4SQRP 4S Power Meter

Assembly Manual v. 1.10

Four State QRP Group

Kit Designed by David Cripe, NMØS

Manual by Joe Eisenberg, KØNEB

Step 1 – Inventory parts and PC boards

The 4S Power Meter kit is a 10 watt QRP HF analog SWR and power meter. You can directly read SWR and forward as well as reflected power levels with two meter ranges, 1 watt and 10 watts. Check off the parts inventory using the BOM page. The case is made up of six PC boards which will be soldered and assembled together following the assembly of the main board and placement of components on the front panel. Use the photo on the BOM page for parts location reference.

Step 2 – Mounting the resistors on the main board

Note that some resistors have a 5-stripe color code and some might have 4-stripe codes. This is due to some being more precise 1% tolerance values. Be sure to use a meter or component tester to test them to be sure of their values before mounting them.

There are 12 100K resistors (BROWN-BLACK-BLACK-ORANGE-BROWN). Mount the 100 K resistors at R4, R5, R17, R22, R25, R26, R28, R31, R32, R37, R38, and R49.

There are 10 10K resistors (BROWN-BLACK-BLACK-RED-BROWN). Mount the 10K resistors at R18, R20, R21, R23, R24, R27, R29, R40, R44, and R45.

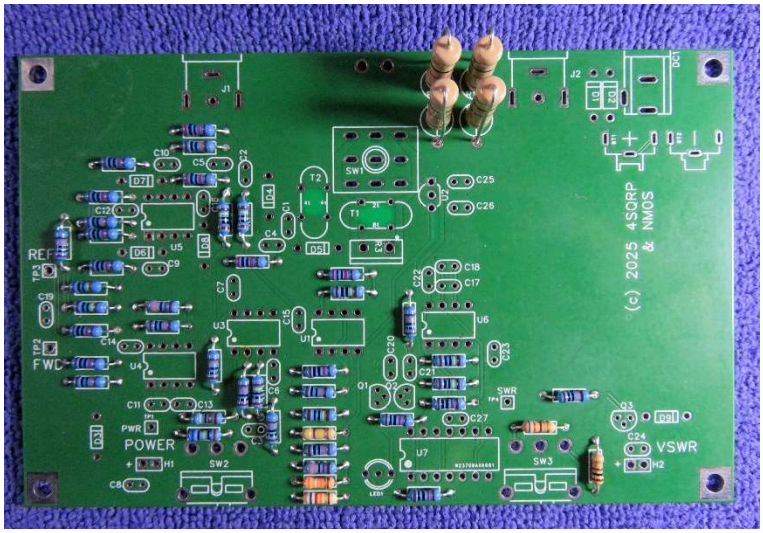
There are 9 1.0M resistors (BROWN-BLACK-BLACK-YELLOW-BROWN). Mount the 1.0M resistors at R1, R2, R14, R19, R30, R34, R35, R41, and R42.

There are 4 20K resistors (RED-BLACK-BLACK-RED-BROWN). Mount the 20K resistors at R6, R8, R9, and R16.

There are 2 33K resistors (ORANGE-ORANGE-BLACK-RED-BROWN). Mount the 33K resistors at R33 and R46.

Mount the 59-ohm resistor (GREEN-WHITE-BLACK-GOLD-BROWN) at R7

Mount the 100-ohm resistor (BROWN-BLACK-BROWN-GOLD) at R39



Mount the 604-ohm resistor (BLUE-BLACK-YELLOW-BLACK-BROWN) at R15

Mount the 620-ohm resistor (BLUE-RED-BLACK-BLACK-BROWN) at R36

Mount the 39K resistor (ORANGE-WHITE-ORANGE-GOLD) at R47

Mount the 62K resistor (BLUE-RED-ORANGE-GOLD) at R48

Mount the 470K resistor (YELLOW-PURPLE-YELLOW-GOLD) at R43

There are 4 1K 2-watt resistors (large sized brown-black-red-gold). Mount the four 1K resistors vertically, according to the outline on the board and the photos at R10, R11, R12, and R13.

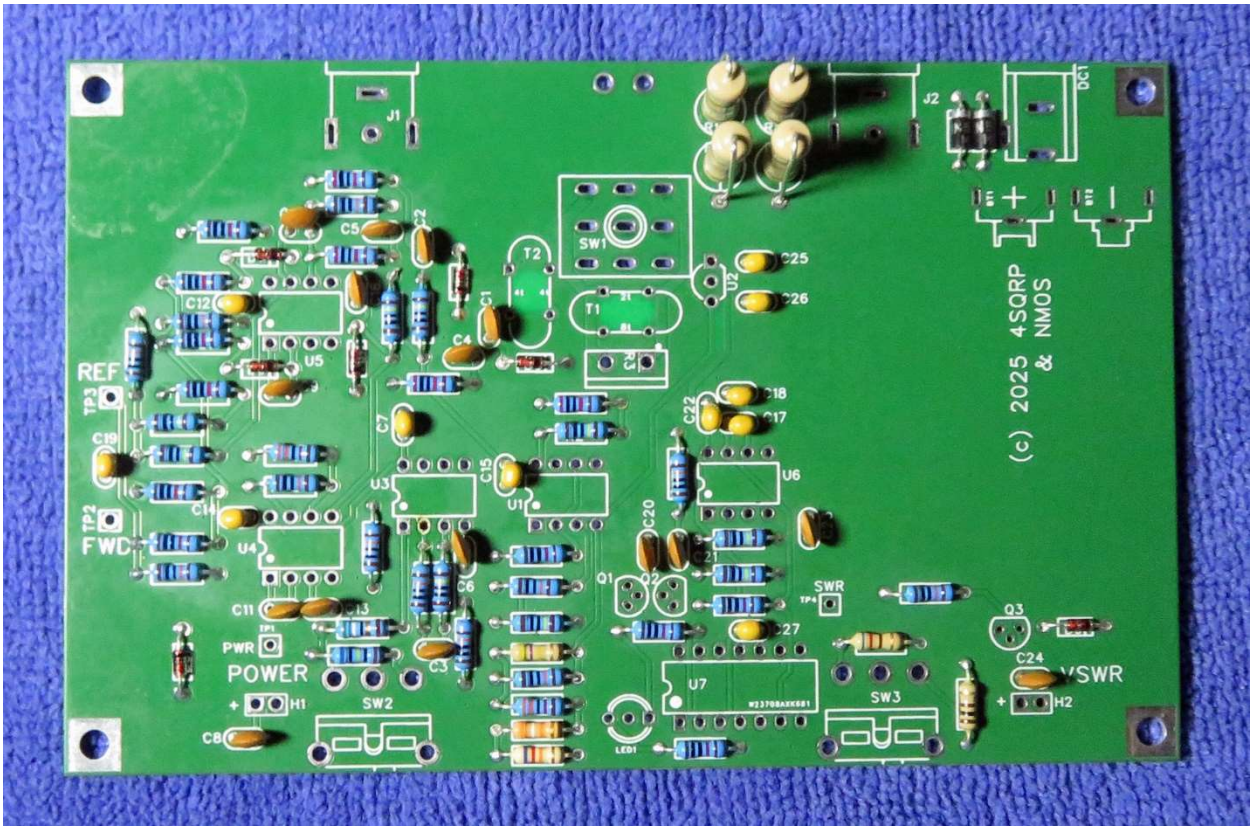
R3 is a 10-ohm resistor that is packaged very similar to a TO-220 style transistor but has only two leads. This will be mounted later along with the heatsink.

