V2 Power Shelf Specification

Version 2.0

AC/DC PSU 6.6kW @ 12.6V_DC

(2+1) redundant with li-ion BBU

FB PN: 14-000136





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1-Feb-2015	Rev 1.0	OCP version (PSU, Shelf, Communication specification all buddle together.)
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Summary

This specification defines the requirements for a 6600W standalone V2 Power Shelf, single-voltage 12.6V_{DC} output, powered from a three-phase AC line, hosting three 3300W (N + 1) hot swap single-phase power modules. This product is used to power IT Systems and provide both online and back-up power functions. This shelf will also host three BBU modules for the power backup functions. This power shelf will be installed into the V2 Open Rack.

In this document PSU refers to the power supply unit module and BBU refers to the battery backup unit pack.

V2 Reference Specifications:

V2 PSU, Rev 2.0 V2 BBU, Rev 3.4 V2 Communication Manual, Rev4.6a

Mechanical PSU Dimensions:	139mm x 534.5mm x 833.7mm (HxWxD)	
AC Input Range:	200V _{AC} to 277V _{AC}	
Outputs:	12.6V _{DC} /530A @ 6600W (droop)	
Efficiency:	Efficiency (230V _{AC} and with fan powered internally)	
	89.5% at 10% of the load	
	93.5% at 20% of the load	
	95.5% at 50% of the load	
	90.5% at 100% of the load	
Holdup Time:	20ms @100% loading (worst case scenario)	
Communication:	RS485	
LEDs:	Green LED for 12.6V _{DC} indication	

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2 Mechanical Requirements

2.1 Shelf Mechanical Outline

The figure below outlines the mechanical chassis of the power shelf which has six slots. The top three are for the V2 PSU and the bottom three slots are for the V2 BBU.

- Please refer to the mechanical 3D drawing provided for all the mechanical dimensions, tolerances, and mechanical highlight notes.
- The weight of the empty shelf shall also not be greater than 40lbs.



Figure 1: V2 power shelf front image

2.2 Retention

The power shelf shall be retained to the rack via two screws, one on each side. Refer to mechanical drawings for location and more information. Note the weight of the shelf with the three BBUs and PSUs can be up to 150lbs, therefore the retention should be able to withstand shock and vibration specifications. There will also be 8 screws which attach the output busbar blades to the rack busbar. This is only used for making good electrical contact and is not used to retain the shelf, mechanically to the rack.

2.3 Airflow Requirements

There are no external fans in the power shelf. The shelf shall be designed so that it allows the lowest impedance for the PSU exhaust air to easily blow out of the shelf. Therefore, the internal busbar design shall be designed to reduce the back pressure.

The same airflow requirements must be met as the V2 PSU:

- During normal AC operation mode, the ΔT shall be greater than 12.5°C, if T_inlet \leq 35°C when both 2 or 3 PSUs are installed in any slot combination.
- T_outlet ≤ 60°C at any operating temperature range.
- No temperature sensors are needed in the shelf since they are already located in the PSU.
- The maximum temperature of any touchable part of the PSU during normal operation or when servicing shall be below 70°C.

2.4 Acoustic Requirements

Following ISO7779 Section 8.8, mean sound pressure level at the bystander positions shall not exceed 83dBA at any operating condition, with three PSUs installed in the shelf. Worst case might be when all three PSUs are running at full fan speed.

2.5 Temperature Requirements

The power shelf shall operate within the following temperature range, -5°C to 45°C.

- Ambient operating temperature range: -5°C to +45°C
- PSU is able to start at -15°C of ambient temperature
- Operating and Storage relative humidity: 10% to 90% (non-condensing)
- Storage temperature range: -40°C to +70°C
- Transportation temperature range: -55°C to +70°C (short-term storage)
- Operating altitude with no de-ratings: 3000m (10 000 feet)

2.6 LEDs

A 5mm green LED, installed on rear panel which turns on when there is greater than 11V_{DC} on the common output busbar. This is a '12.6V_{DC} Power Good' indication, from the rear of the shelf so that the operators will know when servicing the rack (from the rear) if the shelf is still producing 12.6V_{DC} outp<u>ut</u>.

Color	Ideal Wavelen (nm)	gth Wavelength (nm)	Range	Intensit y
Gree n	525	505-535		-

2.7 Labels

In addition to the product safety label, a yellow rectangular safety label shall be placed near the AC input connector, which instructs the operator that caution high voltage, and to disconnect AC plug from the AC source before installing or removing the connector. Sample of the label will be submitted to Facebook for review and approval.

