

## Steps to solder components in order for OSC7.8

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Please look the board over carefully and read the instructions and parts list to familiarize yourself with the

assembly procedure before you begin.

IC's are marked on one end with a small indented "notch". The IC sockets are also notched.

The ESP32 DEV board faces with the mini USB port towards the edge of the board.

Electrolytic (cylindrical shape) capacitors have a + & - side .

Please note that there will be some components silkscreened on the board that are "legacy" and no longer used in this version.

Solder all components on the bottom of the board, and insert the wires through holes & solder to bottom of board.

Part 1 : High Voltage supply

\*\*\*\*\*If you are building the HV version (1,000+VDC) you only need to make one jumper connection, HV0.

\*\*\*\*\*If you are building the LV version (600+VDC) you will need to connect jumpers LV1, LV2, and LV3.

D1 - 1N4007 diode NOTE ORIENTATION

R1 - 10 ohm , 3 W resistor ( brown black black )

D3 - 1N4007 diode NOTE ORIENTATION

C1 - (LV version) = 4.7 uF , 450 V capacitor , NOTE ORIENTATION + - , (HV version) = 4.7uF, 630V capacitor - NON POLARIZED

C4 - (LV) = 4.7 uF , 450 V capacitor , NOTE ORIENTATION + - , (HV) = 4.7uF, 630V capacitor - NON POLARIZED

P2 - 1M ohm potentiometer (105), DON'T SOLDER WIPER YET

P1 - 1M ohm potentiometer , DON'T SOLDER WIPER YET

P3 - (top adjust) - 50Kohm (503) or 47Kohm (473) potentiometer. This is the same physical size as P1 & P2

R3 - For the HV version - 1M 1/2 W \*\* For the LV version - 470K ohm, 1/2 W ( yellow purple yellow ) resistor

Neon bulb (HV indicator)

R37 - 10M ohm resistor ( brown black blue )

F1(Fuse) - 1.6A, 250V fuse or fuse holder & bus fuse.

4 pin jumper - only necessary to switch between 120VAC (U.S.) and 240VAC (some other countries)

- If this is not necessary, you may solder a small jumper to the appropriate holes (120 or 240, marked) to make a permanent connection.

Solder 8" of ~18 gauge wire with black insulation to Fuse input marked "HOT" (left side, end of Fuse closer to X1).

Solder 8" of ~18 gauge wire with white insulation to NEUTRAL

Part 2 : Low voltage supply & wave shaper, relay control

S3 - tactile pushbutton switch ( toggle display on / off )

Relay - it only fits correctly one way

Rfilament - (next to S3) - this will be determined by the type of CRT used. Generally, 4.7 ohm, 3 watt works for many CRTs, however, for some types a different value may be used, i.e., some European types like DG7-6 may need a 10 ohm, 3 watt.

When you first connect your CRT and power it on, you should read the voltage across the filaments (heaters) and determine if this falls within the specs for your CRT type. If the voltage is too high, use a higher value resistance for Rfilament to lower CRT filament voltage. This can be different depending on the individual crt, some experimenting may be necessary to find the optimal value, but in most cases it's okay to start by using the 4.7 ohm 3 watt resistor included.

R38 - 2.2 K ohm , ¼ watt ( red red red )

Q7 - 2N3904 NPN transistor ORIENT correctly - emitter should be next to Q7

R33 - 10 K ohm , ¼ W , ( brown black orange )

B1 - full wave rectifier bridge NOTE ORIENTATION ( it has - & + )

R14 - 100K ohm , ¼ W ( brown black yellow )

C6 - 1,000 uF, 16 V+ cap NOTE ORIENTATION

R29 - 1K ohm, ¼ W

D9 - 1N4001 diode NOTE ORIENTATION

R27 - 10 K ohm, ¼ W ( brown black orange )

Q8 - 2N3904 transistor , collector should be at Q8

D56 - 1N4001 diode NOTE ORIENTATION

P6 (side adjust) - 50K ohm side adjust potentiometer (x centering) These don't go all the way through the holes, ok to solder on top of board

P7 (side adjust) - 50K ohm pot (y center)

C22 - .01 uF (103) cap

C10 - 100 uF, 6.3 V cap NOTE ORIENTATION.

R26 - 470 ohm , ¼ W or 10K for less brightness

5mm (large) LED - NOTE ORIENTATION, long lead is anode ( + )

7805 - 5V regulator NOTE ORIENTATION

### Part 3

Q1 - STX13005 NPN transistor

R99 - For a 5UP1 crt - 220K ohm ( red red yellow )

R4 - For a 5UP1 crt - 220K ohm ( red red yellow )

R6 - 180 K ohm resistor (brown grey yellow)

R8 - 180 K ohm resistor (brown grey yellow)

P4 - 50 K ohm, .12W potentiometer (503) (top adjust, next to Q1) (ok to solder on top of board)

Q4 - STX13005 NPN transistor

R13 - 10 K ohm resistor (brown black orange)

R31 - 10 K ohm resistor (brown black orange)

