Manufacturing Test Specification
Power Management PCB
PB540/PB560/PB520

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Revision History

Revision	Change Order	Author	Approval by	Approval Date	Summary of Change
00	ECO-R163871	[redacted]	See Agile	See Agile	Initial Draft
A	ECO-R167338	[redacted]	See Agile	See Agile	Initial Release
B	ECO-R170566	[redacted]	See Agile	See Agile	Add ReqPro tags
C	ECO-R197325	[redacted]	**See Agile**	**See Agile**	Battery Charger Test – limit update. Ref CDP 10062350

TABLE OF CONTENTS

1. SCOPE

This specification defines the functional test requirements for the PB540, Power Management PCBA, P/N 3821100.

2. APPLICABLE DOCUMENTS

The test specification is developed with reference to the appropriate issue of the following documents at the time of this document preparation.

[1] Power Supply Board Hardware Requirements Specification (HRS) P/N 10025029

[2] PB540 Power Management PCB, Schematic P/N 4096600.E02.000

[3] Power Supply Board SRS, P/N 10025031

3.DEFINITIONS

AC	-	Alternating Current
CPU	-	Central Processing Unit
DC	-	Direct Current
FET	-	Field Effect Transistor
GND	-	Electrical Ground
IC	-	Integrated Circuit
ICSP	-	In Circuit Serial Programmer
I/O	-	Input/Output
MB	-	Megabyte (1 MB = 2^20 = 1048576 bytes)
LED	-	Light Emitting Diode
PCB	-	Printed Circuit Board
SPI	-	Serial Peripheral Interface
UART	-	Universal Asynchronous Receiver Transmitter
UUT	-	Unit Under Test
Vcc	-	Positive supply voltage for bipolar junction transistor based ICs
Vdd	-	Positive supply voltage for FET based ICs
rpm	-	Revolutions per minute
0xn	-	Hex number format

4. BOARD TEST

4.1 Power Sources Tests [HRS[1], HWSSUB14]

The Power Management PCB can be connected to three power sources. This section checks the ability of the UUT to detect the individual presence of the AC Mains, External DC or Battery power sources and switch between the individual sources when required.

4.1.1 AC Mains Supply Test [HRS[1], HWSSUB77, SRS[3], PSFSYST6.6]

When the UUT is powered with the AC Mains supply only, the test will check that the UUT detects the AC source by reading the output of the AC-DC Power Module (VACDC) voltage value. The VACDC value read shall be greater than 32V to be regarded as present. The test shall check that the Ext DC value read is to be less than 12V, and the Battery voltage value read is to be less than 24.5V indicating these sources are not regarded as connected to the UUT.

4.1.2 External DC Supply Test [HRS[1], HWSSUB2]

When the UUT is powered exclusively with the External DC power supply (set to 29VDC), the test will check that the UUT detects the External DC source by reading the Ext DC voltage value to be greater than 12V. The output of the AC-DC Power Module (VACDC) shall be checked to be less than 32V and Battery voltage read is to be less than 24.5V indicating these sources are not regarded as connected to the UUT.

4.1.3 Battery Supply Test [HRS[1], HWSSUB3]

When the UUT is powered exclusively with the battery source (29VDC), the test will check if the UUT detects the battery source reading the battery voltage to be greater than 24.5V. The Ext DC value shall be checked to be less than 12V and the output of the AC-DC Power Module (VACDC) value read to be less than 32V indicating these sources are not regarded as connected to the UUT.

4.1.4 Loss of External DC Detection Test [HRS[1], HWSSUB 10, SRS[3], PSFSYST6.5]

The test will check that the UUT will detect the loss of the External DC Power Supply. The test will check the output of the Ext DC sense comparator (ST10 uC input RB0) to be set when the Ext DC Power Supply is not connected.

4.1.5 Loss of AC Detection Test [HRS[1], HWSSUB 11, SRS[3], PSFSYST6.4]

The test will check that the UUT will detect the loss of the AC Mains supply. The test will check the output of the AC sense comparator (ST10 uC input RB1) to be set when the output of the AC-DC Power Supply Module is not connected.

4.1.6 Power Supply Switching Test

[SRS[3], PSFSYST6.1] For each of the three power sources, AC Mains, External DC Power and Battery Power, a pair of FETs are used to switch ON or OFF power from that particular source. The test will turn ON and OFF each pair of FETs and verify the power switch operation is successful .

4.1.7 Battery Cut-Out/Restore Voltage Level Test [HRS[1], HWSSUB12]

This test is performed when the UUT is operated solely on the battery power source and checks the cut-out and restore battery voltage levels.

1. The test will check that when the battery voltage is decreased to 20.2V DC ±1V, battery power to the UUT will be switched off thus communication with the UUT shall cease.

2. After performing Step 1, the test will check that when the battery voltage is increased to 24.50V DC ±1V, communication and operation of the UUT shall be restored.