2.8 Silkscreen

Silkscreen text of "Slot #1", "Slot #2", "Slot #3" should be added to designate the three columns (each PSU/BBU pair). Slot #1 should be the first slot to the left looking at the shelf from the front (where you insert the PSUs and BBUs). Silkscreen shall also be added to show that the top three slots are for the "PSU" and the bottom three slots are for the "BBU".

There should be silkscreen text for every input and output connectors on the back of the PowerShelf. The suggested silkscreen text are as follows, "MGMT", PWR OK", and "3Ф AC INPUT". The text "12 VDC" should be written above the green LED. Silkscreen text should be added to indicate which main output blade is "+" and "-". Please refer to the attached mechanical reference drawing for suggested placement.

3 Shelf Block Diagram



Figure 2: High level shelf block diagram

4 Shelf Block Diagram

4.1 AC Input

The power supply unit must be able to operate at 180V_{AC} to 305V_{AC} RMS auto ranging input.

	Min	Rated	Max	Frequenc y
Voltag e	180 V _{AC}	200-277 V _{AC}	305 V _{AC}	50-60Hz

4.1.1 AC Input Connector

All the connectors used on the rear of the shelf must be a locking latch mechanism. All the connectors must also be keyed. The input/output shelf PCB must be insulated at the bottom to prevent any short circuits with the mechanical shelf chassis. The opening shall be large enough to accommodate extra room needed for unlatching the latch mechanism.

The AC input power inlet is a 5 pin Positronic connector p/n: SP5YYE48MoLN9A1/AA-PA1067, male socket high conductivity contacts, board mount right angle, RoHS compliant, solder type with metal fasteners for mechanical strength. General requirements for the AC connector are as follows:

- Must be locked in type
- Must have the possibility to install a pre-mating pin (bottom right pin) for GND.
- Must be at least 32A rated and 600V (Size 12 contacts)
- Its connector counterpart (carrying the AC voltage from the grid) must be able to have a custom molded strain relief built on the housing, for the safety and for mechanical strength)
- There should also be two screws on the side of the connector that directly connect the screw into the standoff between the PCB and sheet metal of extra strength.



Figure 3: AC input Positronic Connector

Pin Assignment: The top three pins should be used for Line 1, Line 2, Line 3, and the bottom left pin should be used for neutral and the bottom right pin should be ground where its male pin is longer than the other 5 pins (looking at the male connector from the back of the shelf).

4.2 AC Surge Protection Inductors

An inductor for each of the three lines and neutral shall be installed, near the AC input Positronic connector, one for each of the input lines. The inductor shall be wound around a ferrite cylindrical core at least 8mm in diameter and with at least 1.8mm diameter copper winding. The minimum inductance shall be around 0.7-1mH. The Vendor is free to choose the inductor to be used. The main purpose of this is to help with AC surge protection.

4.3 Power Quality

Power factor and iTHD (total harmonic distortion of the AC input current, with order of the harmonics up to and including 40) at rated voltage (2 PSUs installed in the shelf):

	Voltag e	Shelf Loading	Requiremen t
Power Factor	200-277	>10%	PF > 0.95
iTHD	200-277	>10%	iTHD < 10%

- Power supply should not shutdown with 10% harmonic AC input voltage for full working range (180-305V_{AC})
- Due to sharing inaccuracies at low loading, power quality can be tested when shelf loading is ≥ 20% loading.

5 DC Input

The DC input of the shelf is provided by the li-ion battery (BBU) slots below each PSU Bay. Each DC input only connects to the power supply above it. The DC input power is not shared between PSUs.

5.1 DC Input Voltage

The DC input voltage will be supplied to each PSU via its corresponding battery pack (BBU) placed below the PSU.

Min	Rated	Max	
28V _{DC}	31.85-52.5 V _{DC}	$55 V_{DC}$	

6 DC Output

There are two outputs of the shelf, the main 12.6V_{DC} ouput and the 9V_{DC} output for the two signals Redundancy_Lost_L and Power_Fail_L.

