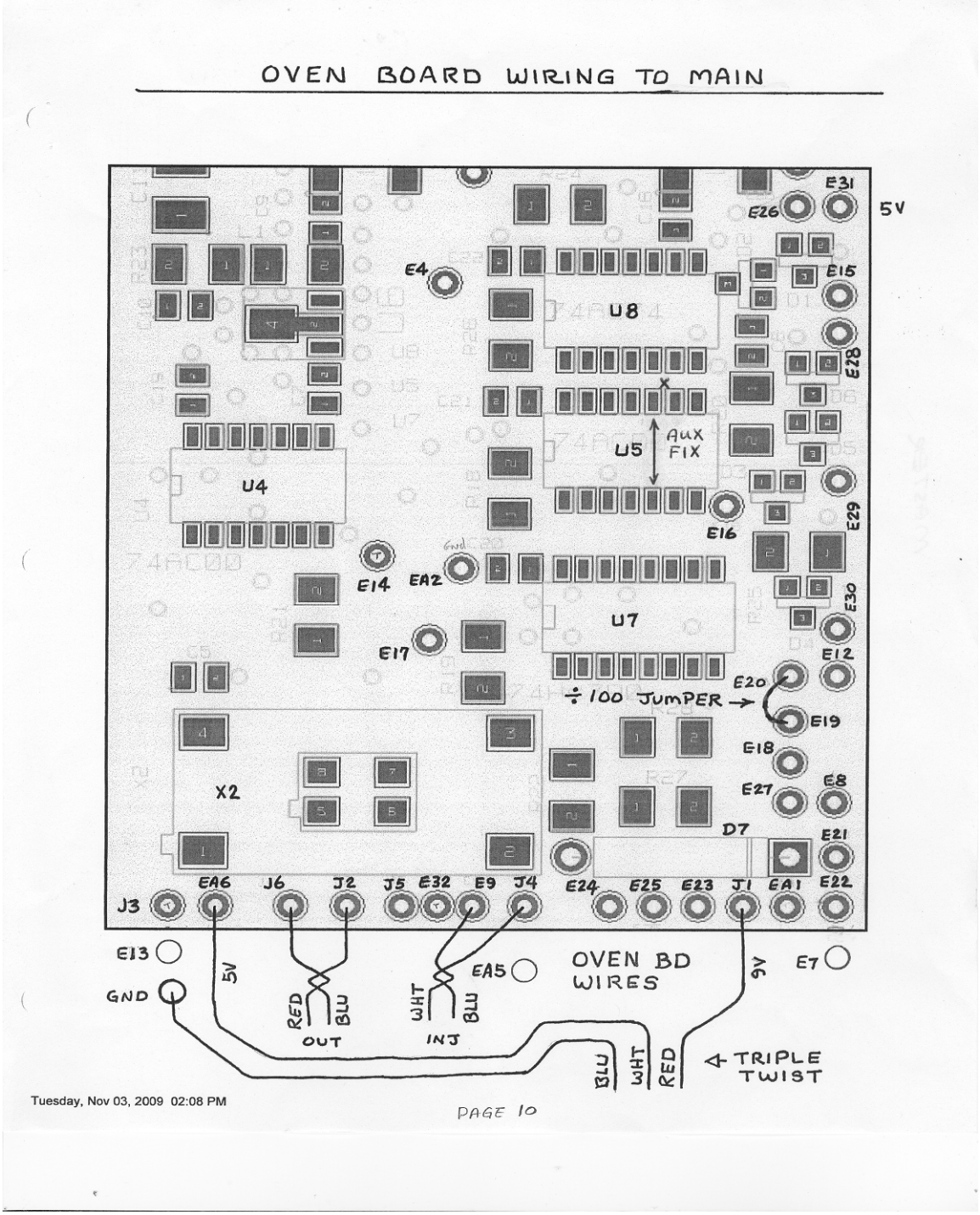
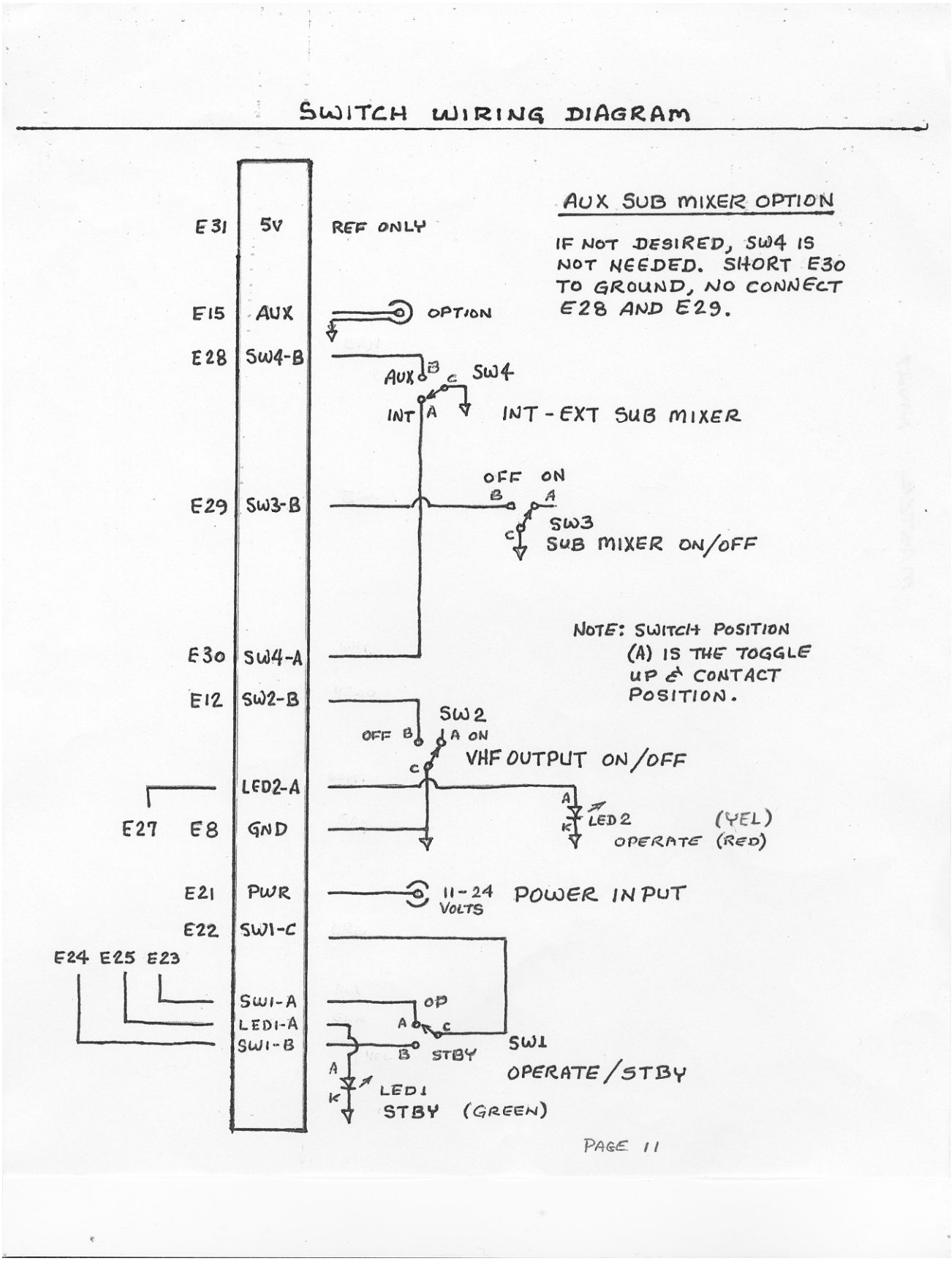
AUX FIX: Cut trace between pins 9 and 10 of U5, connect pin 10 to pin 5.