Step 3 – Mounting the capacitors

There are only two values of capacitors in this kit and are very easy to identify. The 10nf capacitors are brown disk type and are labeled 103. The 100nf capacitors are yellow and are labeled 104.

There are 16 10nf capacitors (103). Mount the 10nf capacitors at C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C13, C16, C20, C21, C23, and C24.

There are 11 100nf capacitors (104). Mount the 100nf capacitors at C7, C12, C14, C15, C17, C18, C19, C22, C25, C26, and C27.



Step 4 – Mounting the diodes

There are three different types of diodes in this kit. There are two 1N5817, which are black diodes with a stripe on one end, the 1N4048, which are 7 small glass diodes with a black stripe on one end, and one bicolor LED with three leads.

Mount the two 1N5817 diodes at D1 and D2. Pay attention to which way the stripes are facing per the marks on the board.

Mount the seven1N4148 diodes at D3, D4, D5, D6, D7, D8 and D9. Also pay close attention to placing the striped end as per the markings on the PC board.

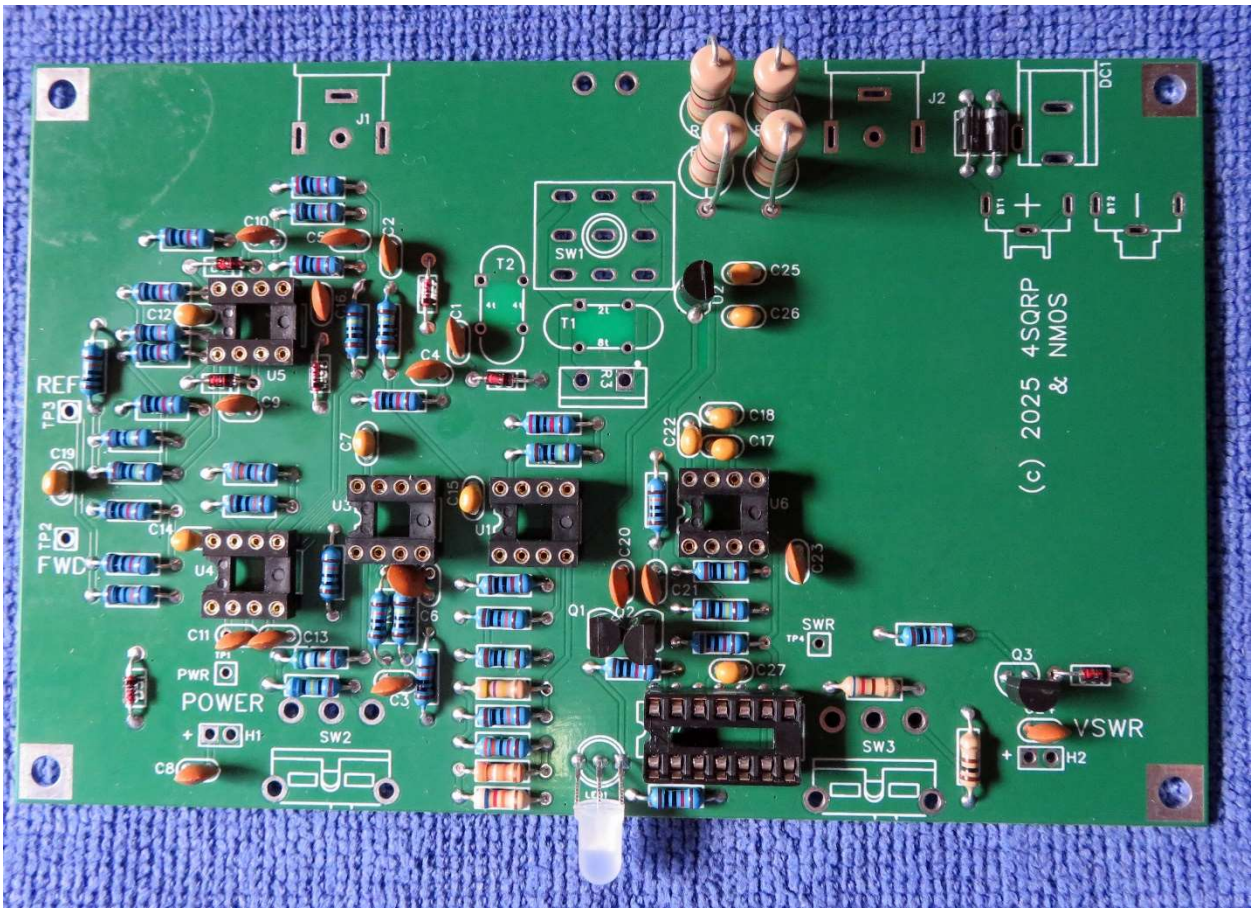
Mount the bicolor LED at LED1. There are three leads on LED1. Be sure the longest lead (the center lead) goes in the center hole and the longer of the two outside leads goes into the square hole on the PC board and the shortest lead goes in the remaining hole. Mount the LED so that when bent over, the LED collar is even with the PC board when bent over at a right angle to face outward from the PC board. See the photo example in Step 5.

Step 5 – Mounting the three transistors and U2

There are three 2N7000 transistors and one 78L06 voltage regulator IC which looks identical to the three transistors. Check the markings carefully!

Mount the 78L06 voltage regulator at U2. Make sure it is positioned so the part matches the outline on the board.

Mount the three 2N7000 transistors at Q1, Q2 and Q3, making sure the part positioning matches the part outline.



Step 6 – Mounting the IC sockets and ICs

There is one 14-pin IC socket supplied in this kit for U7. There are five 8-pin IC sockets supplied in this kit.

Mount the 14-pin IC socket at U7, making sure that the side with the notch on it is on the same side as the notch outline on the PC board.

Mount an 8-pin IC socket at U1, U3, U4, U5 and U6 also paying close attention to the position of the notched end of these sockets being matched to the outline on the board.

Using an IC pin straightener or other appropriate tool, make sure the pins on all ICs are straight and do not curl under while mounting them.

Mount U7, the LM339P 14-pin IC in the socket at U7 paying attention to matching the notch on the IC to the notch on the socket and board marking.

Mount U1, the TLC555CP 8-pin IC at U1, also paying close attention to the position of the notch or indented dot to the board markings, and the socket notch if used.

Mount the remaining four TLV272 8-pin ICs at U3, U4, U5, and U6 making sure the notch or corner dots match the markings on the board.

Step 7 – Mounting the switches

There are three switches. The largest one is a 9-pin toggle switch, as well as two slide switches. Making sure they are mounted flat and evenly is essential to having the case panels fit correctly.

