
True Three Phase 380 – 480 Vac to 48Vdc Power Shelf

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OPEN

Compute Project

Scope

This document defines the technical specifications for:

- A true 3 phase 380 – 480 Vac to 48Vdc Power Shelf used in Open Compute Project Open Rack Standard V2.0
- The shelf is 2 open rack units high
- Is fed with a single 50A AC cord whip
- Delivers power using bus bar clips onto the 48V bus located in the shallow depth (660mm) cabinet as defined in Open Rack Standard 2.0

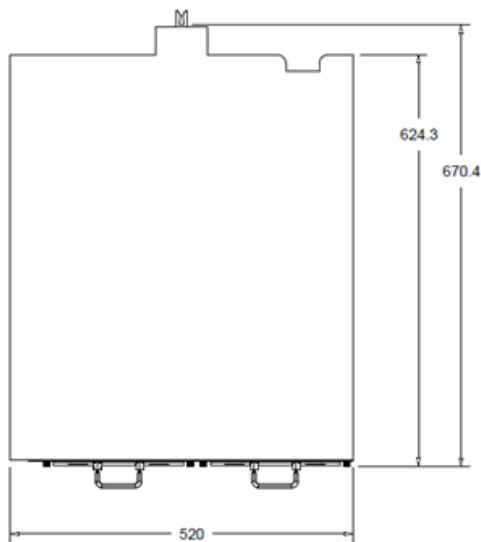


Benefits

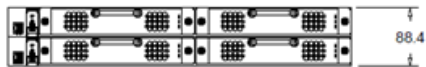
1. Simple AC wiring in the data center. AC distribution wiring includes three phase conductors and one safety ground. No neutral is required.
2. AC phases are intrinsically balanced. Each 3-phase power converter processes all 3 phases, so provisioning to match need, and unit failures do not change the phase balance on the AC power feed into the facility. There should be no billing anomalies.
3. Simple powering of an Open Rack or cabinet. A single 50A whip can power an entire cabinet – depending on data center rack thermal capability.
4. Power can be flexibly located vertically in the rack. A dedicated position for power, driven by the need for bus bar studs, where power is introduced, is not required. The 2-rack unit shelf can be placed as needed in the rack to support logical partitioning of the data processing equipment.
5. Easy integration into Enterprise/Building management systems using Ethernet protocols (SNMP and MODBUS).



Compatibility

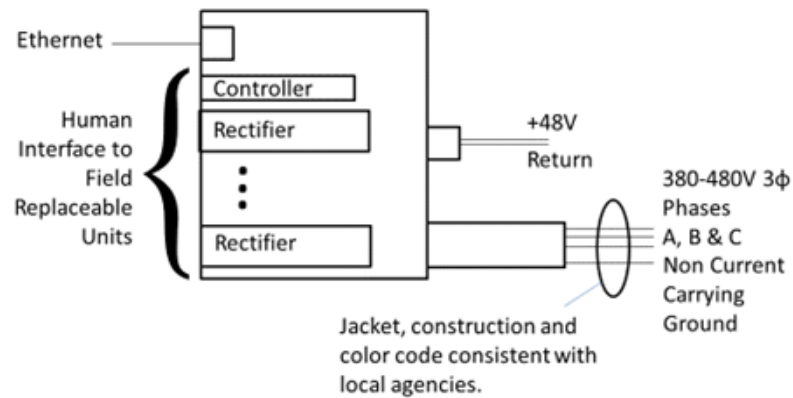


- The true three phase power shelf is 2 OpenU tall (96mm).
- The depth is 625mm, except where the floating (+/-2mm) busbar interface is defined. A 2 meter long four conductor power cord (3 phases and safety ground) pigtail is provided in the right rear corner. For UL Listed North American applications at 480Vac, the cord shall be terminated with a UL/CSA listed 3-Pole, 4-Wire Grounding twist lock connector (such as Hubble CS8165C or Leviton CS8165C). For 380V applications the cord will match standards for host country and be provided blunt cut at 2 meters for termination on site. The strain relief for this pigtail shall accommodate the 616mm depth and allow for a 90-degree bend, up or down, in 100mm.
- The width and fastenings are to fit in the Open Rack V2.0.