This drawing has the TRIPLE TWIST on the right, but actually is to the left out of the OVB. Also see picture on page 18 of this DOC.

Marker


SWITCH WIRING DIAGRAM
AUX SUB MIXER OPTION
IF NOT DESIRED, SW4 IS NOT NEEDED. SHORT E30 TO GROUND, NO CONNECT E28 AND E29.
E31
5V
REF ONLY
E15
AUX
OPTION
E28
SW4-B
AUX
B
C
SW4
INT
A
INT - EXT SUB MIXER
OFF ON
B
A
E29
SW3-B
C
SW3
SUB MIXER ON/OFF
NOTE: SWITCH POSITION (A) IS THE TOGGLE UP & CONTACT POSITION.
E30
SW4-A
E12
SW2-B
SW2
OFF B
A ON
C
VHF OUTPUT ON/OFF
LED2-A
A
K
LED2
(YEL)
OPERATE (RED)
E27
E8
GND
E21
PWR
11-24 VOLTS
POWER INPUT
E22
SW1-C
E24 E25 E23
SW1-A
LED1-A
SW1-B
OP
A
C
B
STBY
SW1
OPERATE/STBY
A
K
LED1
STBY (GREEN)
PAGE 11

TESTING AND CALIBRATION OF THE OVEN BOARD

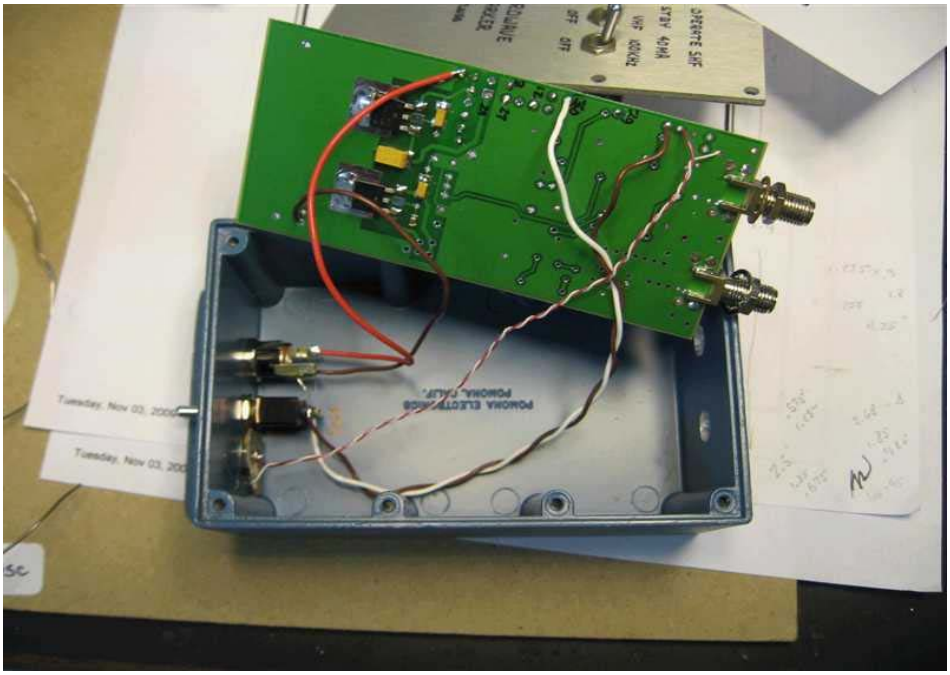
1) PRELIMINARY TESTING of OVB before insulation wrap. Using a regulated power supply that also reads current, connect +9 volts to the tri-wire red lead. Common return to the blue. The current should read just under 100 mA. Hold the OVB board between your two fingers, and within a few seconds, it should start feeling warm. That a good sign. Remove power.
2) Connect a +5v regulated supply to the WHITE of the tri-wires with gnd common to the blue lead. Apply power and observe only about 10 mA.. Turn power off.
3) Connect a scope to the RED wire of the red/blue twisted pair with gnd common to blue. With both currents meeting above limits, apply the 9 and 5 volts. Observe ~ 5 volts PtoP with some overshoot, and a 19.2 MHz square wave. As soon as you do, turn power off, pat yourself on the back and continue with the insulation work.
4) INSULATED OBV TESTING. Now you only have to recheck the +9v current for an indication that the oven is regulating the temperature. Again apply +9 volts to the tri-wire red with blue as ground return. It should return to just under 100 mA with power applied. Wait for 1 ½ to 2 minutes and observe the current dropping quickly to about 50 mA. After another minute it will go below 50 mA. If it does, your insulation job was good and you will be ready to wire the OVB to the Main Board after everything else is finished.
5) Consult Joe (KI4NPV) or me for frequency calibration.

