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Power Supply Board Hardware Requirements Specification
PB 540

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide the requirements for the Power Supply Board.

1.2 Scope

This document provides the requirements for the Power Supply Board used in PB560, PB540 and PB520 products.

1.3 REVISION HISTORY

Revision	Date	Author	Change Description
A	05/27/08		Initial Release of Specification.
B	09 Sep 08		Add note on the IPC Class II/III requirement
C	03-Nov-08		Clarified requirements, updated format, Added priority of the power sources, clarified when charging is allowed
D	20-Jan-2009		Incorporate redlines from Verification Review.
E	21-july-2011		Update requirement HWSSUB7 as per CDP # 10062350

2.0 Glossary/Acronyms

Acronym	Definition
°C	Celsius Degree
A	Ampere
ac	Alternating Current
CPU	Central Processing Unit
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read Only Memory
GND	Electrical Ground
ICSP	In Circuit Serial Programmer
Kb	Kilobytes
kHz	Kilo Hertz
LED	Light Emitting Diodes
Mb	Megabytes
mA	Milliamps DC
mbar	Millibar
ms	Milli Seconds
ns	Nano Seconds
O_2	Oxygen
PC	Personal Computer

PCBA	Printed Circuit Board Assembly
PWM	Pulse Width Modulation
rpm	Revolutions per minute
sccm	Square centimeter cubic per minute
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
V	Volt
VDC	DC Voltage
W	Watt

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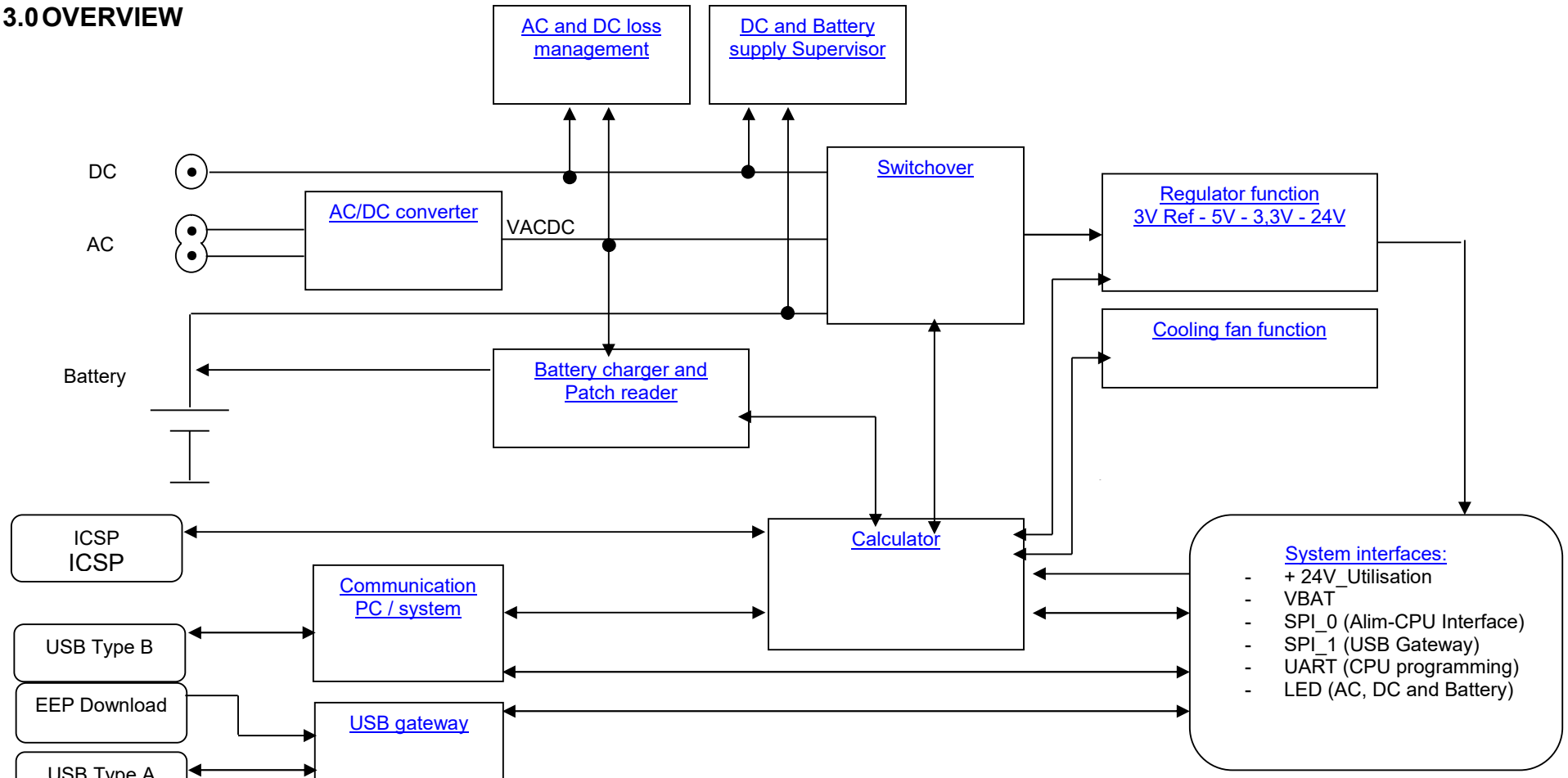
3.0 OVERVIEW