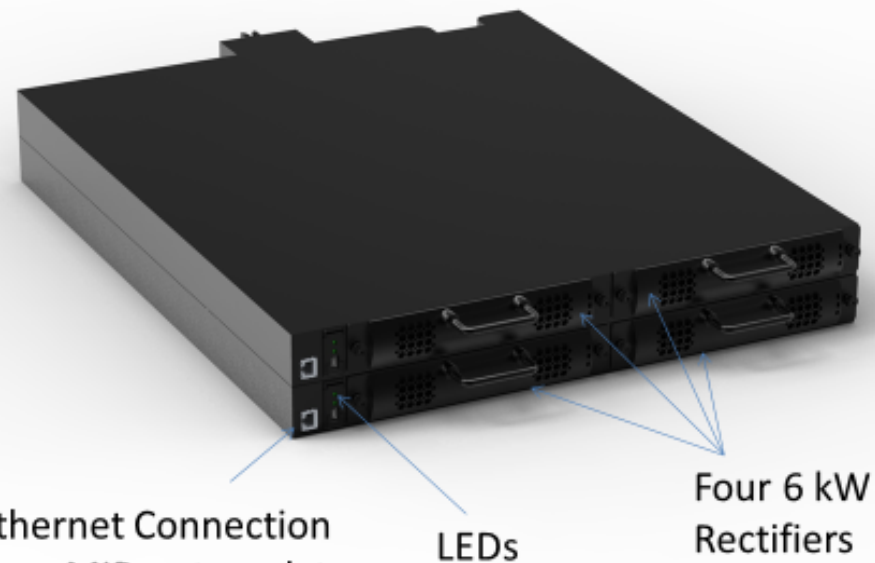


Compatibility

Block Diagram



Cold Aisle View



AC Input – Line Voltage

	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes
1	Input Voltage 3Ø	Operating	V_{IN}	320	380/400/480	530	V_{ac}	Voltage is supplied via 3 wire with a frame ground for safety.
2		No damage continuous	V_{IN}	0		600	V_{ac}	Telcordia GR-947-CORE, section 3.1. Input voltages below 320 V_{ac} shall not cause damage to the rectifier. Non-latching rectifier shut-down OK.
3		Low Voltage: Turn-OFF		(300)		320	V_{ac}	At least 5.0 V of hysteresis shall exist ($V_{on} > V_{off} + 5.0$) between turn-on and shutdown on any particular unit.
4		Turn-ON		(315)		330	V_{ac}	
5		High Voltage: Turn-OFF		530		(550)	V_{ac}	Rectifier may turn off at input voltage above minimum value.
6		Turn-ON		520		(540)	V_{ac}	
7	Input Current Drain (3Ø)		I_{IN}			15.0	Amps	At input low voltage shut-down.
8	Inrush Current Limiting		A_{PK}			30.0	Amps peak per Ø	Measured at 480 V_{ac} . Inrush current caused by EMI capacitors plus the circuit inrush shall not cause the input breaker to trip.
9	Over-current Protection					30	Amps	Telcordia GR-947-CORE, section 3.5. External Breaker requirement.



AC Input – Parameters

	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes
1	Input Frequency	Operating	F_{IN}	47	50/60	63	Hz	Telcordia GR-947-CORE, section 3.1.
2		Slew Rate		3			Hz/ .5C	Half cycle is between zero crossings.
3	Input Voltage Unbalance		V_{IN}	-15	1	+10	%	Telcordia GR-947-CORE, section 3.1. Line to line voltage unbalance.
4	Input Current Imbalance	Over all loads				1.5	%	Steady State. Unit should actively balance input current from each phase as a percent of full scale at 480V. Typically less than 1.5% phase imbalance.
5	Source Impedance			0.20	0.25	0.30	Ohms	NEC allows 2.5% of source voltage drop inside a building
6	ac Ground							NEC. The rectifier shall be grounded to ac service.
7	Hold-Up time	High Line Unit at 320 Vac	T	10	12		ms	Output allowed to drop from float voltage, 2.25 Volts per cell (VPC) to 1.75 VPC [54.5 Vdc to 42 Vdc with 6kW] constant power load. 60Hz, 25°C..
8	Ride through	at Nominal Vin, 25°C)	T	1/2	1		cycle	@ Nominal, 25C and Full load.



