

PAPR v 3.1 PCB Production Tests
9/16/21
Brent Bolton

Introduction

This document describes test to be performed on the PAPR version 3.1 board after assembly but before conformal coating and installation into a fully assembled PAPR unit. This document assumes all components have been tested by their respective manufactures and so does not attempt comprehensive tests of circuit nodes within components.

The object of these tests is to insure that all circuit nodes on the PCB are exercised and checked. Digital circuits will be switched on and off and correct operation in each state verified. Analog circuits will be varied and measured where possible, or measured for correct values if not.

Many tests require support from software running on the microcontroller chip. This software is available as a special mode of the standard production software.

The following tests should be performed in order after pick and place, reflow, and visual inspection of each PCB.

Test 1. Initial bring up power checks.

1) Connect a bench power supply to Charger Connector JP4 pins 2 and 3. 3 is +. Limit current to approximately 100mA and set voltage to 25.5 volts.

2) Read current draw from supply. Should be between 0.1 and 0.5 mA.

3) Using a multimeter or oscilloscope, measure voltages of board power supply test points.

--TP6 should read the same as the bench supply.

--TP3 should be 12 +/- 0.6 volts.

--TP2 should be 5 +/- 0.25 volts.

--TP1 should be same as TP2.

--TP9 should be 4.1 +/- 0.15 volts.

See Appendix 1 (below) for the locations of all the test points.

4) Change supply voltage to 18V. Check that TP3 still in correct voltage range.

Test 2. Program and bring up terminal.

1. 1) *If MCU is unprogrammed:* Increase current limit to 1A. Connect programming cable to JP5 and program with the PAPR Product firmware and PAPR Product fuse settings. Check that part programs and verifies. Disconnect cable from JP5.

2) Change supply back to 25.5 volts. Disconnect from JP4. Connect to battery connector JP2. Pin 2

is +.

--Check that TP6 is at zero volts.

--Check that TP1 is at 3.8 +0.4, -0.2 volts.

3) Increase supply current limit to 3A for remaining tests. Supply should be connected to battery input.

4) Connect device running a serial terminal program to JP6. 1 is serial out, 2 is serial in, 3 is ground. Parameters are 57600 baud, 8 bits, 1 stop bit, no parity, no flow control, local echo. (Note: some terminal programs send each character when typed, other programs only send when you do Enter. Either way is OK).

5) Reset the board by disconnecting and re-connecting JP2. The serial terminal should say "**Type 't' to enter test mode**". Within 3 seconds, type 't' or 'T', followed by Enter or Return. The terminal should say "<<< **Test Mode** >>>".

Test 3. LED's.

1) **On the terminal, enter "1" to invoke LED test.** LED's should illuminate sequence one at a time and then all turn on simultaneously followed by all turning off and the test repeating. Check that all LEDs turn on and off and, when all are on, are on at an even brightness. Press any key to terminate the test.

Test 4. Fan.

1) Connect fan to JP1.

2) **Enter "2" to start the fan test.** Fan should turn on at low speed while terminal displays RPM, which should be in the range 20000 to 23000, and current which should be in the range 300 to 600. After 5 seconds, the test repeats at medium speed and then high speed. At medium fan speed, RPM should be 22000-26000, and current should be 400-900 mA. At high fan speed, RPM should be in the range 24000-29000, and current should be 600-1000 mA. The sound of the fan should be consistent with reported speeds. Test should turn off fan for 5 seconds and then repeat. Check that fan is fully off. Press any key to terminate the test. Disconnect JP1.

Test 5. Speaker.

1) Connect speaker to JP2.

2) **Enter "3" to start the speaker test.** Speaker should turn on a full volume. Measure with dB meter if unsure -- volume should be 95 dBA (or higher) at 10 cm. Current should be below 0.1 mA. Press any key to terminate the test. Speaker should then be off.

(Since this might be disturbing on a test floor, it's OK to apply a 100 Ohm load across the speaker terminals and verify the voltage waveform with a scope. The oscilloscope probe should be connected across JP2 pin 1 and ground, not across the JP2 terminals)

Test 6. Pushbuttons.

1) **Enter "4" to start the pushbuttons test.** When SW1 is pressed LED1 should illuminate. When SW2 is pressed, LED3 should illuminate. SW3 lights LED5 and SW4 lights LED7. Press the switches individually and in all combinations of two and verify that only the selected LEDs are on. Press any key to terminate the test.

Test 7. Voltage sensing.

1) **Enter "5" to test voltage reference.** Terminal should display voltage reference in millivolts. Value should be 2500 +/- 20. Press any key to terminate the test.

1) **Enter "6" to test battery voltage.** Voltage should read the same as the supply +/- 100 mV. Vary supply voltage up and down slightly to make sure it tracks. Press any key to terminate the test.

Test 8. Charger detect.

1) **Enter "7" to test charger detect.** Immediately disconnect the serial cable JP6. After 5 seconds, the single amber LED4 starts flashing. Short JP4 pins 1 and 2 together with metal tweezers or similar. LEDs 1 and 7 should illuminate. Do this several times. Test will automatically terminate and terminal function will be restored 4 seconds after the last time the pins were shorted. Immediately re-connect the serial cable to JP6.

Test 9. Current sensing.

1) Connect an electronic load to JP4 pins 2 and 3. Set load current to 500mA but leave disabled.

2) **Enter "8" to test current sensor.** Test will display current in mA on terminal. Turn on load and verify that displayed current is within 5 percent of set point. Increase current in 500mA steps up to 2.5A and verify that displayed current tracks. Verify that current is close to zero when load is disabled. Press any key to terminate the test.

3) Switch load and supply connections so that load is on battery connector and supply is on charge connector. Set load current to 500mA but leave disabled.

4) **Enter "8" to test current sensor.** Test will display current in mA on terminal with opposite sign as above. Turn on load and verify that displayed current is within 5 percent of set point. Increase current in 500mA steps up to 2.5A and verify that displayed current tracks. Verify that current is close to zero when load is disabled. Press any key to terminate the test.

Finish up

Once you have finished testing, you may power down the board by disconnecting JP2 power and JP6 serial port. If you wish to run the board in normal mode, reconnect power to JP2. You may go back to Test Mode at any time by connecting the serial port to JP6 and resetting the board by disconnecting/connecting JP2.

Appendix 1: Test Point Locations

In the image below, PCB test points are indicated by a green dot.