4.1.8 Ext DC Source Cut-Out/Restore Voltage Level Test [HRS[1], HWSSUB13]

This test is performed when the UUT is operated solely on the Ext DC power supply and checks the cut-out and restore Ext DC voltage levels.

1. The test will check that when the Ext DC voltage is decreased to 9.60V DC ±1V, Ext DC power to the UUT will be switched off thus communication with the UUT shall cease.
2. After performing Step 1, the test will check that when the Ext DC voltage is increased to 10.40V DC ±1V, communication and operation of the UUT shall be restored.

4.2 3.0 VDC Reference Test [HRS[1], HWSSUB41]

This test checks the operation of the 3.0V Reference power source. Measure the 3.0 VDC Reference voltage to be 3.0V ± 0.01V (2.99V - 3.01V DC)

4.3 PIC 5V Test

This test checks for the proper operation of the T2 FET which is used to disconnect the on board 5V source to the PIC VDD pins when the ICSP power source is connected. Measure the PIC 5VDC voltage to be 5.0V ± 0.20V (4.80V - 5.20V DC)

4.4 3.3V DC Regulator Supply Test [HRS[1], HWSSUB39]

This test checks the operation of the 3.3V DC regulator circuit. Measure the 3.3 VDC supply voltage to be 3.3V ± 0.1V (3.20V - 3.40V DC)

4.5 5V DC Regulator Supply Test [HRS[1], HWSSUB36]

This test checks the operation of the 5V DC regulator circuit. Measure the 5VDC supply voltage to be 5.0V ± 0.20V (4.80V - 5.20V DC)

4.6 Board Temperature Test [HRS[1], HWSSUB20]

The Board Temperature is to be read from the UUT and checked to be the equivalent of between 10º-50ºC

4.7 Battery Temperature Test [HRS[1], HWSSUB9]

The Battery Temperature is to be read from the UUT and checked to be the equivalent of between 23º-27ºC using a fixed resistor for 25 ºC for the battery thermistor.

4.8 DC-DC Converter Test [HRS[1], HWSSUB31]

The test will check the operation of the DC-DC Converter circuit. The test shall vary the voltage of the External DC Power supply from 12V to 30V in 2V steps, and check that the DC-DC Converter output is 24VDC +/- 0.5V.

4.9 Cooling Fan Test [HRS[1], 4 HWSSUB21]

The test will check that the cooling fan can be controlled and return the feedback to operate at the minimum speed of less than 4,000 rpm and at the maximum speed of greater than 6,000 rpm. The cooling fan shall be tested at the min/max speeds when connected to the AC Mains source for power and using the Ext DC source for power sources.

4.10 Battery Memory Test [HRS[1], HWSSUB8]

The test will check that the UUT can read the battery memory EEPROM verifying operation of the 1 wire UART communication interface. The test shall read the battery identifier and verify it is SAFT.

4.11 Battery Charger Test [HRS[1], HWSSUB6, 7]

The test will check the battery charger connection FETs, T25 and T26 for switching in the open and closed states. FET T29 will be activated to simulate end of charge battery current and the current difference with FET T29 on will be tested to be Vcharge/195 ohms ± 20%.

The PWM Charger is to be tested, by checking charge voltage at the min/max PWM V Charge and the min/max PWM I Charge settings. With the charger set to MAX PWM V and MAX PWM I, the charge voltage shall be between 26.5-29.40V. With the charger set to MIN PWM V, the charge voltage shall be between 30.50-33.00V. With the charger set to MAX PWM I, the charge current measured at 'I_Bat' shall be between 300-600mA. With the charger set to MIN PWM I, the charge current measured at 'I_Bat' shall be between 1150-1550mA.

4.12 Power Supply Leds Test [HRS[1], HWSSUB47,82,83]

The test shall write commands to turn ON/OFF the 3 power supply leds, namely AC Mains, Ext DC, and Battery Leds. The test shall verify the successful switching of these Leds.

4.13 USB Ports Test [HRS[1], HWSSUB42]

The Power Management PCB supports two USB ports. Two ports J12 and J13 can be used to transfer patient data and ventilator settings. The USB ports J12 and J13 shall be tested by checking for the successful recognition of the insertion of a USB memory device formatted in the FAT32 file format.

4.14 PC Mini USB Port [HRS[1], HWSSUB51 SRS[3], PSFSYST8.1]

The USB Mini B Port is used to interface with a PC and download software. The PC port operation is verified by the successful transfer of data with the Power Management PCB.

4.15 Software Download using ISCP [HRS[1], HWSSUB18]

Connectors are provided on the Power Management PCB to support the use of an In Circuit Serial Programmer to download the software to the PIC and the EEPROM used for the USB Host Controller. Connector J14 is used to program the EEPROM and connector J2 is used to program the PIC memory. The ISCP connections are verified by the successful programming of the EEPROM and PIC memory.