Voltage	Mi n	Max	Peak / Time	Slew Rate
12.6V _{DC} (main)	οA	530A	120% / 18 secs	1A/µS
			170% / 3ms	
9V _{DC}	oА	1A	N/A	N/A

6.1 12.6V_{DC} Main Output

The 12.6V_{DC} outputs are a pair of busbar blades, which are 50mm tall, 3mm thick, with 23mm distance between the positive and negative pair. The length of the busbar should be less than 190mm with the busbar offset by 2.5mm (negative is shorter). Looking from the rear of the shelf, the +12V_{DC} busbar is the busbar to the right and protrudes 2.5mm outwards. There should be four round shape holes in a square pattern with 25mm distance from the center of the round hole. Please refer to the figure below and the detailed mechanical drawing attached at the end of the specification. The busbar should be able to directly interconnect with the busbar installed in the V2 OpenRack. The busbar shall be protected with shrink tubing insulating material, preferably red color for the +12Vdc and black color for the return. Ferrites CM chokes are installed on the 12V.5_{DC} output.

The output busbar blades shall be nickel plated (3-5um) with silver (5-7um) on top. The Vendor is free to propose alternate plating thickness. The final look (smooth or grain) depends on the finish of the copper blade base material. The plating finish itself can be matte (smooth finish) or brush (grain finish), whatever is best for the interface resistance of the terminal lug. Output busbar at the contact interface areas shall be free of pits and plating defects.

6.1.1 Output Capacitor board

An external PCB with capacitors can be placed inside the shelf just before the 12V_{DC} busbar blades exit the shelf. This can be used to help meet ripple and transient specification. Max capacitance of the board 4x470µF ±20%.

6.1.2 Dynamic Loading

The power shelf (with 2 PSUs or 3 PSUs installed in the shelf) shall meet voltage regulation specified in the above section during the dynamic loading conditions below. The measurement shall be from the new steady state value (due to droop) to the voltage spike/dip peaks during a transient-load and be within ±3%, under the following conditions:

- Electronic load set in "constant current" mode.
- Load step of 0%-25% with 0.1A/µS slew rate, 50hz to 50kHz, 10% duty cycle to 90% duty cycle
- Load step of 10%-90% with 1A/µS slew rate, 50hz to 50kHz, 10% duty cycle to 90% duty cycle
- Load step of 50%-120% with 1A/µS slew rate duty cycle & load step of 50%-170% with 1A/µS slew rate duty cycle

6.2 9V_{DC} Output

- A six pin POWER_FAIL_L connector will be needed to send out the 9V_{DC} (1A max) POWER_FAIL_L and REDUNDANCY_LOST_L signal.
- The 9V_{DC} output should be available within 500µs from when the signals, POWER_FAIL_L and REDUNDANCY_LOST_L signals, are asserted low.
- The connector to be used in the shelf should be the Molex Minifit Jr (P/N: 39-30-1062). • Other source connectors are Tyco: 1-794528-1 and FCI: 10127819-06211PLF.

Below we can see the pinouts as if we were looking at the rear of the PowerShelf. The POWER_FAIL_L and REDUNDANCY_LOST_L signals will also be routed to pin 2 and 3 respectively, after the optocoupler to the RJ45 connector, as well as the RTN pin can be routed directly to the pin 1 on the RJ45 connector, which is also S_RTN.



Figure 4: 9V_{DC} Molex Minifit connector (viewing from back of the shelf)

6.3 Internal Connectors

- The BBU signals and PSU signals shall be routed to the PCB on the shelf.
- The connectors should be of latching type.
- Both the PSU female mating connector and the BBU male connector in the shelf shall be of floating type so that when the PSU or BBUs are installed they mate easily with their respective mating connectors.

6.3.1 PSU mating connector

The main 12.6V_{DC} output busbar blades of the PSU will mate with the Tyco Crown Clip II connector (TE P/N: 1643903-3) which will be attached to the internal shelf output busbar. The area where the Tyco clip is screwed onto the internal busbar, shall also be silver so that the contact interface is silver on silver which will create less loss. There will be no offset of the mating female connectors since the PSU output blades are already offset by 3.1mm.



Figure 5: Tyco Crown Clip II female mating connector, 12.6V_{DC}

6.3.2 BBU Mating connector

The power shelf shall house the male BBU connector from the cable harness. This connector will be floating inside the shelf to allow proper mating with the BBU. The BBU signals shall go to the shelf PCB and then to the PSU. The main power wires delivered the BBU power shall go directly to the PSU input via the cable harness.

