

Nixie Clock Main Board Assembly

The top side of the board is identified with the lettering “TMD Innovations”

Some of the components can be destroyed by discharge of static electricity. Use precautions to avoid static electricity.

Make sure all components are mounted tightly against the circuit board.

Trim all long leads after soldering.

1. Locate, install, and solder resistor R1 a 5.1k Ohm $\frac{1}{4}$ watt resistor.
Marked Green-Brown-Red
2. Locate, install, and solder resistor R2 a 330 Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Black
3. Locate, install, and solder resistor R3 a 680k Ohm $\frac{1}{4}$ watt resistor.
Marked Blue-Gray-Yellow
4. Locate, install, and solder resistor R5 a 4.7k Ohm $\frac{1}{4}$ watt resistor.
Marked Yellow-Violet-Red
5. Locate, install, and solder resistor R23 a 10k Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Black-Orange
6. Locate, install, and solder resistor R24 a 10k Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Black-Orange
7. Locate, install, and solder resistor R25 a 10k Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Black-Orange
8. Locate, install, and solder resistor R26 a 10k Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Black-Orange
9. Locate, install, and solder Diode rectifier D2 1N5819. The banded side of the diode points toward the square hole in the circuit board.
10. Locate, install, and solder Diode rectifier D3 UF4007. The banded side of the diode points toward the square hole in the circuit board.
11. Locate, install, and solder capacitor C6 a 681pf capacitor.
Marked 681
12. Locate, install, and solder capacitor C10 a 33pf capacitor.
Marked 330
13. Locate, install, and solder capacitor C11 a 33pf capacitor.
Marked 330
14. Locate, install, and solder crystal X1 the 12Mhz Crystal. When installing the crystal use a small paper shim under the crystal. If the crystal is pushed tight against the circuit board it may cause a short between the leads. After soldering the crystal to the board use an ohm meter to test between the crystals leads for a short before trimming the leads. If correctly installed a short should not exist. The paper shim should be removed after testing the crystal.
15. Locate, install, and solder an 8 pin socket in the U2 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.

When installing the sockets it's easiest to solder down two pins on opposite corners of the socket. Then after verifying that the socket is properly seated go back and solder all pins to the board. After installing each socket verify that there are no solder bridges between the pins.

16. Locate, install, and solder an 8 pin socket in the U13 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
17. Locate, install, and solder a 14 pin socket in the U14 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
18. Locate, install, and solder a 40 pin socket in the U12 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
19. Locate, install, and solder resistor array RN1 a 10k Ohm resistor array. Pay attention to the orientation of the resistor array. The end of the array with the dot goes towards the edge of the circuit board.
Marked 10A103G
20. Locate, install, and solder resistor array RN2 a 10k Ohm resistor array. Pay attention to the orientation of the resistor array. The end of the array with the dot goes towards the edge of the circuit board. **The circuit board has a missing trace that needs to be bridged between pin 10 on the resistor array and pin 31 of the microprocessor chip U12. An "X" showing the correct pin is printed on the parts layout diagram. Use a small piece of wire wrapped around pin 10 of the resistor array and pin 31 of the IC socket. Solder the wire on both pins.**
Marked 10A103G
21. Locate, install, and solder capacitor C2 a .1uf capacitor.
Marked 104
22. Locate, install, and solder capacitor C4 a .1uf capacitor.
Marked 104
23. Locate, install, and solder capacitor C7 a .1uf capacitor.
Marked 104
24. Locate, install, and solder capacitor C16 a .1uf capacitor.
Marked 104
25. Locate, install, and solder capacitor C17 a .1uf capacitor.
Marked 104
26. Locate, install, and solder capacitor C18 a .1uf capacitor.
Marked 104
27. Locate, install, and solder Bridge rectifier D1 W005M. The longer lead marked with a "+" goes into the square hole in the circuit board
28. Locate, install, and solder battery holder BH1. It will only go on the board in one direction, the single lead to the center of the circuit board.