Mount the two slide switches at SW2 and SW3, making sure they are mounted flat. A good method of making sure they are flat is to solder only one pin, then reheat it while pressing on the switch to be sure it is seated flat and even. Then solder the remaining pins.

Mount the 9-pin switch at SW1. Once again be sure it is seated evenly before soldering the remaining pins. See the photo in Step 8.

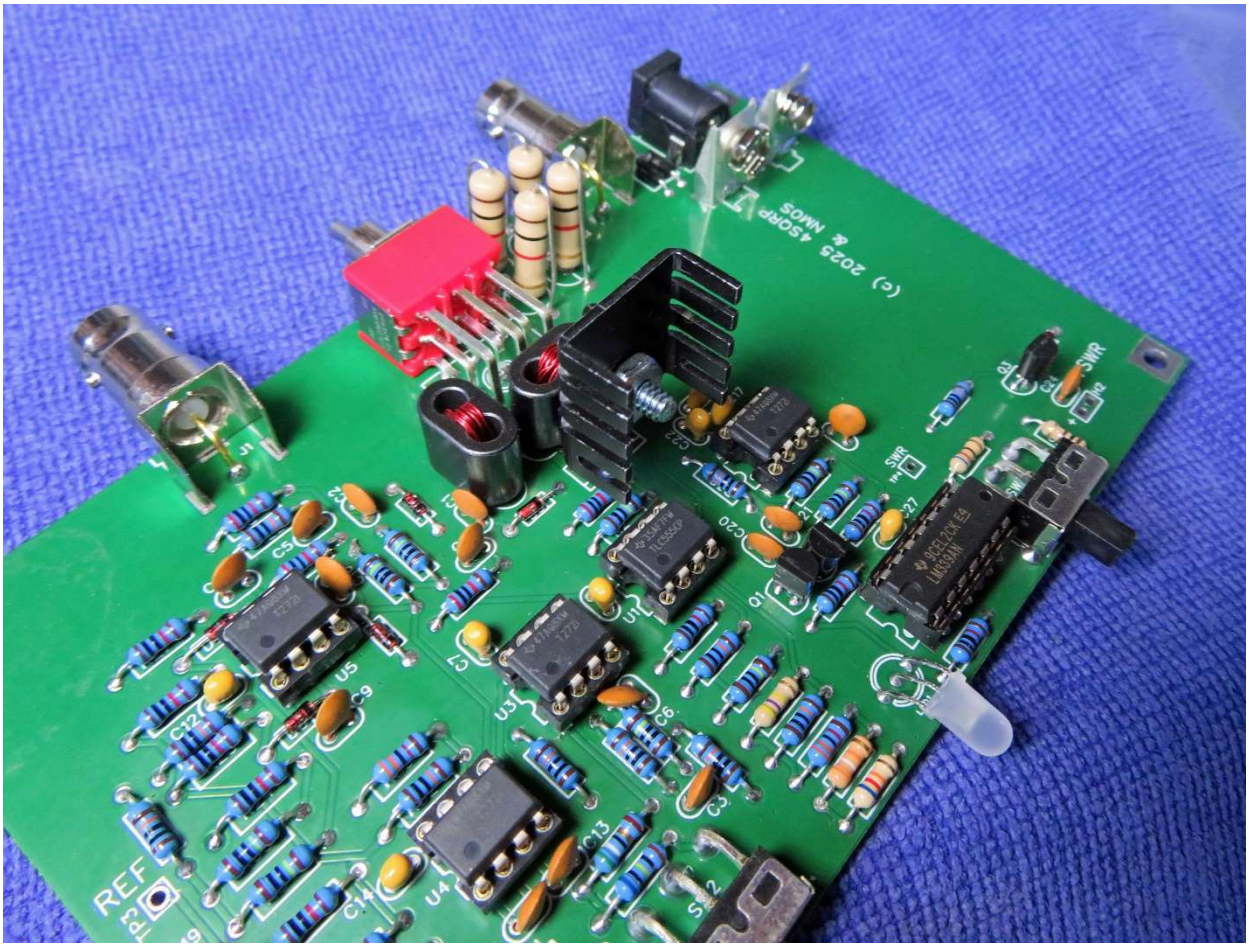
Step 8 – Mounting the power and BNC jacks and 9V battery tabs

The coaxial DC power jack is mounted at DC1. As with the switches, it is best to solder just one pin first, then if needed reheat it and move it if necessary to make sure it is flat against the board and the part is aligned with the outline of DC1 on the board. Then solder the remaining pins. This will be sure to align it correctly with the case panel.

The two BNC jacks mount at J1 and J2. These jacks have a lot of metal which can draw away a lot of heat so it is best to turn up the heat on your soldering iron to maximum to be sure of getting good solder flow to hold these BNC connectors in place correctly. Also use the one-pin method to be sure they are straight and flat before soldering the remaining pins. The center pin is the best to start with.

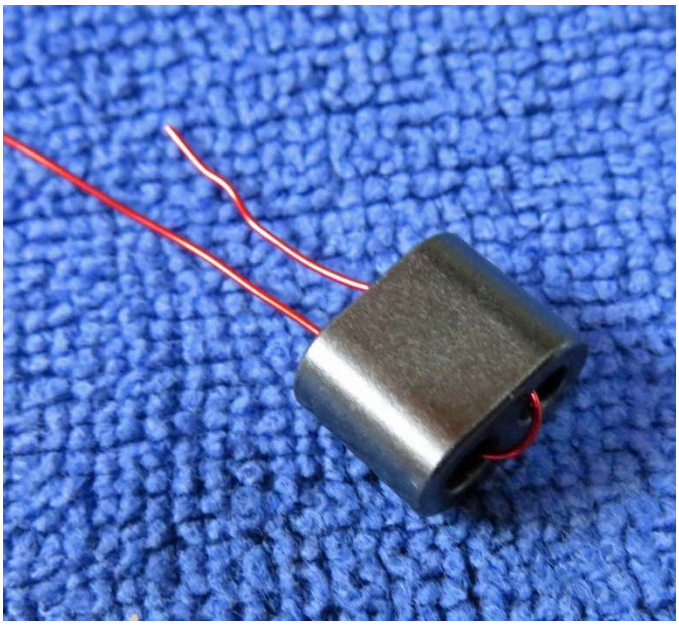
There are two 9V battery tabs, one with a smaller connector and one with a larger connector. The smaller one is the negative (-) and the larger one is the positive (+) terminal. Place the positive one where the plus (+) sign is printed and the negative one where the (-) sign is and press them in firmly and straight. It helps to use a 9V battery, preferably a dead one to hold them in place by snapping a 9V battery on. If it is not a dead battery, be VERY

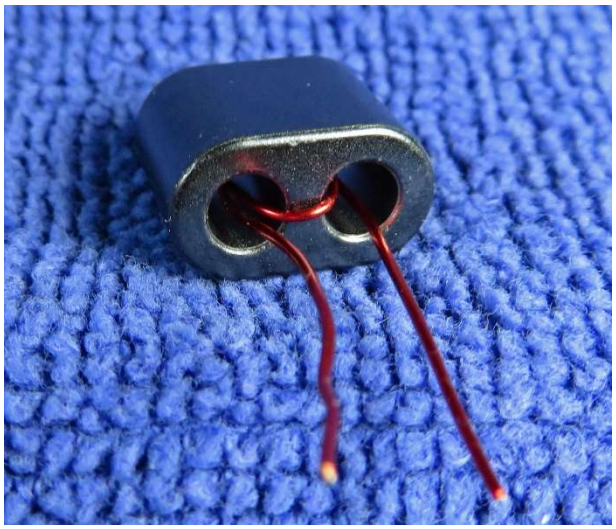
careful not to allow the tabs to touch each other or to touch a metal surface below them, like if you are using a cookie sheet. Use good insulating material like wood to protect the terminals and your work surface while soldering the tabs and any time the battery is snapped in place. Like the BNC connectors, these battery tabs draw a lot of heat away and so using the highest heat setting on your soldering iron will help make good connections.