TESTING OF THE FINISHED UNIT

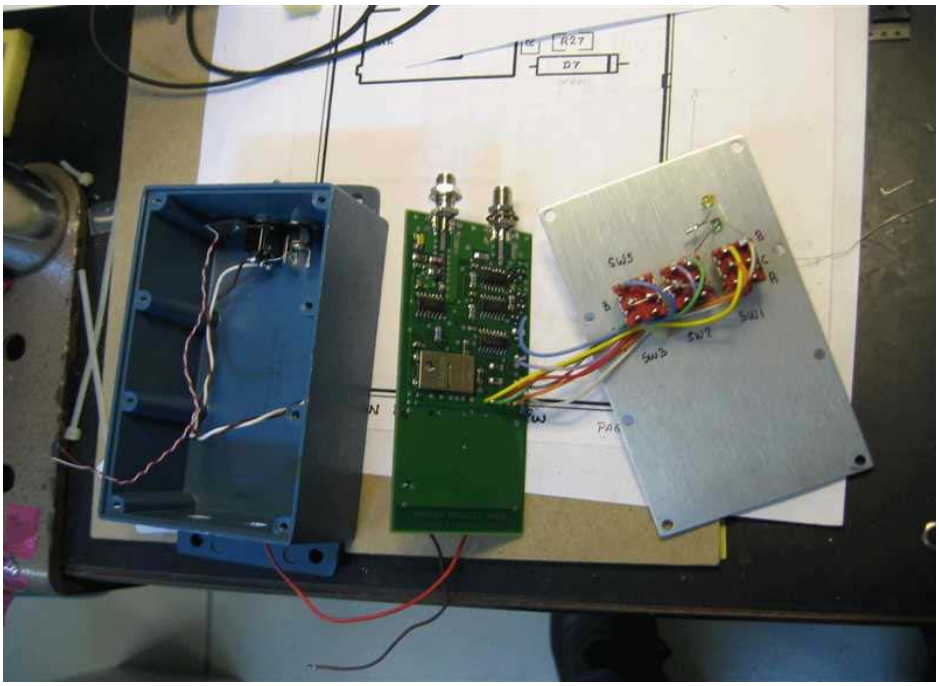
1) Total unit current is the only test left. The +9 volt internal regulator is connected when outside power is applied. In STBY, VHF and 100 Khz off, the initial current is ~100 mA. After 2 minutes the unit is usable and current drops to =<50 mA. In OPERATE, the current is 60 mA more. With the VHF and 100 Khz sub marker on, the current is about 10 mA more, for a total of ~70 mA. Everything ON and OVB hot, total current ~120 mA.
2) Both the SHF and VHF/UHF outputs have high pass filters, so the levels of output are kept below -25 dBm through the whole spectrum. This protects most preamps from someone connecting the marker directly to a receiver front end. The 10 Ghz marker, with the sub-marker off, has been measuring -58 dBm. The markers, without the sub-marker on, will always be stronger. More information will be coming about the use of the units as we get more units in the field. Joe is working on a modification to cross feed the two outputs to use one antenna. Bringing out the 100 Khz for use on all bands 222 and below is coming.
3) Again, consult Joe (KI4NPV) or me for frequency calibration. The ovens can be disconnected and mailed to us for calibration.
4) Basic use is, 1.296 Ghz and below, use the VHF/UHF SMA output. All above, use the SHF SMA output. The VHF/UHF is switchable so the marker is not heard on common IFs.