7 Efficiency

The busbar system should be designed such that there should be a maximum loss of 33W (0.50% efficiency loss) total at worst case condition when the shelf is running at maximum 6600W. Worst

case condition can be 2 PSUs populated in the shelf (total load 6.6kW) in various combination of the slots (e.g. 2 PSUs populated in slot #1 and #3, may be the worst case since they are furthest from the center). The 12.6V_{DC} measurement shall be taken at the end of the shelf output busbar blades (near the 8 screw holes) and the AC input power measurement shall be taken at the female side of the 5 pin Positronic connector. Design note: the output busbars should be placed inside the shelf in such a way that they do not impede the airflow out of the PSU modules.

AC input Voltage	≥ 230Vac				
Load	10%	20%	30-90%	50%	100%
Efficiency	89.5%	93.5%	94.5%	95.5%	90.5%

8 Communication/Signals

An RJ45 output is needed on the rear panel of the shelf for the RS-485 digital bus. The connector should ideally be placed flush with the output of the shelf and its cutout on the sheet metal shall accommodate the latch. The signals going outside the shelf via this connector shall have 100V_{DC} isolation. More information for the technical use of this connector can be found in the V2 PowerShelf Communication specification document.

Pin	Wire color	Function
1	White/Orange	GND
2	Orange	POWER_FAIL_L
3	White/Green	REDUNDANCY_LOST_L
4	Blue	+RS-485 A
5	White/Blue	- RS-485 B
6	Green	Shelf Position
7	White/Brown	Rack Position
8	Brown	Rack Position

8.1 RS485

Pins 1, 4, and 5 are used for the RS485 interface via the RJ45 connector.

8.2 Facebook Signals

The two signals mentioned on Pin 2 and 3 shall be active low. Power_Fail_L and Redundancy_Lost_L respectively.

8.3 Rack Addressing

Pins 6 is used for shelf position and pin 7 and 8 are used for rack position designation. Please refer to V2 Communication Specification for more information.

9 Environmental Requirements

- Gaseous Contamination: Severity Level G1 per ANSI/ISA 71.04-1985
- Ambient operating temperature range: -5°C to +45°C

- Shelf is able to start at -15°C of ambient temperature
- Operating and Storage relative humidity: 10% to 90% (non-condensing)
- Storage temperature range: -40°C to +70°C
- Transportation temperature range: -55°C to +70°C (short-term storage)
- Operating altitude with no de-ratings: 3000m (10000 feet)
- System level ambient temperature: target is < 27°C (for information only)

9.1 Vibration and Shock

The power shelf shall meet shock and vibration test per EN 60068-2-6 and 60068-2-27 for both nonoperating and operating condition, with the specifications listed below. During operating vibration and shock tests, the shelf shall exhibit full compliance to the specification without any electrical discontinuities.

During the non-operating tests, no damages of any kinds (included physical damages) should occur and they should not corrupt the functionalities of the shelf per the specifications.

9.1.1 Vibration Non-Operating

Excitation Mode:	Sinusoidal
Test Frequency:	5Hz to 500Hz (5.0-9.0Hz) 6mm peak to peak
	(9.0-500.0Hz) 1g
Amplitude:	1g
Frequency Change Rate:	1 octave / min
Test Directions:	3 directions in space (x,y,z)
Duration:	10 sweep cycles for each direction (2hours 13 minutes)
Test Temperature:	Room temperature
Electrical Work:	none

9.1.2 Shock Non-Operating

Shock Pulse:	half sinus
Shock duration:	11MS
Shock Amplitude:	12g
Test Directions:	6 directions
Number of Shocks:	60 (10 per each direction)
Test Temperature:	Room temperature
Electrical Work:	None

9.1.3 Vibration Operating

Excitation Mode:	Sinusoidal
Test Frequency:	5Hz to 500Hz
	(5.0-9.0Hz) 6mm peak to peak
	(9.0-500.0Hz) 1g
Amplitude:	0.5g
Frequency Change Rate:	1 octave / min
Test Directions:	3 directions in space (x,y,z)

Duration:	10 sweep cycles for each direction (2hours 13 minutes)
Test Temperature:	Room temperature
Electrical Work:	Power supply in operation

9.1.4 Shock Operating

Shock Pulse:	half sinus
Shock duration:	11MS
Shock Amplitude:	6g
Test Directions:	6 directions
Number of Shocks:	30 (5 per each direction)
Test Temperature:	Room temperature
Electrical Work:	Power supply in operation

10 Production Line Testing

Testing shall be completed in several stages on 100% of the power shelf to ensure it meets high quality production standards.

Shelf BOM and manufacturing information shall be traceable, and all information shall be easily retrieved as requested by Facebook.