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3.1 Input description

- **External DC voltage:** External direct current power supply allowing input voltage from 12V to 33V. Allow ventilator to be used in ventilation mode only but doesn't allow battery charge.
- **AC power supply:** Powers the AC/DC converter which supplies 33V DC.
- **Battery**: Ventilator internal battery. Technology Li-Ion – 26V Nominal Voltage.
- **USB Type B:** Communication and programming interface between PC and CPU or Power Supply management microcontroller.
- **USB Type A:** Interface used for mass storage peripheral connection.
- **Main switch:** Used for starting ventilator.
- **ICSP:** Microcontroller programming interface.
- **USB EEPROM Download:** USB gateway programming interface.

3.2 Output description

- **24V Util:** Regulate voltage to power other boards.
- **AC LED:** Direct connection between keyboards AC LED and microcontroller.
- **DC LED:** Direct connection between keyboards DC LED and a linear regulator to indicate direct current voltage.
- **Battery LED:** Direct connection between keyboards Battery LED and microcontroller.
- **SPI_0:** Bus allowing data exchange between CPU board and power management board.
- **SPI_1:** Bus allowing data exchange between CPU board and USB gateway on power management board.
- **VBAT:** Direct connection between CPU board and battery for voltage measurement.
- **UART ST10:** Bus allowing communication between Pc and CPU board via USB/2-UART converter.

4.0 ELECTRICAL REQUIREMENTS

4.1 AC/DC Converter

HWSSUB1 The AC/DC converter shall comply with **UL 60601-1** *Medical Electrical Equipment - Part 1: General Requirements for Safety* June 30, 2003.

4.2 AC Input

HWSSUB77 The Power Supply board shall monitor the AC/DC converter output (VACDC) within a 0 to 36 VDC range with an accuracy of +/- 1VDC.

The AC/DC converter supports an AC input voltage range of 90 VAC to 250 VAC.
The AC/DC converter works at AC frequencies of 50 Hz through 60Hz.

4.3 VACDC Output

The AC/DC converter produces a DC output of 33 VDC +/- 5%.
The AC/DC converter is capable of supplying 3 A of current.

4.4 DC Input

HWSSUB81 The DC Input shall support a voltage range of 10.8 VDC to 33VDC.
HWSSUB80 The DC Input shall draw less than 3A (100W).

HWSSUB2 The Power Supply board shall monitor the DC input within a 0 to 36 VDC range with an accuracy of +/- 1VDC.

HWSSUB15 The Power Supply board shall provide a reverse connection protection for the DC supplies.

4.5 Battery function

4.5.1 Battery monitoring

HWSSUB3 The Power Supply board shall monitor the battery voltage within a range 0V to 33V, with an accuracy of +/-1V.

HWSSUB4 The Power Supply board shall measure charge and discharge battery current within a range from -3A to +1.5A with an accuracy of +/-200mA.

4.5.2 Battery charger

The Power Supply board shall charge the battery only when AC voltage is present.
HWSSUB5 The Power Supply board calculator shall be able to stop the charge when the battery is charged to 29.4VDC +/- 0.15VDC.