Marker

MAIN BOARD BOTTOM VIEW

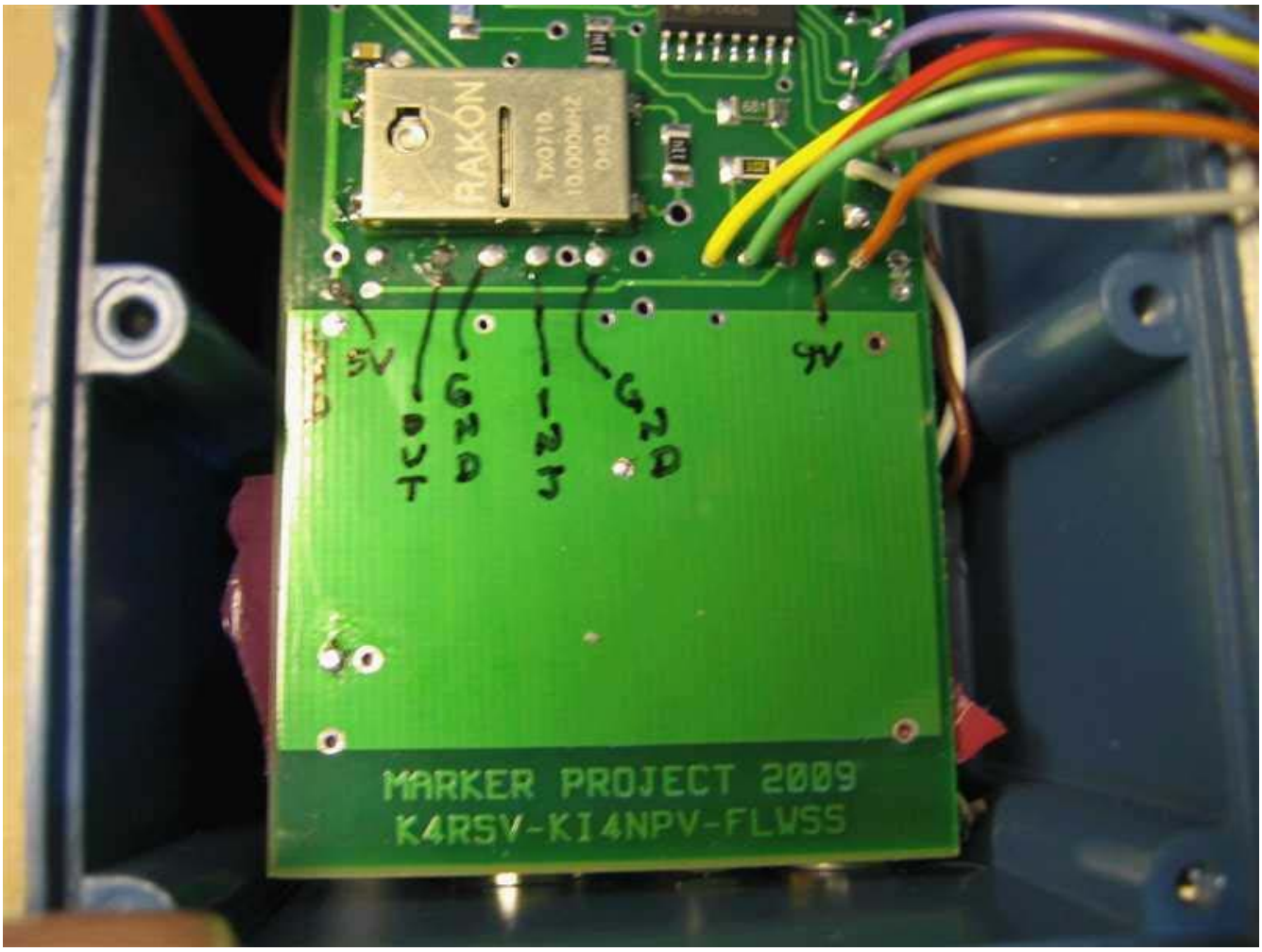


Shows AUX Option in bottom left of container. SMA and ON/OFF switch. The upper connector is for power input.



Shows wiring to Main Board from switches and LEDs.

OVB WIRING AID



POMONA BOX 2901 NOTES

If you are using the Pomona 2109 box, drill the two .250 SMA holes .675 inches up from the top of the mounting flange; not bottom.

This box has a serious tapered wall. The rear of the board will be higher than the front. Too high and the OVB will not have enough head room and press and flex the rear of the Main Board. To reduce MB flexing. Joe installed spacers under the board. I used double sticky tape on top of the AUX switch, seen in the upper middle of the box, until it formed a bumper stop to support the OVBs downward pressure. See page 17.

Additional hardware: (1) Container, (3) SPDT miniature switches, (2) LEDs, low voltage power.

AUX Option: Additional (1) SPDT switch, small coax connector (RCA , SMA, etc).

Marker

FINISHED UNIT

I wish to acknowledge Joe Ruggieri KI4NPV for his help in getting this project completed. His technical contributions were very instrumental to this design. He also donated many components as well as time. The benefactors of this project will have a valuable low cost precision instrument due to Joe's efforts and donated parts. A special thanks also goes out to Steve and Sandra of DOWNEAST MICROWAVE for their support and help to keep this project within budget.

Thanks to Jim Hagan (NN4AA) for the push to include the Sub-marker feature and thanks to everyone else for their patients.

I want to thank Chuck K0VXM for being the inspiration for me an many others to go beyond 2 meters. He's an asset to us all, you know what I mean.

George Presley, K4RSV