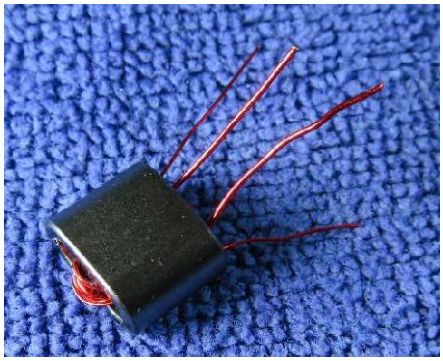
Step 9 – Winding the two binocular toroids and mounting them

There are two binocular toroid cores and two kinds of enameled wire supplied in the kit. The toroid cores get their name from the fact that they shaped like a pair of binoculars. The thicker wire supplied is the 24-gauge and the thinner wire is the 28-gauge wire. The photo on the left shows the beginning of winding T1.

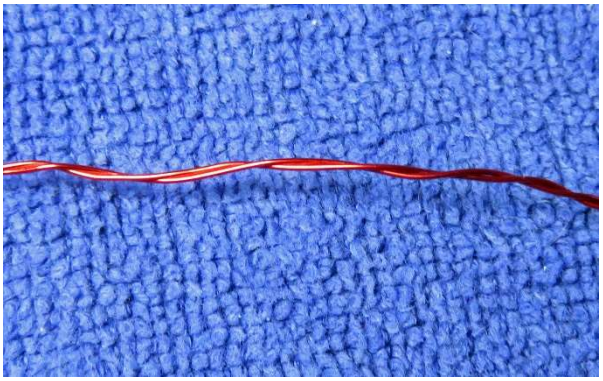


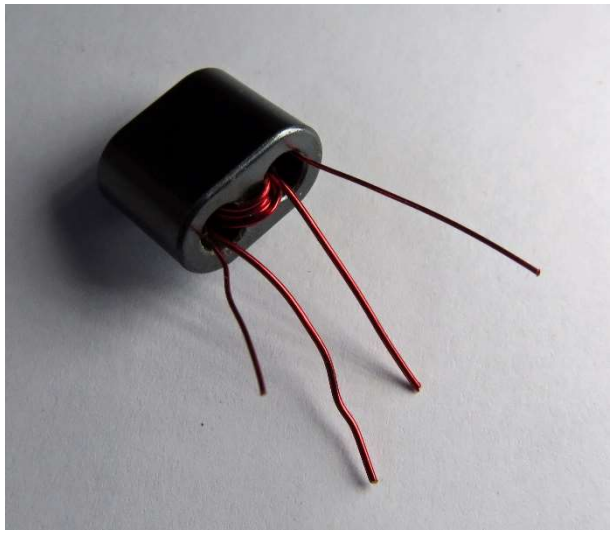


Wind T1 using the thicker 24-gauge wire by feeding it through one hole and then through the other hole and keeping it taut, feed it again through the first hole and again through the second hole. There should be 2 turns visible on the top of the toroid and just one on the bottom. Trim the wire so that one inch protrudes from each of the bottom holes. We count the turns by how many times the wire passes through the top holes.

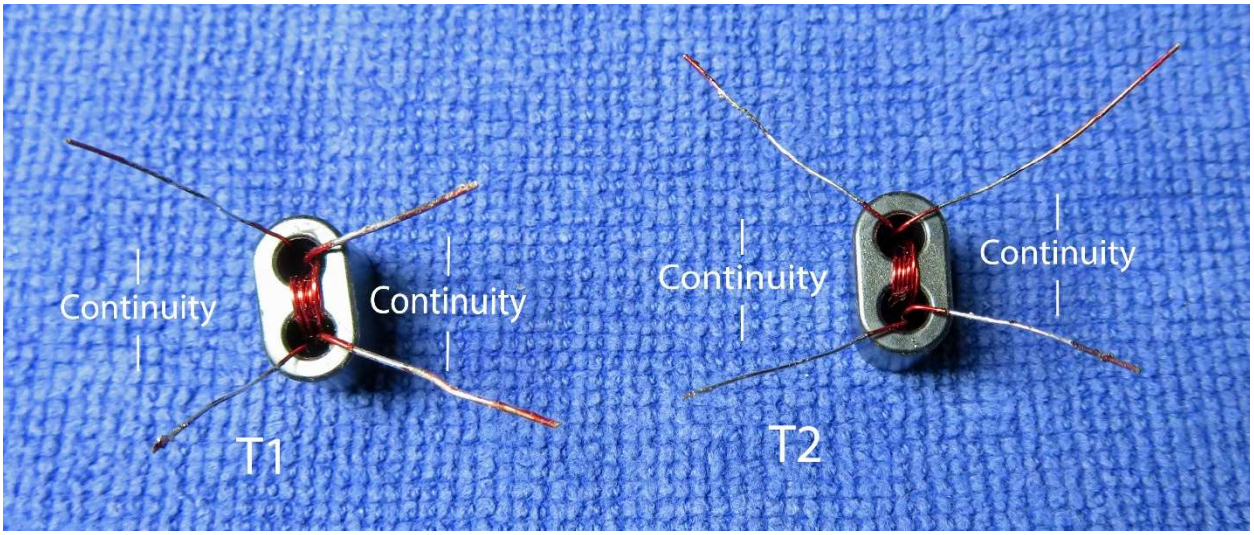


Using the thinner 28-gauge wire wind 8 turns, once again threading it snugly and trimming the wires to one inch. Using an emery board, carefully remove the insulation from about 1/16” below the toroid core to the end of each wire. Using your soldering iron with the heat turned up full, melt solder on to the tip to form a drop and hold that drop on the wire where you have removed insulation. Any remaining insulation will be burned off. Draw the solder blob along the wire, slowly moving away from the toroid core. This melts off the remaining insulation and tins the wire. Spread the wires out at the bottom, keeping the two thicker wires on one side and the two thinner wires on the other side.