29. Locate, install, and solder small round crystal X2 the 32.768khz Crystal.
30. Locate, install, and solder trimmer resistor R4 a 5k Ohm trimmer resistor. The white adjustable control points out towards the edge of the circuit board.
Marked 502
31. Locate, install, and solder switch S1 the RED mode switch. Solder the mounting tabs for a solid physical mount.
32. Locate, install, and solder switch S2 the BLACK mode switch. Solder the mounting tabs for a solid physical mount.
33. Locate, install, and solder socket J1 a 16 pin socket connector.
34. Locate, install, and solder socket J2 a 16 pin socket connector.
35. Locate, install, and solder connector J3 a 2 position screw down connector. Point the screws towards the edge of the circuit board when installing.
36. Locate, install, and solder header J4 a 3 pin short header connector. This connector can be used to connect off board mode and setting switches.
37. Locate, install, and solder header J5 a 4 pin short header connector. This connector is used to connect to a WWVB radio. If the radio is not used a shorting bar must be placed across the middle two pins.
38. Locate, install, and solder capacitor C9 a 10uf 16 volt electrolytic capacitor. Pay attention to the polarity of the capacitor. The long positive lead goes into the square pad.
39. Locate, install, and solder capacitor C8 a 2.2uf 250 volt electrolytic capacitor. Pay attention to the polarity of the capacitor. The long positive lead goes into the square pad.
40. Locate, install, and solder capacitor C1 a 220uf 25 volt electrolytic capacitor. Pay attention to the polarity of the capacitor. The long positive lead goes into the square pad.
41. Locate, install, and solder capacitor C3 a 180uf 16 volt electrolytic capacitor. Pay attention to the polarity of the capacitor. The long positive lead goes into the square pad.
42. Locate, install, and solder capacitor C5 a 470uf 35 volt electrolytic capacitor. Pay attention to the polarity of the capacitor. The long positive lead goes into the square pad.
43. Locate, install, and solder inductor L1 a 100 uH toroid inductor.

Marked 2112-V

44. Locate, install, and solder inductor L2 a 330 uH drum inductor. Use the closer set of holes to solder the inductor to the circuit board. Marked 331
45. Locate Q1 an IRF720 TO220 style power transistor. Mount Q1 to a heat sink with a 6-32 screw, lock washer, and nut. Install Q1 on the circuit board with its tab facing away from the 330 uh inductor.
46. Locate U1 the LM2595T TO220 style voltage regulator. Mount U1 to a heat sink with a 6-32 screw, lock washer, and nut. Install Q1 on the circuit board with its tab facing away from L1.
47. Locate U2 the MC34063 8 pin dip regulator. Carefully install the IC into its socket. Pay attention to the orientation of the IC, pin 1 is closest to Q1 and L2 . After installation make sure all of its pins are seated properly and not bent under the IC.
48. **WARNING – DANGEROUS Voltages are created from the power supply.** In this step you will test and adjust the high voltage power supply. If you are unsure what you are doing PLEASE get help.

When performing adjustments or anytime voltage is applied the clock must be handled with great care. Always make sure the board is on a non-metallic insulated surface. Never allow anything to short across any of the circuit board traces.

Refer to the parts layout diagram and the photograph of the main board for this step. Orient the main circuit board with J1 in the lower left corner. In this position pin one of J1 and J2 are in the upper right corners of the connectors. Using a piece of ½ bare copper wire insert a wire into pin 1 of J1. Insert another wire into pin 9 of J1. Insert another wire into pin 16 of J2. Make sure that none of the wires are touching each other or any other component. With the AC adaptor unplugged, connect the 12 volt power leads to J3 and tighten the wires firmly in the connector.

Power Connections:

J1 pin 1	+5 Volts
J1 Pin 9	+180 Volts
J2 Pin 16	Ground

Connect the positive lead of a volt meter to pin 9 of J1 and the ground lead to pin 16 of J2 and plug in the AC adaptor. If everything was properly installed you should not get any smoke or sparks. Your meter should be showing about 120 volts with the adjustment on R4 centered. Adjust the high voltage by turning R4's control to the right until you get a reading of 180 volts. Now move the positive volt meter lead to the wire on pine 1 of J1. You should see a reading close to 5 volts. Unplug the AC

adaptor. Wait a few minutes to allow the high voltage to bleed off before handling the board.