10.1Hi-Pot

• The shelf shall be tested 100% in production for both Hi-Pot (with the applicable limits for the AC leakage current) and ground continuity (per the applicable standard). Stamps shall be applied to the chassis proving that both tests passed in productions.

10.2 Ground Continuity

• The ground bond test is to be verified at design stage, and it must comply with applicable IEC standards.

Tech tips:

- Ground continuity test is performed on the GND pin of a line cord-terminated product (normally center pin of an IEC320 socket). This test verifies that the safety ground is present in the system, but it does not test the ability of the safety ground to withstand any faulty current.
- The ground bond test is performed in a similar fashion and it verifies that a products safety ground can adequately handle any fault currents due to an insulation failure. The test duration may vary (it can be as high as 120 seconds).

11 Compliance Requirements

The power shelf shall comply with the following standards as well as stand-alone unit, and it shall be Certified and labeled accordingly.

11.1 Safety Certifications, Applicable Documents

- UL60950-1 (and CAN/CSA-C22.2 No. 60950-1 plus all revisions
- Latest version of IEC/EN60950-1 plus all country deviations
- Latest version of UL 62368-1
- NRTL report and certifications (cUL, CSA/UL)
- CE Declaration of Conformity, accompanying by CB Report and Certificate
- Official Journal of the European Union 2014/35/EC Low Voltage Directive
- BIS IS13252:India BIS Safety standard for ITE products
- Taiwan CNS 14336: Chinese National Standard (Power Supply Safety)

11.2 Emissions Standards Compliance

The power shelf shall comply with the following applicable emission and immunity requirements.

- o Official Journal of the European Union 2014/30/EC EMC Directive
- EN61000 / IEC61000 applicable standards for Emissions and Immunity Requirements
- EN55024 (Generic standard)
- EN61000-3-2 (Harmonics) [with 15A input per line]
- EN61000-3-3 (Voltage Flicker) [with 15A input per line]
- EN61000-4-2, Level 4 (ESD)
- EN61000-4-3 (Radiated Immunity, 3V/m)
- EN61000-4-4, Level 4 (EFT/Burst)
- EN61000-4-5 (AC Mains Surge Immunity, 2kV DM and 4kV CM)
- EN61000-4-6 (Conducted Radio Frequency Immunity, 3V/m)
- EN61000-4-11 (AC Mains Voltage Dips & Sags, Fluctuations)
- EN/CISPR 55024 (Latest Version) Information Technology Equipment
- Power shelf shall always resume operations after any fatal PLD
- Output Voltage shall never dip if backup voltage is applied to the shelf
- Backup functionality is not affected by substantial repetitive dips & sags
 - GR-1089-CORE, Issue 4 (Power Line Disturbances)

Note: When the PSU is installed at System level, the equipment under test powered by the PSU shall continue to operate without interruptions and/or reset occurrences during the above tests under EN61000-4-(*).

11.2.1 Input Surge

The power shelf shall be tested in accordance of the EN61000-4-5 and up to the following limits below:

• 2kV DM (Differential Mode is Line to Neutral)

• 4kV CM (Common Mode is Line/Neutral to ground)

The power shelf shall be protected against surge events and it will not be damaged in such occurrences. The PSU shall continue to operate without functional failures or hiccups during surge tests per the above limits. The output voltage shall also not be affected by the surge pulses under any conditions. Surge events shall not be able to reset the system (12.6V_{DC} remains in regulation) when the shelf is used in the final application at system level (a system board will be provided to perform this test). At system level, the shelf is powered by a custom AC PDU, which is directly connected to the tap box without any other protection or surge circuitry. Under these conditions, the PSU is expected to pass 2kV DM and 4kV CM (to be tested and verified), stand alone and at shelf level with (one, two or three) power modules installed in the shelf.

11.3 Further Applicable Immunity Standards

- EN61000 standards for Industrial Immunity
 - EN61000-6-1 (Immunity / Light Industry)
 - EN61000-6-2 (Immunity / Industry)

This section of BS EN 61000 applies to electrical and electronic apparatus intended for use in industrial environments. This standard applies to an apparatus intended to be connected to a power network supplied from a high or medium voltage transformer dedicated to the supply of an installation feeding industrial plants, and intended to operate in (or in proximity to) industrial locations. This standard applies also to apparatus that is battery operated and intended to be used in industrial locations. The environments encompassed by this standard are industrial, both indoor and outdoor, and where heavy inductive or capacitive loads are frequently switched, and/or with presence of high currents and associated magnetic fields.

