**K9HZ T41 MAIN BOARD**

**BUILD INSTRUCTIONS for PCB V12.6**

**December 1, 2023**

**Background Information:**

The K9HZ T41 MAIN board is the next generation of hardware for the T41 software-defined transceiver. This is essentially Al Peter’s V012 board with the addition of some extra control lines for off-board accessories, front panel support, display voltage selection, new display driver section, and a soft-ON/OFF unit that provides for Teensy shutdown code. The only plug-in boards used in this version are the Teensy audio hat and the Teensy board itself. The rest of the plug-in board hardware has been moved to the MAIN board so that it can be customized to the needs of the T41. This gives lower noise and wider flat bandwidth signals from and to the DAC and ADC.

Two additional things are new:

1) The MAIN board has its own power supply (and, in fact, all V012 boards have their own power supply), 12V power is switched on at the MAIN board and distributed to the rest of the radio boards.

2) You will notice there are now parts on the back side of the MAIN board. This was done to optimize space and reduce noise. There is also a “Teensy Audio Hat Adapter” (shipped with the MAIN board) that shifts the audio hat to one side of the Teensy so that it clears the on-board power supply heat sinks. When this adapter is used, you must use 90-degree header pins for connection of the Q-OUT/AGND/I-OUT signals adjacent to Teensy pins 17/18/19 on the top side of the MAIN board.

To use the legacy Switch Matrix board and encoders (ala V010/V011 boards), one jumper needs to be installed to connect PIN 9 of the front panel/ Encoder connector on the MAIN board to PIN 39 of the Teensy (do that on the bottom). If you are using the new Front Panel boards and connections, this jumper is not needed.

Finally, you must select the display voltage via J2 (get this right or you may destroy your display).

Don’t install Q2. We will get to that later.

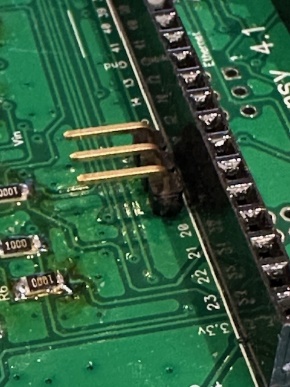
**Inventory and Prework**

Before you begin, inventory your parts against the latest BOM to make sure you have everything you need to complete the MAIN board, the Teensy Audio Hat, and the Teensy Audio Hat offset board. See Figure 1. . The complete BOM is given in Tables 1 and 2.

**Building the Boards**

With a medium heat, fine-tipped soldering iron (30-40W) assemble the V012.6 Main board in the following sequence for best results. It essentially amounts to mounting the smallest parts close to the board first. Leave the larger parts until the end.

1. Mount all **SMD** parts on the backside of the board first. There are 14 SMD parts on the backside… All are clearly marked. Resistors and R1, R2, R3, R4, R5, R8, R9, R14, R15, and R16. Capacitors C4, C5, and C10. Diode D5. Remember… mount EITHER the **BLUE** parts or the **RED** parts but not both (blue is for just reverse polarity protection, red is for reverse polarity protection and the on-off power control and black is for either option).
2. Mount U5 and U6, the SOIC packages. There are several good ways to do this. You can put a drop of super-glue gel on the board and put the part in place with a tweezers… and then solder the part. You can also put a spot of solder on one corner pin on the board… solder the part down at that point, and complete the soldering. You can also use paste solder and a heat gun… whatever technique works best for you. There are plenty of YouTube videos on soldering SOIC packages onto circuit boards that can be reviewed before you start.
3. Mount the SMD parts on the top side of the board. Mind the polarity of the LEDs and the diodes (the bar on the part on the board should match the bar on the diode). Remember to only mount parts D1, C9 if you want that option.
4. Next, mount the test point header pins and connections (not those in boxes). Note that the “exciter out” I/Q output jack has pins next to the Teensy for connection to the teensy audio hat. You should use 90-degree header pins here to clear the audio hat above them properly. See below.



1. Mount the thru-hole parts except for the voltage regulators including the female headers for the Teensy and for U4.
2. Mount the connectors. This includes the 2x5 IDC male pin connectors, and the audio jacks. **NOTE** that the “Acc” connector, the “Bands” connector, the ethernet connection, and the second Teensy USB connection go on the back side of the board. If you are using the “front panel” board, you don’t have to populate the “Encoders” connector unless you think you might use it for experimentation at a later date.
3. Set the jumper at J2 in the proper position for the voltage of your display. When in doubt, set it to the 3.3V position.
4. Finally, mount voltage regulators U1 and U3. Start by mounting U1 and U3 securely to their heat sinks using a small dab of heat transfer compound and the appropriate screw. Then solder the heatsink and regulator to the board. There are holes to mount the heatsink and regulator assembly to either side of the board for your convenience. If you will not use the offset board for the Teensy Audio Hat, the heatsinks and regulators should be mounted on the back side of the board. Note the pin orientation of the regulators if you mount them on the back side.
5. You can now add a fan to the edge of the board. Glue the fan down using hot glue and solder the fan power wires to the holes provided. The fan is 12 volts.
6. Mount the Teensy 4.1 and the Audio hat. The hat is oriented to plug into the end of the Teensy with the board mounted USB mini connector.
7. Make a cable to connect the “R\_OUT” (or Q) and “L\_OUT” (or I) with ground to the 90-degree pins next to the Teensy board (pins 17, 18, 19). The best way to do this is to use jumper wires with female .1 inch header socket ends (AKA DuPont connectors) cut to the needed length and soldered to the Audio Hat. Twist the wires together for best noise immunity.

**Testing The V012.6 Main Board.**

**FIGURES AND TABLES**

**Table 1. V12 Boards (Main, Teensy Audio Hat, and Hat Offset)**