49. Locate and install U13 the DS1307 a 8 pin IC. Pay attention to the orientation of the IC, pin 1 is closest to the small crystal X2.
50. Locate and install U14 the 74HCT04N a 14 pin IC. Pay attention to the orientation of the IC, pin 1 is closest to the corner of the circuit board.
51. Locate and install U12 the AT89C51RC a 40 pin IC. Pay attention to the orientation of the IC, pin 1 is closest to the edge of the circuit board.
52. Locate the three 1 1/8 inch and the four 1/2 inch nylon standoffs. The four 1/2 standoffs pass through the holes on the underside of the circuit board. On the three front standoffs screw on the three 1 1/8 inch. These standoffs will support the display board. Screw a 4-40 nut onto the single standoff on the back board. Be sure not to over tighten the nut or standoffs or you will strip the nylon screws.
53. The real time clock uses a 2032 lithium battery. When installing the battery the + (plus) side goes down into the holder. You may install the battery at anytime.

Display Board Assembly

The top side of the board is identified with the lettering “TMD Innovations”

Some of the components can be destroyed by discharge of static electricity. Use precautions to avoid static electricity.

Make sure all components are mounted tightly against the circuit board.

Trim all long leads after soldering.

54. Locate, install, and solder resistor R13 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

55. Locate, install, and solder resistor R15 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

56. Locate, install, and solder resistor R27 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

57. Locate, install, and solder resistor R28 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

58. Locate, install, and solder resistor R29 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

59. Locate, install, and solder resistor R30 a 1.2 Meg Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Red-Green

60. Locate, install, and solder resistor R6 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

61. Locate, install, and solder resistor R7 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

62. Locate, install, and solder resistor R8 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

63. Locate, install, and solder resistor R9 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

64. Locate, install, and solder resistor R10 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

65. Locate, install, and solder resistor R11 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange

66. Locate, install, and solder resistor R12 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange
67. Locate, install, and solder resistor R14 a 33k Ohm $\frac{1}{4}$ watt resistor.
Marked Orange-Orange-Orange
68. Locate, install, and solder resistor R16 a 1k Ohm $\frac{1}{4}$ watt resistor.
Marked Brown-Black-Red
69. Locate, install, and solder resistor R17 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange-Blue-Orange
70. Locate, install, and solder resistor R18 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange- Blue-Orange
71. Locate, install, and solder resistor R19 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange- Blue-Orange
72. Locate, install, and solder resistor R20 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange- Blue-Orange
73. Locate, install, and solder resistor R21 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange- Blue-Orange
74. Locate, install, and solder resistor R22 a 36k Ohm $\frac{1}{2}$ watt resistor.
Marked Orange- Blue-Orange
75. Locate, install, and solder a 16 pin socket in the U3 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
76. Locate, install, and solder a 16 pin socket in the U4 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
77. Locate, install, and solder a 16 pin socket in the U5 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
78. Locate, install, and solder a 16 pin socket in the U6 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
79. Locate, install, and solder a 16 pin socket in the U7 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
80. Locate, install, and solder a 16 pin socket in the U8 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.

81. Locate, install, and solder a 16 pin socket in the U9 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
82. Locate, install, and solder a 14 pin socket in the U10 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
83. Locate, install, and solder a 14 pin socket in the U11 IC position. Pay attention to the orientation of the socket. Pin 1 is indicated by the square hole on the circuit board.
84. Locate, install, and solder capacitor C12 a .1uf capacitor.
Marked 104
85. Locate, install, and solder capacitor C13 a .1uf capacitor.
Marked 104
86. Locate, install, and solder capacitor C14 a .1uf capacitor.
Marked 104
87. Locate, install, and solder capacitor C5 a .1uf capacitor.
Marked 104
88. Locate, install, and solder Q2 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram. Make sure you do not apply too much heat when soldering the transistors.
89. Locate, install, and solder Q3 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
90. Locate, install, and solder Q4 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
91. Locate, install, and solder Q5 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
92. Locate, install, and solder Q6 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
93. Locate, install, and solder Q7 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
94. Locate, install, and solder Q8 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.
95. Locate, install, and solder Q9 a MPSA42 transistor. Pay attention to the orientation of the transistor. Match the contour of the transistor with that on the layout diagram.