HWSSUB6 The Power Supply board shall monitor the battery charge voltage within a range 0V to 33V, with an accuracy of +/-1V.

HWSSUB7 The Power Supply board shall be able to adjust the battery charge with a constant current level (accuracy +/-150mA) in a range of 300mA -1500mA.

A Lithium-Ion battery charge cycle happens in two steps:

1. The battery will initially be charged at constant current:
    - 500mA during ventilation
    - 1500mA when the system is not ventilating
2. The end of charge voltage is held until current falls under 150mA and the charger turn off.

4.5.3 Battery patch reading and writing

HWSSUB8 The Power Supply board shall provide the ability of communicating with the internal memory of the battery.

The battery internal memory is a One-Wire type (DS2431).

4.5.4 Battery temperature measurement

HWSSUB9 The Power Supply board shall provide the ability to measure battery temperature from -30°C to +80°C with an accuracy +/-3°C.

5.0 CALCULATOR

HWSSUB18 System shall integrate a numeric calculator. It will be programmable in circuit. This circuit is used to manage the battery charge, the commutation condition, the alarms, the SPI CPU communication.

HWSSUB19 The Power Supply board shall allow the calculator startup (5VDC regulator) either:

When main switch is on and external DC power or battery source is available or

When AC power is available (in order to manage the battery charger even if the main switch is off)

6.0 SWITCHOVER

6.1 General

HWSSUB14 The Power Supply board shall accept an input from three sources: AC voltage, external DC input, or a battery.

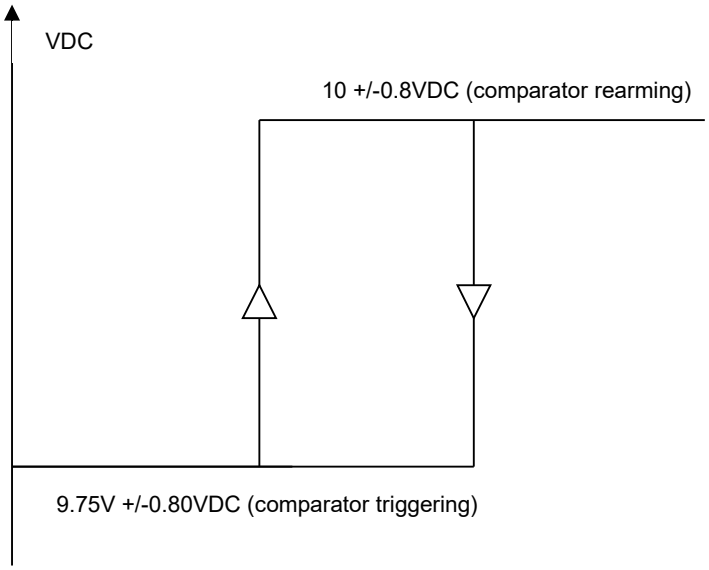
The Power Supply board shall use three power sources in listed priority. If valid power is restored in a higher priority that supply will be used as the source:
1 – AC Input
2 – DC Input
3 – Internal Battery power

HWSSUB16 The Power Supply board shall start the 24VDC regulator when the main switch is on and a power source is available (including AC,DC or Battery supply restoration after accidental power supply loss)

HWSSUB17 The Power Supply board shall provide circuitry to supply 24VDC in the event of a controller malfunction when a power source is available.