11.4 EMI Compliance & Limits

The AC mains tests are conducted as stand-alone unit, at 200Vac and 277V_{AC}, full load (6600W) with the following requirement to comply:

- The power shelf with fully populated, with power supply units and batteries shall comply with Class A limits of above standards for both conducted and radiated emissions, with at least 6dB margin for AC input only.
 - Quick scan with peak mode detection should be done with DC input, and results submitted to Facebook.

11.5 Environmental Engineering Standards

- ETS 300 019-2-3, Class 3.2 (Operation)
- ETS 300 019-2-1, Class 1.2 (Storage)

11.6 Environmental Engineering Standards

- ETS 300 019-2-3, Class 3.2 (Operation)
- ETS 300 019-2-1, Class 1.2 (Storage)

11.7 RoHS/Environmental Compliance

The power supply shall be compliant to the following RoHS and environment regulations (BOM & Manufacturing Process)

• RoHS 2 Directive (2011/65/EU); aims to reduce the environmental impact of EEE by restricting the use of certain substances during manufacture.

- China RoHS.
- Taiwan RoHS.
- REACH Regulation (EC) No 1907/2006; registration with the European Chemicals Agency (ECHA), evaluation, authorization and restriction of chemicals.
- Halogen Free: IEC 61249-2-21, Definition of halogen free: 900ppm for Br or CI, or 1500ppm combined.
- US Conflict Minerals law: section 1502 of the Dodd-Frank Act which requires companies using tin, tantalum, tungsten, and gold ("3TG") in their products to verify and disclose the mineral source.
- The Persistent Organic Pollutants Regulation (EC) No. 850/2004, which bans production, placing on the market and use of certain persistent organic pollutants.
- The California Safe Drinking Water and Toxic Enforcement Act of 1986 ("Prop 65"), which sets forth a list of regulated chemicals that require warnings in the State of California.
- Packaging and Packaging Waste Directive 94/62/EC.
- Phthalates (DEHP, DBP, DiBP, BBP): 1000 ppm (or 0.1% by weight).
- Arsenic: 1000 ppm (or 0.1% by weight).

12 Safety Label

The power shelf will be shipped with the safety label applied to the cover, location is free and up to the Vendor to propose a location. Label is to be UL approved material, ORANGE color "Pantone 715" (or similar agreed upon) with matte finish, no "glossy". The fonts shall be black color, Arial bold with ~ 2.5mm of font size. Barcodes shall follow the "CODE 128-AUTO" standard. The label location and orientation on the chassis cover is indicated in the mechanical drawings given; the sheet-metal shall be recessed 1mm to avoid scratch of the label at power supply installation in the system (see mechanical drawing). Label material shall be scratch resistant as well. The label shall include at least the following information and identification marks. Note, small details can be changed with approval from Facebook. Sample of the label will be submitted to Facebook for review and approval.

- Vendor Name, Country of Origin, Vendor Address
- Model: 700-014672-0000
- Type: "Vendor P/N" (shall also have a barcode)
 - o ACDC-ORV2-6600W
- Facebook Part Number: "FB P/N: 14-000136" (shall also have a barcode)
- The output format should be as follows; Voltage (at No Load), Output (max), Current (max). The maximum accuracy of the values should be to one decimal place. Note, in this case the voltage and current does not match the rated power capability. The Vendor is free to suggest any other format based on Facebook's approval.
 - o Input 1: 200-277V ~ 50/60Hz 22A (3 phase)
 - Output 1: 12.6V == 530A MAX
 - Output 2: 9V == 1A MAX
- Date Code, Serial Number, REV (shall also have a barcode)
 - WWYYYYSSSSSXX shall be included in the third barcode (WW = week of the year; YY+ year; SSSSS = serial number; XX = revision)
- All applicable safety markings (BSMI logo, etc.)