AC Input – Parameters



	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes
	Power Line Disturbance ANSI C62.41.2-2002 Category A, B, & C Low (most severe condition chosen for each of the following tests)							All Tests Applied Both line-to-line and line-to-ground. Transient disturbances shall be applied to one phase at a time. Transients shall be applied at the peak and at the zero crossing of the ac waveform - 90° and 0° phase angle. Voltage regulation limits may be exceeded during these conditions. The rectifier shall sustain no damage. It is permissible for the rectifier to shutdown. If shutdown occurs the rectifier shall automatically restart when the input voltage returns to within operating range. ANSI/IEEE C62.41
					10			Repetitions for each transient disturbance
				1			min	Interval between transient application
9		100kHz Ring Wave			6 0.5		kV kA	Category B Table 2
10		1.2/50µs – 8/20µs Combination Wave			6 3		kV kA	Category B Table 3
11		5/50ns EFT Burst			2		kV	Additional: Table 7 Severity II

AC Input – Parameters

	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes					
12	IEC Surge	1.2/50µs (8/20µs)			2		kV	IEC/EN 61000-4-5 Level 4 Line to line.					
13		1.2/50µs (8/20µs)			4		kV	IEC/EN 61000-4-5 Level 4 Line to earth.					
	Surge & Sag							From nominal input voltage apply surges and sags returning to nominal input voltage. No damage. Voltage regulation limits may be exceeded during these conditions. Surges and Sags shall be applied to one phase at a time, and all three phases simultaneously. Surges and Sags shall be initiated at phase angles of 0 and 90, and 270 degrees. If shutdown occurs the rectifier shall automatically restart when input voltage returns.					
										5			Repetitions for each Surge & Sag
									60			s	Interval between transient application
14	0.35 x Sag				0.35		x Nomi nal Input Volta ge	Worst Case: at minimum nominal input voltage					
					30		cycle s						



AC Input – Parameters

	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes
15		0V Sag			0		V _{ac}	Worst Case: at minimum nominal input voltage
				0.5		200	cycles	
16	Total Harmonic Distortion – Current THD (3Ø)	At current limit [110 A] Load				5	%	All measurements at nominal line 25°C and 60Hz
17		At nominal current [100 A] Load				5	%	
18		At 75% of nominal current [75 A] Load				6	%	5% Desired
19		At 50% of nominal current [50 A] Load				9	%	5% Desired
20		At 25% of nominal current [25 A] Load				12	%	5% Desired



AC Input – Parameters

	Parameter	Qualifier	Sbl	Min	Nom (Typ)	Max	Unit	Applicable Standards & Notes
21	IEC Harmonics				Pass			EN 61000-3-2 (Harmonics) at 50 Hz 380V, 60Hz 480V, 50Hz and 60Hz 240V
22	Power Factor		PF	0.98	0.995			From 50 to 100% load at each listed nominal voltage.
23	Phase Failure							Loss of phase of ac line voltage shall not result in damage to the rectifier. Non-latched shutdown OK, but derated operation with phase failure desired.
24	Line Failure							Interruption and restoration of the AC power shall not nullify the proper operation of the controls, alarm signals, or visual indicators, when installed in battery plants.
25	Leakage Current		I_{IN}			5	%	Of nominal input current per phase. Marking per IEC/EN 60950. The rectifier will only be used in permanently connected / stationary applications and may be connected to IT power systems, i.e. systems without earth connected neutral conductors.
26	Isolation	Input - Chassis / Signals	V	2087			V_{ac}	Per EN60950. Consult factory for testing to this requirement.
27		Input - Output	V	3000			V_{ac}	



DC Output Parameters

- Consistent with Open Rack Standard V2.0

Thermal Design Requirements

- Consistent with Open Rack Standard V2.0

I/O System

- Ethernet, see proposed data structure in appendix.