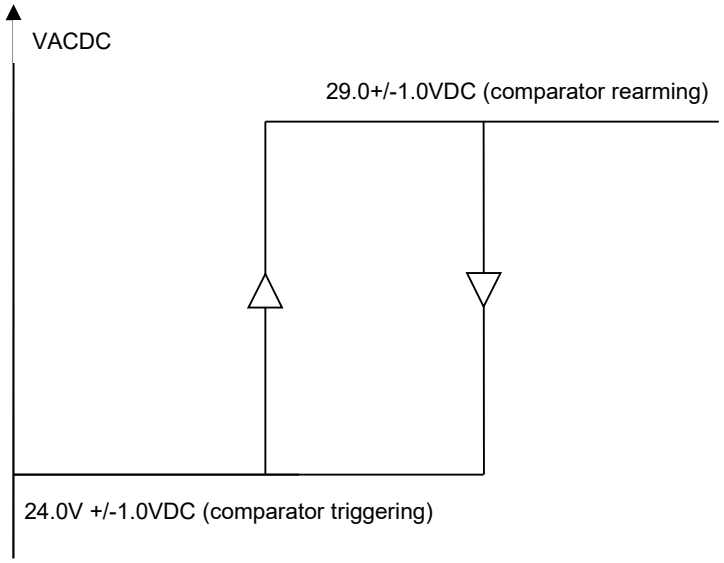
6.2 DC loss management

HWSSUB10 The Power Supply board shall trigger a calculator interruption by a comparator output in order to manage a power supply commutation if the external DC supply if the external DC voltage drops below 9.75VDC, +/- 0.80VDC. The comparator watching the external DC voltage shall be rearmed if the external DC voltage goes above 10VDC, +/-0.8VDC.



6.3 AC loss management

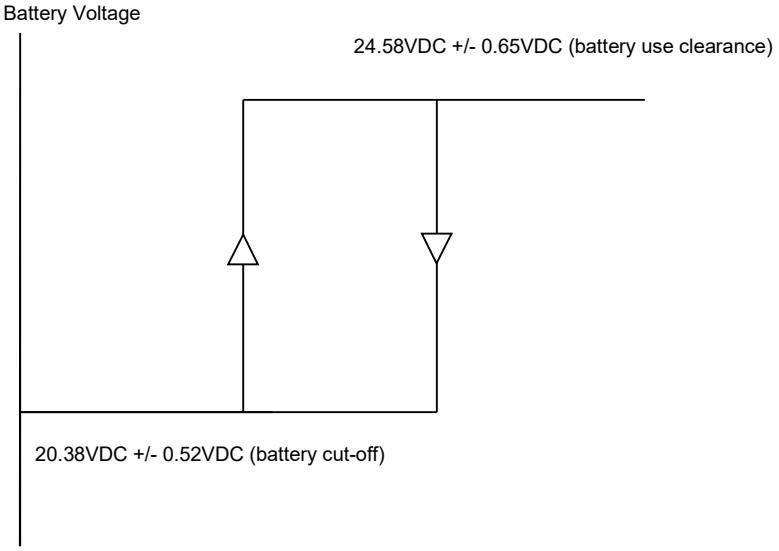
HWSSUB11 The Power Supply board shall trigger a calculator interruption by a comparator output in order to manage a power supply switch if the VACDC voltage drops below 24.0VDC, +/- 1.0VDC. The comparator shall be rearmed if the external DC voltage goes above 29.0VDC, +/-1.0VDC.



6.4 Power source availability

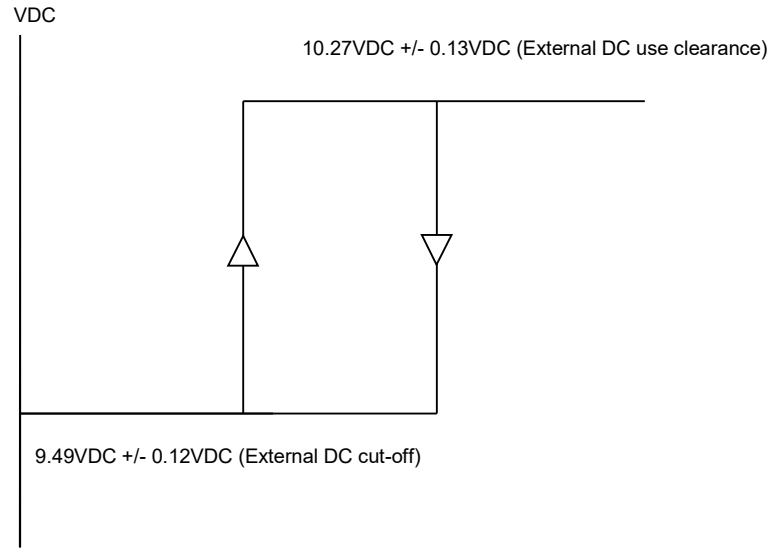
6.4.1 Battery availability

HWSSUB12 The system shall cut-off the battery power supply if the battery voltage drop below 20.38VDC +/- 0.52VDC and the system shall allow again the use of battery power if the battery voltage goes back above 24.58VDC +/- 0.65VDC.