96. Locate, install, and solder V1 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube. Allow yourself plenty of time for this part of the assembly. Have really good light. A small set of needle nose pliers or hemostats is necessary to thread the wire leads of the tube into the holes of the circuit board. There are thirteen wires that need to be inserted into the circuit board. To properly index the Nixie Tube locate the lead that has a white sleeve inside the lower portion of the Nixie Tube. This is the anode of the nixie tube; it connects to the large back plate inside the tube. Where the tube mounts on the circuit board you will see a square pad. Through the hole in this square pad you will insert the anode connection from the Nixie tube. Before installing each tube straighten each lead trying to align the leads to the circuit board pattern. Leave the plastic base piece on the tube. Holding the tube vertically insert the anode lead first to make sure you have proper lead alignment. Then using pliers or hemostats push the other leads into their holes until you have all thirteen wires places. It helps if you elevate the circuit board about a half of an inch. It's also helpful if you place the board on a piece of paper so you can spin the board around as you move from lead to lead. When you have all of the leads in their holes slide the tube halfway down towards the board. Once again verify that you have properly aligned the tube by inspecting the anode lead. If the tube is properly indexed push the tube base snugly against the circuit board. Solder and trim the leads.
97. Locate, install, and solder V2 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube.
98. Locate, install, and solder V3 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube.
99. Locate, install, and solder V4 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube.
100. Locate, install, and solder V5 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube.
101. Locate, install, and solder V6 a NH-14 Nixie Tube. Pay very close attention to the orientation of the Nixie Tube.
102. Locate the long 1.5 inch header pins. The pins mount to the underside of the display board to make a connection to the main circuit board. Two groups of 8 pin single row header pins are used to construct each of the double row headers. Take two sets of 8 pins and at the same time push them into the J1 header position on the underside of the display board. The black plastic strips should be flush to the underside of the board. Until the pins are soldered to the display board the pins will spread. Place the display board onto the main board standoffs. Push the pins from J1 into the socket on the main board. Once you have everything aligned up properly solder the header pins to the top side of the display board.

103. Locate the long 1.5 inch header pins and repeat the header pin installation for J2.
104. There are four colon/indicator boards, two tall and two short. The small neon lamps have a polarity “bump” located on the crimped part of the tube where the leads exit the lamp. To properly assemble the boards this bump should be on the right side of the assembly as you look at the light emitting window at the front of the tube. Hold a neon lamp facing you with the leads exiting back, the polarity bump should be on the right. To mount lamps in the lower holes bend the leads under the lamp using about a one eighth inch radius. The leads should almost come forward to the front of the lamp face. Push the lamp through the larger hole in the bottom of a colon/indicator board. Align the wire leads through the smaller holes. Push the lamp until 3/8 of an inch of lamp passes through the board. Square the lamp in the hole and solder and trim the leads. To mount lamps in the upper holes bend the leads over the top of the lamp using about a one eighth inch radius.

Solder a 4 pin 90 degree header to the front side of each colon/indicator board.

Now mount and solder the colon/indicator boards to the display boards. Do not install the left indicator unless you plan you use a WWVB to set the clock time. Without the radio the indicator will endlessly blink.
105. Locate and install U10 the 74HCT04N a 14 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards J1.
106. Locate and install U9 the 74HCT138N a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards U10.
107. Locate and install U11 the 74HCT04N a 14 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards U9.
108. Locate and install U3 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.
109. Locate and install U4 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.
110. Locate and install U5 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.
111. Locate and install U6 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.
112. Locate and install U7 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.

113. Locate and install U8 the K155NQ1 a 16 pin IC. Pay attention to the orientation of the IC, pin 1 goes towards the nixie tubes.
114. Carefully align the display and main boards together. Pass the studs from the three standoffs on the main board through the mounting holes in the display board. Make sure the header pins from the display board align properly in sockets of the main board. Once everything is properly aligned push the heard pins into the sockets to a depth where the front and rear of the boards are about equidistant. Place 4-40 nuts on the studs protruding through the display board. Because of the tight clearance by the base of the nixie tubes the 1 1/8 standoffs need to be turned into the nuts. To do this you must first loosen the 1/2 standoffs under the main board.
115. Visual check, solder bridges, bent pins on the ic's.
116. Connect power cube