- RoHS-6 symbol of compliance shall be added to the label
- WEEE symbol: the PSU label will have the crossed out wheeled bin symbol to indicate that it will be taken back by the Manufacturer for recycle at the end of its useful life. This is defined in the European Union Directive 2002/96/EC of January 27, 2003 on Waste Electrical and Electronic Equipment (WEEE) and any subsequent amendments

13 Reliability, Quality, Miscellaneous

13.1 Spec Compliance, Quality FA, Warranty

- The Vendor is responsible for the shelf to meet the specifications at stand-alone unit as well as at system level, and for assuring that the power supplies shipped in production will conform to the specifications with no deviations.
- A specification compliance matrix and test report shall be submitted to Facebook for each shelf revision: EVT(P1), DVT(P2), and PVT (Pilot).
- The Vendor is responsible to exceed production quality standards achieved on the pilot run built without fluctuations.
- All failures from EVT, DVT, PVT are required to complete failure and root cause analysis and report corrective action prior to entering mass production.
- Failure analysis on defective RMA units shall be provided to Facebook with corrective action plan, within two weeks from when the units are received at the Vendor's facility.
- The Vendor shall warrant the power shelf for defects and workmanship for a period of three years from the date of shipment when the device is operated within specifications. The warranty is fully transferable to any end user. A standard "VOID" warranty sticker may be applied.

13.2 Mass Production First Article Samples

Prior to final project release and mass production, the Vendor will submit to Facebook a good quantity (21) of PVT production pilot run verification samples, including the following documentation:

- All the pertinent development docs, production docs, and reports necessary to Facebook to release the product for mass production.
- The pilot samples shall be built in the allocated facility for mass production and use hard-tooled chassis and parts (where applicable).
- Full spec compliance matrix, full test report, production line final test 'pass' tickets.
- Samples are shipped using the approved for production shipping box.
- The units are certified and safety label is applied ("Pending Certification" sticker may be allowed until the certification process is complete).

13.3 MTBF Requirements

• The shelf shall meet the MTBF calculation, which is proposed by the Vendor and agreed upon by Facebook. The MTBF calculation should be at 90% confidence level, 45°C of ambient temperature, 277Vac of input voltage, 3 PSUs installed in the shelf, and 6.6kW loading (per Telcordia SR-332 latest version, alternatively per MIL-HDBK-217).

- MTBF goal: The Vendor shall provide to Facebook the best MTBF numbers that the shelf will be able to meet, no matter the minimum requested. Facebook will use this information for an overall reliability study of the whole system.
- The shelf shall have a minimum service life of 5 years (24 hours/day, Full load, 277Vac, 45°C of ambient temperature).

13.4 Design Rating Guidelines, DFT, DFM

- For all the boards used in the shelf design: the in-circuit test coverage and test point access shall be > 95% or higher.
- The Vendor will provide the standard de-rating guidelines normally used for the design of the industrial custom power products for Facebook audit.
- The Vendor shall provide DFT and DFM reports at EVT phase.

13.5 Catastrophic Failure

The shelf shall not smoke or catch on fire during catastrophic failure.

13.6 Disallowed Components

Facebook reserves the right to select some preferred/mandatory parts, during the development phase (selection of an approved vendor list (AVL) subset). The Vendor will work with Facebook to solve system integration problems, should any issues arise.

- Trimmers and/or potentiometers
- Tantalum capacitors
- Dip switches
- High side driver ICs
- Paralleled power MOS are allowed provided that the design prevents parasitic oscillations
- SMT ceramic capacitors are allowed with the case size < 1206. The size 1206 can still be used when SMT capacitors are placed far from the PCBs edge, and with a correct orientation that minimizes risks of cracks
- Allowed ceramics materials for SMT capacitors are: X7R or better material. The COG or NPo types should be used in critical portions of the design, such as feedback loop, PWM clock settings, etc.
- Relays: the use of any electro-mechanical relays, and type shall be discussed up front before any approval is given include them in the design.
- Resistors by Royal Ohm are not to be used
- Facebook will approve all control ICs

13.6.1 Capacitors

- All the electrolytic capacitors shall be rated at 105°C and shall be selected from Japanese and US manufactures only.
- All capacitors shall have a predicted life of at least 5 years at 45°C inlet air temperature under worst conditions.

13.7 Quality Control Process

- Incoming Quality: <0.1% rejections
- CPK values should equal or exceed 1.33 (Pilot Build and Production) using a sample size equal to 32 for CPK measurement.



- CPK measurement should be performed on every batch/lot build of pilot and mass production. During production, weekly CPK reports must be sent to Facebook engineering team.
- The Vendor will implement a further quality control procedure during production, by sampling power supplies randomly from the production line and running full test to prove ongoing compliance to the requirements (it may include EMI production). Process shall be documented and submitted to Facebook prior to production. The relative reports will be ongoing submitted to Facebook.
- PCB boards are UL recognized components rated 94 V-0 and rated 130°MOT.
- Multi-layers (> 2 layers) PCB boards are welcome for a better layout and simplification of the manufacturing process, however if they make sense for cost.