6.4.2 External DC availability

HWSSUB13 The system shall cut-off external DC supply if the external DC voltage drop below 9.49VDC +/- 0.12VDC and the system shall allow again the use of external DC supply if the external DC voltage goes back above 10.27VDC +/- 0.13VDC.



7.0 COOLING FAN FUNCTIONS

HWSSUB20 The Power Supply board shall measure board temperature within a range from -30°C to +80°C with an accuracy of +/-3°C.

HWSSUB21 The Power Supply board shall provide a fan driver to provide temperature control for the board and battery temperatures.

HWSSUB22 The driver shall be able to generate a fan speed command by providing a PWM signal on the fan supply.
HWSSUB23 The PWM signal shall have a frequency of 123 kHz +/- 5%.
HWSSUB25 The cooling fan shall be supplied a voltage within the range of 8V to 24VDC.

8.0 REGULATOR FUNCTIONS

8.1 24V Regulator

HWSSUB30 The Power Supply board shall provide a 24VDC (+/-1.2VDC at currents < 2A, and +1.2V/-2V at currents $\geq$ 2A) output voltage with 3A capacity from the VACDC Output

HWSSUB31 The Power Supply board shall provide a 24VDC (+/-1.2VDC at currents < 2A, and +1.2V/-2V at currents $\geq$ 2A) output voltage with 3A capacity from the external DC power supply.

HWSSUB32 The Power Supply board shall provide a 24VDC (+/-1.2VDC at currents < 2A, and +1.2V/-2V at currents $\geq$ 2A) output voltage with 3A capacity from the internal battery.

HWSSUB33 The 24VDC regulator shall have a 4A current limit (+/- 400mA).

HWSSUB34 The Power Supply board shall provide a monitor for the 24V voltage regulator from 22V to 26V with a +/-0.1V precision.

8.2 5V Regulator

HWSSUB35 The Power Supply board shall provide a 5VDC +/-0.25V voltage with 1A output current from the VACDC Output.

HWSSUB36 The Power Supply board shall provide a 5VDC +/-0.25V voltage with 1A output current from external DC power supply.

HWSSUB37 The Power Supply board shall provide a 5VDC +/-0.25V voltage with 1A output current from the internal battery.

HWSSUB38 The Power Supply board shall provide a voltage monitor for the 5V regulator with a range of 4.5V to 5.5V with an accuracy of +/-60mV.

8.3 3,3V Regulator

HWSSUB39 The Power Supply board shall provide a 3.3VDC +/-0.16V voltage with 500mA output current from 3.3V regulator output.

HWSSUB40 The Power Supply board shall provide a voltage monitor for the 3.3V regulator with a range of 3.0V to 3.6V with an accuracy of +/-10mV.

8.4 3V reference regulator

HWSSUB41 The Power Supply board shall provide a 3V +/-18mV voltage reference with 3mA capacity from a 3V regulator output.

9.0 SYSTEM INTERFACES

9.1 USB gateway

HWSSUB42 The gateway shall integrate a numeric calculator. It will be programmable in circuit. This circuit is used to manage all the Host USB functions: Read, Write, Erase…etc.

HWSSUB43 The Power Supply board USB gateway shall be able to receive a reset flag signal from CPU board through the ribbon cable (J7 - 11).

HWSSUB44 The Power Supply board USB gateway shall be able to provide a busy flag signal to CPU board through the ribbon cable (J7 - 12).

9.2 CPU board interface

HWSSUB45 The Power Supply board calculator shall communicate with CPU board through a SPI bus (# 0) to transfer data.

HWSSUB46 The Power Supply board shall provide a communication path to allow communication between the CPU board and the USB gateway through an SPI bus (# 1).

HWSSUB47 The Power Supply board shall provide a signal for AC supply presence (keyboard led management) to the CPU through the ribbon cable (J7 - 15).

HWSSUB82 The Power Supply board shall provide a signal for DC supply presence (keyboard led management) to the CPU through the ribbon cable (J7 - 16)

HWSSUB83 The Power Supply board shall provide a signal for battery supply presence (keyboard led management) to the CPU through the ribbon cable (J7 - 17)

HWSSUB49 The Power Supply board shall provide the battery voltage to the CPU through the ribbon cable (J7 - 14).

9.3 PC / System Communication

HWSSUB51 The Power Supply board shall provide a communication channel to allow a PC to communicate with the Calculator at 115000 Baud communication speed through a USB port (mini B).