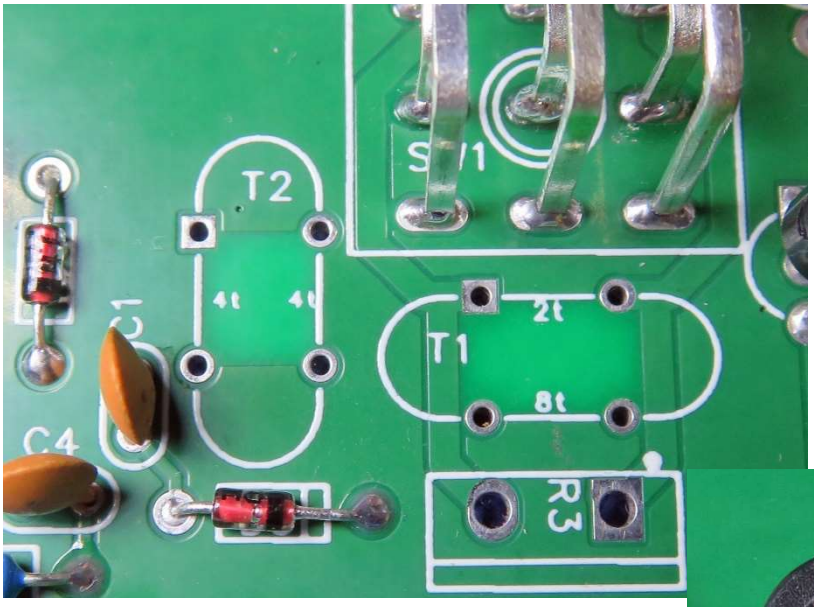




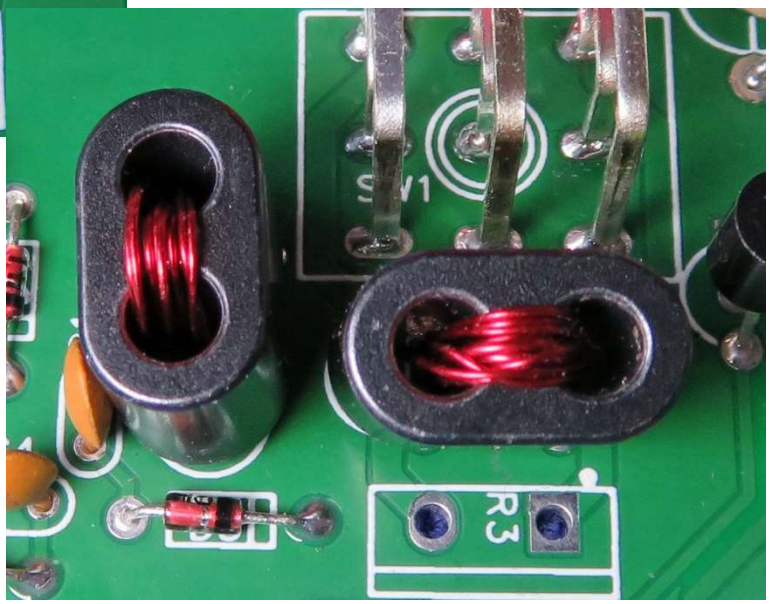
Wind T2 by first preparing the wire. Fold the remaining 28-gauge wire in the center and twist it about 2 turns per inch. Pinch the folded end to form a sharp point. Wind 4 turns as with T1 before. Trim the wires to have one inch coming from the bottom as before. Spread the leads out and strip and tin that as with T1. Using a meter, check for continuity and match each pair on the same side. The two wires on the left side should be connected and the two on the right should be connected and no connection between those and the wires on the opposite side.



Mount the toroids as per the markings on the board. Orient T1 so the thicker 24-gauge wires go in the side marked 2t and the thinner 28-gauge wires go into the holes marked 8t. T2 can be oriented either way. Just be sure that the wires have continuity only on the same

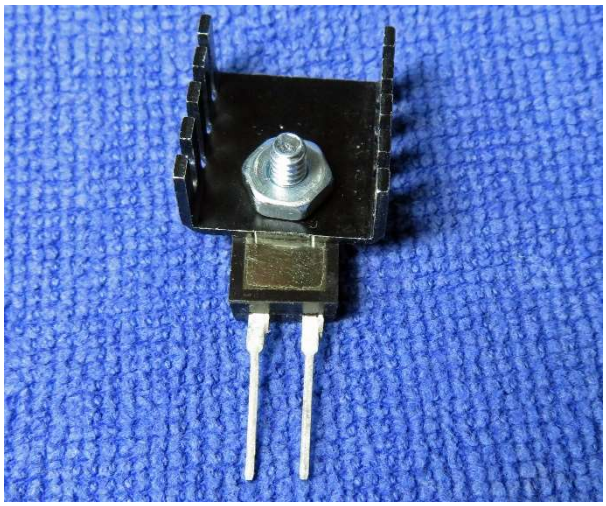


side. One pair of wires should be going to each side marked 4t. Since the T1 and T2 wires are all tinned, they should solder easily to the board.