13.8 Packaging

The shelf shall be shipped using a custom package containing multiple units (max 2 each box). Quality of the packing assembly will be such that the shelf will not be damaged during transportation: shelves will arrive in optimum conditions and so suitable for immediate use. The shipping box 'shock test' shall be proposed by the Vendor and submitted to Facebook for audit and approval. The Vendor is required to provide a test report for shock and vibe and packaging drop test.

13.9 Documentation

The Vendor shall provide Facebook the following documentation (prototypes may not include portion of these documents):

- Theory of Operation
- Block Diagram
- FW state machine
- Schematics, Component Placement, Board Layout (Design files and searchable PDF)
- BOM ordered per Reference Designators
- BOM ordered per Components (including AVL)
- Mechanical Drawings (PDF format. Native files and/or DXFs will be provided to perform collaborative work on the design, for a seamless PS integration at System level chassis)
- Functional Test Report (DVT Report)
- De-ratings Report (worst conditions)
- Temperature Test Report (with indication of critical de-ratings, if any)
- EMI plots for Conducted and Radiated emission
- MTBF data and Report, including calculation
- Production Line Automatic Final Test procedure

NOTE: The Vendor shall propose to Facebook a 'Qualification Test Plan' & 'Reliability Test Plan'. EDVT test procedure in thermal chamber, with four corners thermal shocks, is expected to be included.

13.10Change Authorization/Revision Control

Once the Project is released to mass production, no design changes, AVL changes, Manufacturing Process or materials changes are allowed without prior written authorization from Facebook.

AVL is 'Approved Vendor List' of all the components listed in the BOM (the 'Bill Of Materials'). Any request of changes must be submitted to Facebook with proper documentation showing the details of the changes, and reason for the changes, including changes affecting form, fit, function,

safety, or serviceability of the product. Major changes in the product (or in the manufacturing process) will require re-qualification and/or re-certification to the Product. Hence a new set of First Article Samples may be required to complete the ECO process. Any modifications after approval would "phase-in" during production without causing any delays or shift of the current Production Schedule: enough ECO advance notice shall be given to Facebook (and to all appropriate entities in the Supply Chain) in such as occurrences. All changes must go through a formal ECO process, starting from the Pilot Run and onward, and the revision (shown in the Safety Label) will increment accordingly. Revision Control: copies of all ECOs affecting the product will be provided to Facebook for sign off.

13.11Sheet Metal Material and Zinc Whisker Implications

- Sheet Metal Chassis Material is hot-dip Zinc coated, JIS G3302 SGCC (Z20 to Z22), with 1mm of thickness. The 'Z' parameter defines the metal coating thickness: Z20 is for 40 μm of thickness, and Z22 is for 43 μm.
- The Japanese standard is 'JIS G3302', while the US standard is 'ASTM A653'.
- Mechanical design shall prevent sharp edges and possible metal oxidation in the critical points of the sheet metal (e.g. in the cut & bends portions, etc.).
- Both chassis design and metal base material will not promote the growth and propagation of zinc and tin whiskers.
- Metal base materials with electro-zinc plating, or poor conductivity plating, are not allowed.
- Alloy materials are a possible option, while stainless steel is another possibility provided that it makes cost sense (both options are subject to Facebook approval)
- Aluminum material is not allowed for the enclosures.
- The chassis enclosure, as well as the whole electronics, shall meet certain contamination requirements (see ANSI spec at § 14)
- The modules are not classified as "Fire Enclosure"

13.12Conformal Coating and Protection

The gate terminals of all high-voltage MOSFETs as well as the most sensitive areas of the electronic circuitry in the boards must be protected against potential resistive contacts with other voltage potentials (e.g. MOS Drain leads, etc.) due to whiskers, pollutant particles, dust, moisture (for example contaminant substances can become conductive in presence of moisture), and up to some local wet condensation occurrences.

Local automated, conformal coating shall be applied to critical areas of the boards to protect sensitive circuitries, using an atomized spray process (no dipping process is considered here). The thickness of the coating shall be ~50 μ m to ~150 μ m. The Vendor (mainly the ultimate Manufacturing Facility) shall demonstrate to possess good skills, experience, and long years of experience on automated conformal coating application and process. The power shelf main board shall be partially conformal coated (top & bottom); critical board areas shall be agreed upon, typically the ac high-voltage input section at shelf level, like the AC input, board-mount connector area.

14 Mechanical 2D drawing







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