HWSSUB50 The Power Supply board shall allow data transmission between a PC and the CPU board through a UART communication at 256000 Baud.

9.4 Turbine board interface

HWSSUB52 The Power Supply board shall provide a +24VDC +/-1.2VDC power source to turbine command board with a 3A maximum current capacity.

9.5 Interconnects

9.5.1 USB B Connector – J1

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**+** VUSB		**2**	Data-
3	Data+		**4**	ID
5	**-** Ground		**6**	**-** Ground
7	**-** Ground			

9.5.2 ICSP – PIC Programmer – J2

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	MCLR		**2**	**+** +5V Supply
3	**-** Ground		**4**	PGD
5	PGC		**6**	*NC*

9.5.3 Output AC/DC Power Supply Connector – J3

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**+** VACDC		**2**	**+** VACDC
3	**+** VACDC		**4**	**+** VACDC
5	**-** Power Ground		**6**	**-** Power Ground
7	**-** Power Ground		**8**	**-** Power Ground
9	**+** VACDC		**10**	**+** VACDC
11	**+** VACDC		**12**	**+** VACDC

9.5.4 Input AC/DC Power Supply Connector – J4

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	AC Neutral		**2**	*NC*
3	AC Phase			

9.5.5 External DC Connector – J5

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**+** VDCEXT		**2**	**+** VDCEXT
3	**+** VDCEXT		**4**	**-** Power Ground
5	**-** Power Ground		**6**	**-** Power Ground
7	**-** Ground		**8**	**-** Ground
9	**-** Ground		**10**	**-** Ground

9.5.6 Cooling Fan Connector – J6

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**+** Supply		**2**	**-** Ground

9.5.7 CPU Board Connector – J7

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**-** Power Ground		**2**	**-** Analogic Ground
3	**+** 24V Supply		**4**	**-** Ground
5	SCLK SPI #1		**6**	SCLK SPI #0
7	MTSR SPI 0		**8**	CE SPI PIC
9	MRST SPI 0		**10**	CE SPI USB
11	RESET USB		**12**	USB BUSY
13	**+** 5V Supply		**14**	**+** Battery Supply
15	AC LED		**16**	DC LED
17	BATTERY LED		**18**	MRST SPI 1
19	TX UART ST10		**20**	RX UART ST10
21	RTS UART ST10		**22**	MTSR SPI 1
23	**+** 24V Supply		**24**	**-** Ground
25	**-** Power Ground		**26**	**-** Analogic Ground

9.5.8 Turbine Board Supply Connector – J9

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	**-** Power Ground		**2**	**+** +24V Supply

9.5.9 Battery Connector – J10

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	- Power Ground		2	- Power Ground
3	- Power Ground		4	- Power Ground
5	Temperature		6	EEPROM
7	+ VBAT		8	+ VBAT
9	+ VBAT		10	+ VBAT

9.5.10 USB A #1 Connector – J12

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	+ VUSB		2	Data-
3	Data+		4	- Ground
5	- Ground		6	- Ground

9.5.11 USB A #2 Connector – J13

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1	+ VUSB		2	Data-
3	Data+		4	- Ground
5	- Ground		6	- Ground