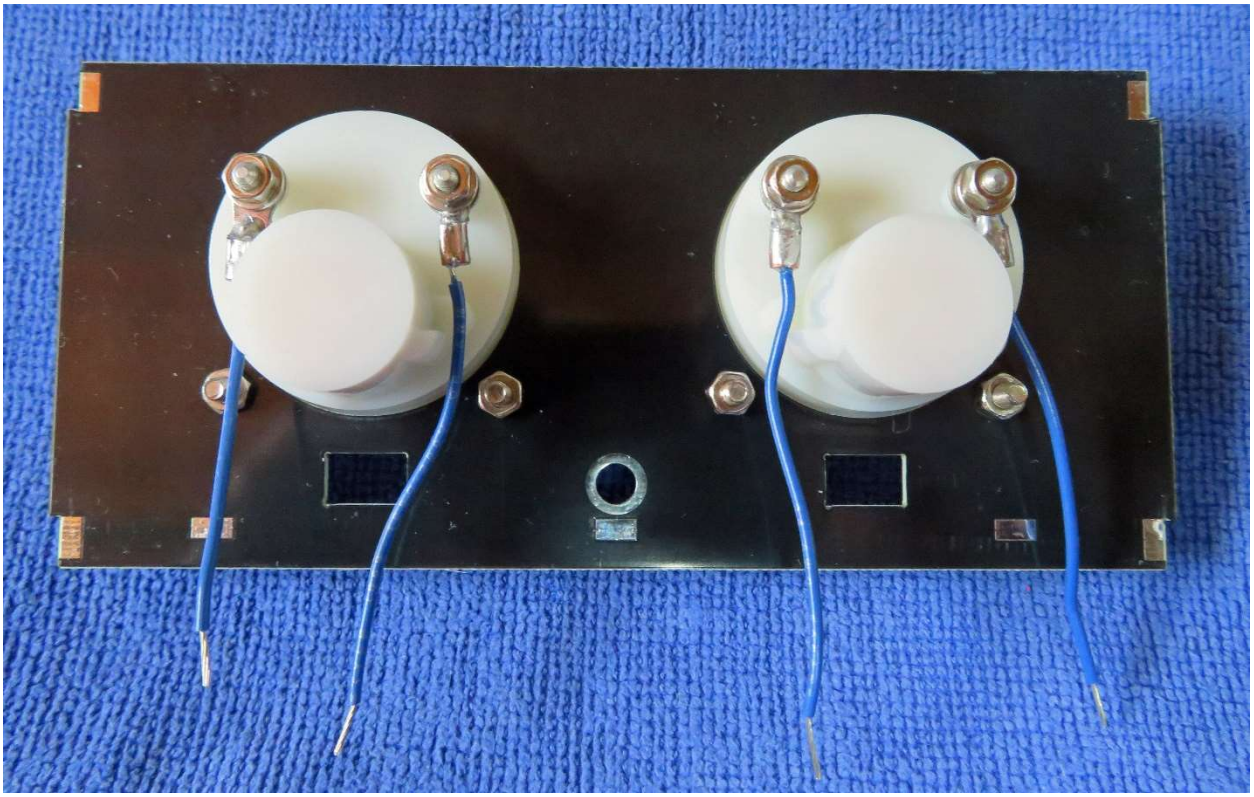
Step 10 – Mounting R3

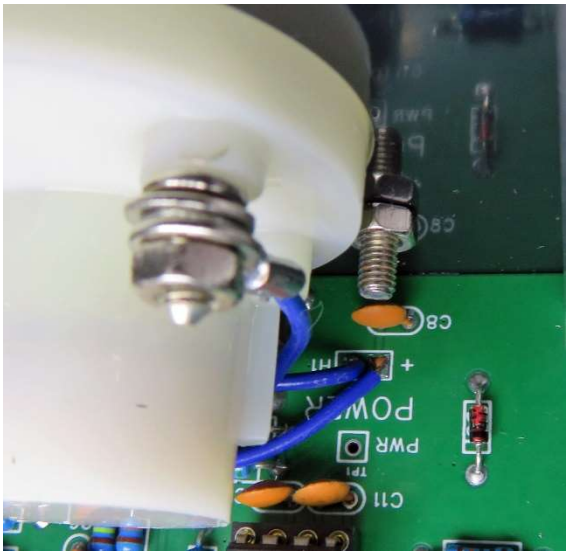
R3 is a 10-ohm resistor that looks like a TO-220 transistor, but has only two pins. Using a 6-32 x 3/8" screw and a nut mount the heatsink as pictured before soldering R3 to the board. Mount this assembly to the board with the heatsink flange facing away from the toroids as marked on the board. See the picture in Step 8 for orientation.

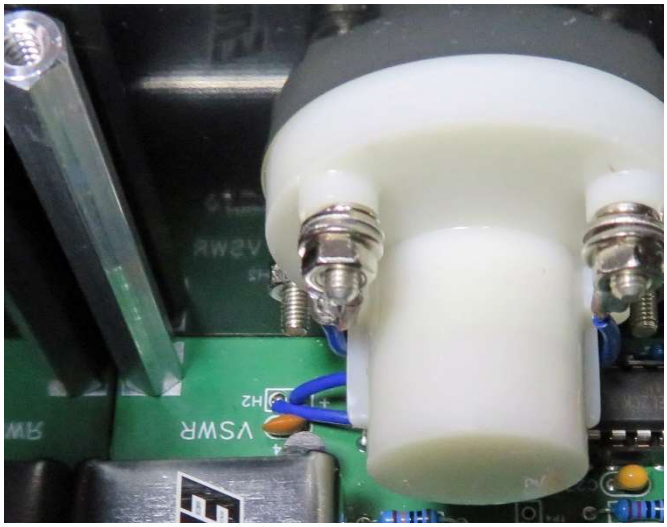


Step 11 – Mounting and wiring the meters

Each meter comes with a bag of small parts. Place each meter through the mounting holes in the front panel. Use a lockwasher and a nut on each screw to hold each meter in place. DO NOT OVERTIGHTEN! The meter case can be broken easily. Cut four 2 ½" long pieces of the insulated wire provided. Strip ¼" of insulation from each end. Tin one end and form a hook at one end of each wire. Alternatively, attach a solder lug to one end of each wire (not supplied). Make note of which lead is marked (-) on each meter. Attach a wire to each meter by using a lockwasher, a flat washer, the wire, then another flat washer and then a nut. Tighten the nut but once again, DO NOT OVERTIGHTEN.

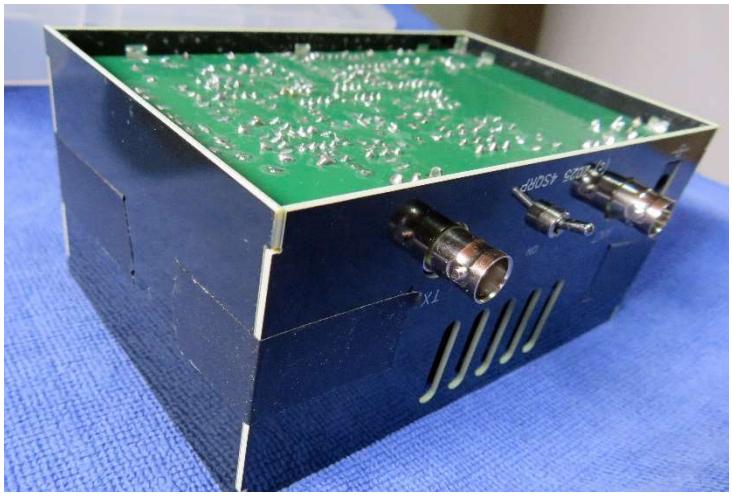






Below one meter are two holes on the PC board that are marked POWER then H1. Solder the (-) wire to the hole marked H1 and the other wire to the (+) hole next to it. Below the other meter are holes marked VSWR and H2. Solder the (-) wire to the hold closest to H2 and solder the other wire to the (+) hole next to it.

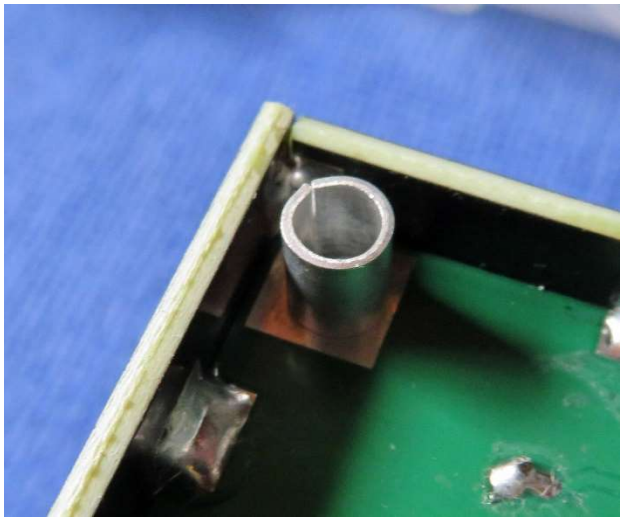
Step 12 – Assembling the case



Fit the front and back case parts with the printed sides and meter faces facing outward. Fit the side pieces with the tinned chassis rectangles facing inwards to meet with those on the main board and the front and back panels. Use electrical tape or rubber bands (or both!) to hold the case parts together. Be sure they all fit square and flush with each other before soldering.