Q2 - STX13005 NPN transistor

P5 - 50 K ohm, .12W potentiometer (top adjust) (ok to solder on top of board)

Q3 - STX13005 NPN transistor

R10 - 10 K ohm resistor (brown black orange)

R9 - 10 K ohm resistor (brown black orange)

R5 - 4.7 K ohm resistor (yellow purple red)

R11 - 4.7 K ohm resistor (yellow purple red)

R7 - 4.7 K ohm resistor (yellow purple red)

R12 - 4.7 K ohm resistor (yellow purple red)

C11 - .1 u F (104) capacitor

C222 - .1 u F (104) capacitor

C33 - .1 u F (104) capacitor

U5 - 8 pin IC socket NOTE ORIENTATION

R25 - 47K ohm resistor

R22 - 47K ohm resistor

U4 - 8 pin IC socket NOTE ORIENTATION

R24 - 47K ohm resistor

R23 - 47K ohm resistor

U6 - 8 pin IC socket NOTE ORIENTATION

two 19 - pin straight pin headers (female) for the ESP32 DEV board

R20 - 2.2 K ohm resistor ( red red red )

R21 - 2.2 K ohm resistor ( red red red )

S1 - tactile pushbutton switch ( fast set )

S2 - tactile pushbutton switch ( slow set )

D57 - 1N4001 diode

Transformer - Primary (1,2,3,4) side is next to fuse, secondaries (5,6,7,8) should line up w/ the holes next to the edge -

the transformer primaries on AN0109 are red - black primaries and blue - green secondaries.

The first red primary wire goes to the holes connected to the NEUTRAL, over "Trans".

the second and third (black & red) wires in the middle go to the holes in the middle connection under the word "Primary"

the third and last is the black wire that goes to the hole under "LV3"

These are marked with small circles on the board in silkscreen.

Connect the white wire to the AC power cord white (neutral) and the black wire to black (hot)

When it's plugged in, the LED should light.

Test for low voltage at (5VDCOUT) (next to Rfilament)

Test the relay control by inserting a jumper wire in pin # 19 and pin # 27 of the ESP32 socket.

The relay should make a small click noise.

\*\*\*\*\* (HV Version only)

If using the Antek AS-05TC200 high voltage transformer,

Connect the primaries in parallel (reds tied together and blacks together)

Blacks connect to HV3 on the board (middle connection of the low voltage transformer primaries)

Connect the reds to HV4 on the board

Connect the white of the first 200VAC secondary to the yellow of the 2nd one.

This will connect the two secondaries in series to make one 400VAC.

Connect the yellow of primary 1 to HV2

Connect the white of primary 2 to HV1

You can also test for high voltage by inserting a jumper wire in pin # 19 and pin # 27 of the ESP32 socket, please see the drawing "ESP32pins".

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PART 4, wires from the board to the crt socket :

Use 20 gauge wire , 8 " lengths , (or longer depending on where you want to mount crt , it will work ok with lengths of 12")

Solder a wire to K (P3 wiper) for the CRT cathode

Wire to F (wiper of P1) for the CRT focus

Wire to A (wiper of P2) for the CRT anode

Wire to G (next to Neon bulb) for CRT control grid

Wire to X1 for CRT X1 plate

Wire to X2 for CRT X2 plate

Wire to Y1 for CRT Y1 plate

Wire to Y2 for CRT Y2 plate

Wire to f (near to R1) for CRT filament

Wire to other f for other CRT filament

Part 6 - bringing the crt to life

Ok now you should be ready to fire up that crt , set P1 - P5 in the middle position of their adjustment .

Now set P7 (side adjust) all the way to the left (counter clockwise), set P6 (side adjust) all the way right (clockwise).

Use a short piece of hookup wire that will fit snugly in the IC socket 's pin sockets, and connect pin # 19 on the ESP 32 socket (in line pin header)

to pin # 27 on ESP32 socket.

Plug in the AC power cord and in a few minutes, hopefully you will begin to see a blob or dot in about the middle of the screen.

Adjust P1 until the spot is as round as it can get. Adjust P2 until it is as sharp as it can get .

P3 (brightness) may also need to be adjusted to get the optimal focus.

Readjust P1

Unplug the cord .

Now plug in the two IC's marked "4132" into the sockets U5 & U4, being careful to NOTE the orientation (the notch should be "up", or towards the middle of the board)

Plug the AC power cord back in.

Adjust P6 & P7 (side adjust) to their middle positions . You should see the spot again , center it & readjust P1 & P2 for the best focus / roundest spot

Now unplug the power cord , and insert the IC marked 12f629 into socket U6. Plug power cord back in, and when the spot reappears, watch for it to move a slight bit left / right up / down.

This means the shifter is working.

Unplug the power again , and insert the ESP32 board, and plug back in and follow the instructions for setup.

If you're just using manual time set (no wifi) just press and hold "slow set" button for a few seconds until the relay clicks and the neon bulb lights.

The clock screen should appear, but may need adjustment for size (P4 & P5) and / or brightness, focus and astig.

It may also need to be centered using P6 & P7.