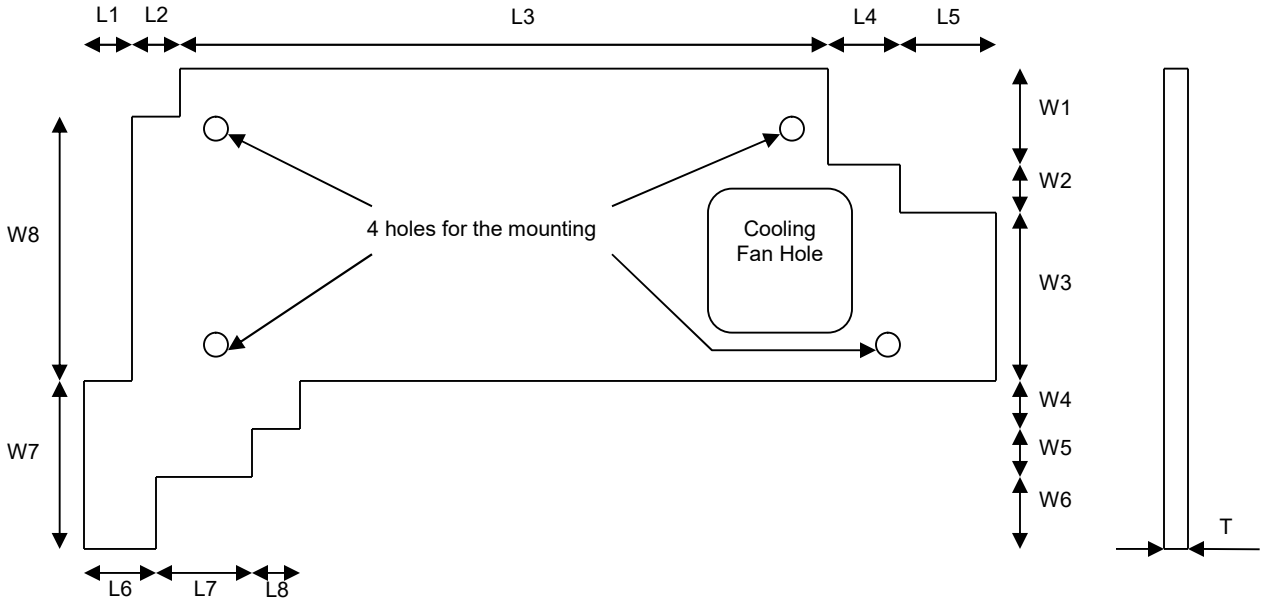
9.5.12 USB EEPROM Programmer Connector – J14

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
4	+ +3.3V Supply		2	SDA
3	SCL		1	- Ground

10.0 MECHANICAL REQUIREMENTS

10.1 Size

HWSSUB53 The length (L1) of the PCBA shall be 6.7mm +/- 1mm
HWSSUB54 The length (L2) of the PCBA shall be 12.2mm +/- 1mm
HWSSUB55 The length (L3) of the PCBA shall be 167.3mm +/- 1mm
HWSSUB56 The length (L4) of the PCBA shall be 19mm +/- 1mm
HWSSUB57 The length (L5) of the PCBA shall be 26mm +/- 1mm
HWSSUB58 The length (L6) of the PCBA shall be 15.4mm +/- 1mm
HWSSUB59 The length (L7) of the PCBA shall be 19.8mm +/- 1mm
HWSSUB60 The length (L8) of the PCBA shall be 15mm +/- 1mm
HWSSUB61 The width (W1) of the PCBA shall be 29.75mm +/- 1mm
HWSSUB62 The width (W2) of the PCBA shall be 6mm +/- 1mm
HWSSUB63 The width (W3) of the PCBA shall be 61.7mm +/- 1mm
HWSSUB64 The width (W4) of the PCBA shall be 5.3mm +/- 1mm
HWSSUB65 The width (W5) of the PCBA shall be 6.3mm +/- 1mm
HWSSUB66 The width (W6) of the PCBA shall be 16.9mm +/- 1mm
HWSSUB67 The width (W7) of the PCBA shall be 32.2mm +/- 1mm
HWSSUB68 The width (W8) of the PCBA shall be 80mm +/- 1mm
HWSSUB69 The thickness (T) of the PCBA shall be 1.6mm +/- 0.5mm



10.2 Mounting

HWSSUB70 4 holes Ø 4.6mm shall be plan to fix the CPU board on the device
HWSSUB71 1 square 45mm x 44mm shall be provided to place the cooling fan.

10.3 Cooling

N/A.

10.4 Fabrication

HWSSUB72 The Printed Circuit Board shall be fabricated with the standard:
IPC-A-610D Class III: 2005, Acceptability for Electronic Assemblies.
Exceptions shall be listed on the fabrication drawings.

10.5 Protection

HWSSUB73 A plastic cover shall be added on the both AC/DC Supply heatsink.

10.6 Labelling

HWSSUB74 The PCBA shall be labeled with its Name, Part Number and Revision which is also human readable.

11.0 PACKAGING REQUIREMENTS

HWSSUB75 Packaging shall be designed to minimize the level of waste and waste disposal as per the European Directive on handling waste packaging.
HWSSUB76 Packaging shall be tested to the international standard ISTA2A.