Solder a center set of pads or one end first on each piece to be sure everything is held straight and flush. It is easier to reheat and adjust if only one is done on each piece at first.

Once everything is OK, solder the remaining case pads together, including the top four corners as well.



Turn the case upside down and place the four aluminum standoffs over each of the four holes. Gently place the bottom cover (the top and bottom covers are identical!) over the case bottom, being careful not to move the standoffs out of place. Take the four longer screw and pass them through each corner hole, making sure they pass through the standoffs and the main board. Using four fingers, hold the four screws in place while you turn the case over on to the bottom making sure the screws hold in place. Do this over a mat or other surface you prefer but be careful what you use as the screws can scratch the surface. A thin towel works fine. Thread the four long standoffs on to each screw and tighten them all by hand as far as you can easily go. Then, using a screwdriver, tighten all four snugly, but don't overtighten! Insert a 9V battery on to the battery snaps, paying close attention to the polarity if you plan on using it. The kit can also be powered by a 12 VDC power supply, whether or not there is a battery inside. When inserting the battery, be sure not to bump the transistor that is immediately adjacent to the bottom of the battery. Use the four remaining screws to attach the top of the case. Put them in loosely at first to be sure all are threaded correctly before tightening them. Attach the peel and stick rubber feet to the bottom of the case.

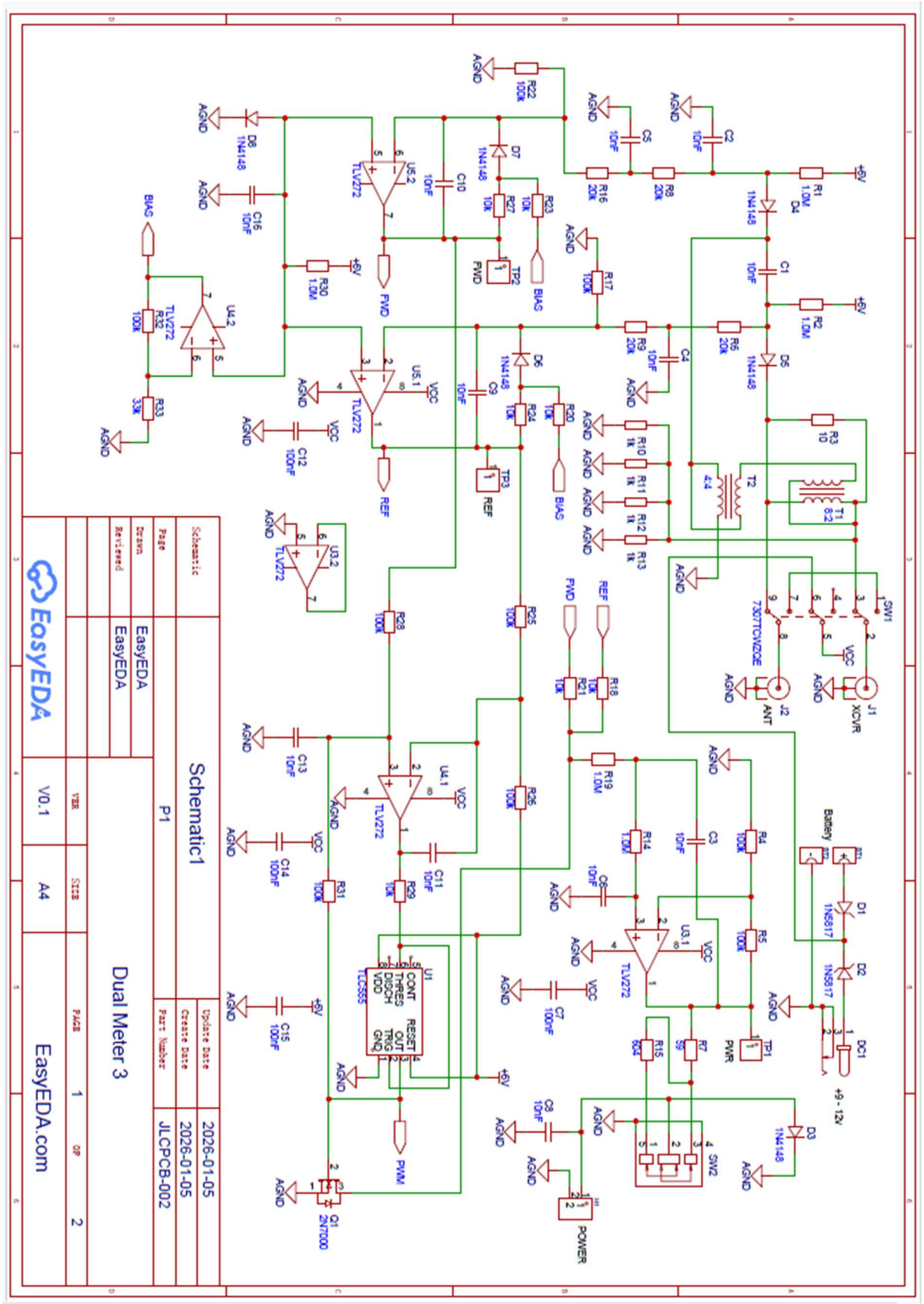
Step 13 – Testing

If you have not installed a 9V battery, connect a 12 VDC power source to the coaxial power jack on the back. If your QRP RF source is 1 watt or less, use the 1W scale as selected by the left switch and the 10:1 position of the right switch. Otherwise, use the 10W position. **DO NOT use more than 10 watts with this meter.** Connect a 50-ohm dummy load to the ANT BNC jack on the back and connect your RF source to the TX BNC jack. Turn the meter on using the toggle switch on the back. The LED should light green. Key your transmitter and note the reading. The right-hand meter shouldn't move much and the LED should stay green. In normal operation, the LED will turn red if the SWR is above 2:1.

Helpful links:

3D IC Pin Straightener: https://www.thingiverse.com/thing:4964069

10W BNC Dummy Load: https://a.co/d/0b8ftbcm


Schematic1
Dual Meter 3
EasyEDA.com
EasyEDA
Schematic
Page
Drawn
Reviewed
P1
EasyEDA
EasyEDA
Create Date
Part Number
Update Date
2026-01-05
2026-01-05
JLCPCB-002
VER
V0.1
SIZE
A4
PAGE
1
OF
2
+6V
AGND
VCC
BIAS
FWD
REF
PWM
+9 - 12v
Battery
XCVR
ANT
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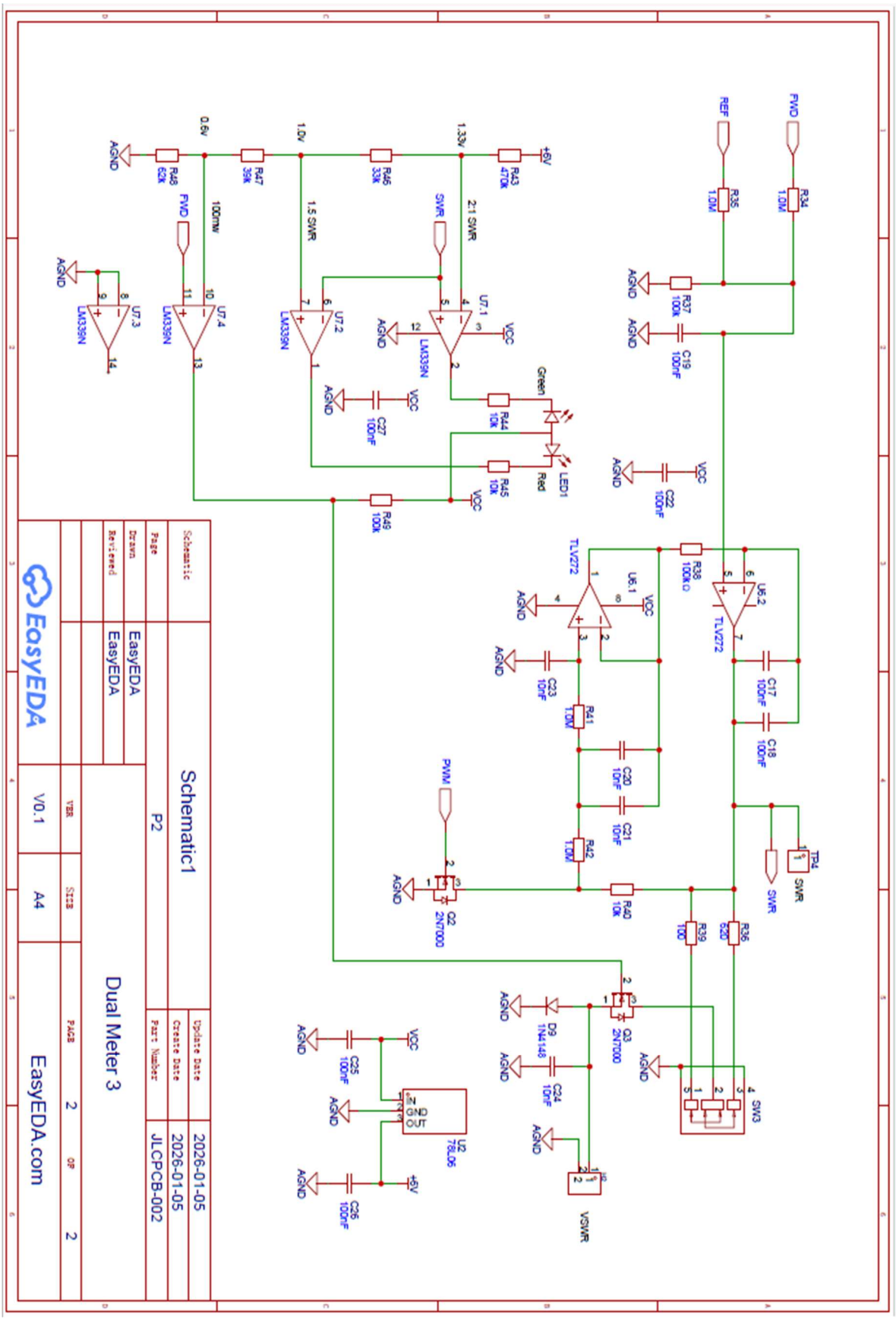
Schematic1
Dual Meter 3
EasyEDA.com
P2
V0.1
A4
2026-01-05
JLCPCB-002
EasyEDA
FWD
REF
SWR
PWM
VSWR
TLV272
LM339N
2N7000
78L05
1N4148
Green
Red
0.6v
1.0v
1.33v
+6V
VCC
AGND
1.5 SWR
2:1 SWR
100mw

BOM

1	1	9v battery clip	BT1
2	1	9v battery clip	BT2
3	16	10nF (103)	C1,C2,C3,C4,C5,C6,C8,C9,C10,C11, C13, C16,C20,C21,C23,C24
4	11	100nF (104)	C7,C12,C14,C15,C17,C18,C19,C22, C25, C26,C27
5	2	1N5817	D1,D2
6	7	1N4148	D3,D4,D5,D6,D7,D8,D9
7	1	Power Jack	DC1
8	2	BNC	J1,J2
9	1	Bicolor LED	LED1
10	3	2N7000	Q1,Q2,Q3
11	9	1.0M BROWN-BLACK-BLACK-YELLOW-BROWN	R1,R2,R14,R19,R30,R34,R35,R41, R42
12	1	10 (TO-220 case)	R3
13	4	20k RED-BLACK-BLACK-RED-BROWN	R6,R8,R9,R16
14	1	59 GREEN-WHITE-BLACK-GOLD-BROWN	R7
15	4	1k - 1WATT BROWN-BLACK-RED-GOLD	R10,R11,R12,R13
16	1	604 BLUE-BLACK-YELLOW-BLACK-BROWN	R15
17	1	620 BLUE-RED-BLACK-BLACK-BROWN	R36
18	12	100k BROWN-BLACK-BLACK-ORANGE-BROWN	R4,R5,R17,R22,R25,R26,R28,R31, R32,R37,R38,R49
19	10	10k BROWN-BLACK-BLACK-RED-BROWN	R18,R20,R21,R23,R24,R27,R29,R40, R44, R45
20	2	33k ORANGE-ORANGE-BLACK-RED-BROWN	R33, R46
21	1	100 BROWN-BLACK-BROWN-GOLD	R39
22	1	470k YELLOW-PURPLE-YELLOW-GOLD	R43
23	1	39k ORANGE-WHITE-ORANGE-GOLD	R47
24	1	62k BLUE-RED-ORANGE-GOLD	R48
25	1	7307TCWZQE	SW1
26	2	SS-12D11G5R	SW2,SW3
27	2	BN43-302	T1,T2
28	1	TLC555CP	U1
29	1	78L06	U2

30	4	TLV272	U3,U4,U5,U6
31	1	LM339P	U7
32	2	10mA Analog Meter	M1, M2
33	5	6-32 x 3/8"	
34	4	6-32 x 11/16"	
35	4	6-32 x 2.25" Standoff	
36	4	6 x 1/4" spacer	
37	1	TO-220 Heat Sink	
38	1	6-32 nut	
39	1'	24 AWG stranded hookup wire	
40	6'	28AWG Magnet Wire	
41	1'	24AWG Magnet Wire	
42	4	Rubber Feet	
43	5	8 pin DIP sockets	
44	1	14 pin DIP socket	

Some resistors are 1% tolerance and are marked with 5 stripes and have a BROWN stripe at the end. Some of these 1% resistors will have a BROWN stripe on both ends, meaning they are values that begin with 1 and are also 1% tolerance. If in doubt, check it with a meter! Resistors R10-11-12-13 are 1K 1watt resistors 5% tolerance, so they are larger and have a gold stripe at the end. R3 is 10 ohms and is in a TO-220 case similar to a power transistor, but with only two leads.